

SIMULATION ANALYSIS OF THE BLOOD SUPPLY CHAIN AND A CASE
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ABSTRACT

SIMULATION ANALYSIS OF THE BLOOD SUPPLY CHAIN AND A CASE STUDY

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Efficient management of blood throughout the countries is of great economic importance, in addition to its major impact on the success of medical operations. This study is concerned with the analysis of policies for managing a unique blood supply chain network, which is defined in the new Blood and Blood Products Law of the Republic of Turkey. The main objective of the study is to obtain a better understanding of the system, and to find improved policies to be able to manage it efficiently. A discrete event simulation model is developed to analyze the blood supply chain of a pilot region in Turkey. Effects of different management policies on the supply chain performance are analyzed. Important improvements are achieved in terms of the selected performance measures such as outdate, mismatch and shortage rates of the region. Our proposed model can be used by both national health authorities and the Turkish Red Crescent Society as a decision support tool to analyze other regions and to examine alternative policies.

Keywords: Supply Chain Management, Discrete Event Simulation, Blood

ÖZ

KAN TEDARİK ZİNCİRİNİN BENZETİM ANALİZİ VE BİR ÖRNEK ÇALIŞMA

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Bir ülkede kanın verimli yönetimi, medikal operasyonların başarısı üzerinde çok etkili olduğu gibi, ekonomik açıdan da büyük bir öneme sahiptir. Bu çalışma, Türkiye Cumhuriyeti'nin yeni kan ve kan ürünleri yasasında tanımlanan özgün bir kan tedarik zinciri ağının yönetimi için politikaların analiz edilmesine ilişkindir. Bu çalışmanın temel amacı, sistemin daha iyi anlaşılabilmesi ve verimli bir şekilde yönetilebilmesi için iyileştirilmiş politikaların bulunmasıdır. Türkiye'deki pilot bir bölgenin kan tedarik zincirinin çözümlemesi için ayrık olay tabanlı bir benzetim modeli geliştirilmiştir. Farklı yönetim politikalarının tedarik zinciri başarımı üzerine olan etkileri analiz edilmiştir. Son kullanma tarihi geçmiş kan oranı, uygunsuz eşleştirilmiş kan kullanım oranı ve kan yokluk oranı gibi seçilen başarı ölçütlerinde belirgin iyileşmeler sağlanmıştır. Önerilen model ulusal sağlık otoriteleri ve Türkiye Kızılay Derneği tarafından alternatif politikaların irdelenmesi ve diğer bölgelerin çözümlemesi amacıyla bir karar destek aracı olarak kullanılabilecektir.

Anahtar Kelimeler: Tedarik Zinciri Yönetimi, Ayrık Olay Tabanlı Benzetim,
Kan

To My Family

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TABLE OF CONTENTS

ABSTRACT	iv
ÖZ	v
ACKNOWLEDGMENTS	vii
TABLE OF CONTENTS	viii
LIST OF TABLES	xvi
LIST OF FIGURES	xxix
CHAPTER	
1.INTRODUCTION.....	1
2.BLOOD SUPPLY CHAIN MANAGEMENT AND THE RELATED LITERATURE	6
2.1. Blood and Blood Banking.....	6
2.1.1. Statistical Analysis of Demand, Usage, Donor Arrival, Blood Age and Production	11
2.1.2. Evaluation of the Use of Alternative Storing Procedures and Alternative Therapies and Their Impact on the Blood Supply Chain.....	16
2.1.3. Crossmatching Policies	17
2.1.4. Economies of Scale in Blood Banking	20
2.1.5. Regionalization of Blood Banking.....	21
2.1.6. Perishable Inventory Management and Blood Banking Applications	22
2.1.6.1. Perishable Inventory Management.....	22
2.1.6.2. Applications of the Perishable Inventory Theory and Analytical Models in Blood Inventory Management	27
2.1.7. Simulation and Blood Banking Inventory Management.....	29
2.1.7.1. Simulation in Healthcare.....	29
2.1.7.2. Simulation in Blood Bank Inventory Management	33

3.BLOOD SUPPLY CHAIN AND THE CASE STUDY	40
3.1. Blood, Blood Components and Blood Groups.....	40
3.1.1. Blood and Blood Components	40
3.1.2. ABO Blood Typing.....	42
3.1.3. Rh Factor.....	43
3.1.4. Crossmatch.....	43
3.2. Blood Supply Chain Network	44
3.2.1. Alternative Blood Supply Chain Networks	44
3.2.1.1. SC Model	44
3.2.1.2. MIC Model.....	44
3.2.1.3. CMC Model	45
3.3. Blood Supply Chain Structure in Turkey and the New Blood and Blood Products Law.....	48
3.4. The Case Study	50
3.4.1. Turkish Red Crescent Society Blood Banking Services Reorganization Project	50
3.4.2. The Pilot Region Considered in the Study.....	52
3.4.3. Description of the Main Processes in the Centers.....	53
3.4.3.1 Regional Blood Center.....	53
3.4.3.2. Donation Center	56
3.4.2.3. Transfusion Center.....	57
4.THE PROPOSED APPROACH	61
4.1. The Modelling Approach.....	61
4.2. Inputs of the Simulation.....	63
4.2.1. Blood Collection Parameters (BCP)	64
4.2.2. Blood Disposal Parameters (BDP).....	64
4.2.3. Blood Transfer Parameters (BTP).....	65
4.2.4. Donation Center Parameters (DCP).....	66
4.2.4.1. Analysis of the Historical Data of Isparta and Burdur DCs.....	66
4.2.5. Inventory and Allocation Parameters (IAPP)	68
4.2.6. Regional Blood Center Parameters (RBCP)	70
4.2.6.1. Analysis of the Historical Data of the West-Mediterranean RBC ...	70

4.2.7. Simulation Run Parameters (SRP)	72
4.2.8. Transfusion Center Parameters (TCP)	73
4.2.8.1. Forecast for Number of Daily Requests and Size of the Requests ..	74
4.2.8.1.1. Size of the Requests	74
4.2.8.1.2. Number of Daily Requests	75
4.2.9. Transfusion Process Parameters (TPP)	79
4.3. The Simulation Model (SiModel)	81
4.3.1. Calculation of Commonly Used Values.....	83
4.3.1.1. Target Inventory Levels	83
4.3.1.1.1. Target Inventory Levels of TCs	83
4.3.1.1.2. Target Inventory Levels of DCs.....	84
4.3.1.1.3. Target Inventory Levels of RBC	84
4.3.1.2. Reorder Points for Ad-hoc Deliveries.....	85
4.3.1.2.1. Reorder Points of TCs for Ad-hoc Deliveries.....	85
4.3.1.2.2. Reorder Points of DCs for Ad-Hoc Deliveries	85
4.3.1.3. Reorder Points of TCs for Routine Deliveries	86
4.3.1.4. Upper Inventory Limits.....	86
4.3.1.4.1. Upper Inventory Limits of DCs for Transfers to RBC	86
4.3.1.4.2. Upper Inventory Limits of RBC for Transfers to Other Regions	87
4.3.1.5. Lower Inventory Limits of RBC for Ad-Hoc Deliveries.....	87
4.3.1.6. Units Needed to be Transferred	87
4.3.1.6.1. Units Needed to be Transferred to TCs.....	88
4.3.1.6.2. Units Needed to be Transferred to DCs	88
4.3.1.6.3. Units Needed to be Transferred to RBC	89
4.3.1.6.4. Units Needed to be Transferred to Other Regions	89
4.3.1.7. Transferable Inventory Levels	90
4.3.1.7.1. Transferable Inventory Levels of RBC for Ad-hoc Deliveries ..	90
4.3.1.7.2 Transferable Inventory Levels of DCs for Transfers to RBC	91
4.3.1.7.3. Transferable Inventory Levels of RBC for Transfers to Other Regions.....	91
4.3.1.8. Supply Indices.....	92

4.3.1.8.1. Supply Indices of TCs.....	92
4.3.1.8.2. Supply Indices of DCs	92
4.3.1.9. Supply Index Ratios	93
4.3.1.9.1. Supply Index Ratios of TCs	93
4.3.1.9.1.1. TCs Supplied by a DC	93
4.3.1.9.1.2. TCs Supplied by RBC.....	93
4.3.1.9.2. Supply Index Ratios of DCs.....	94
4.3.1.10. Supply Ratios	94
4.3.1.10.1. General Supply Ratios	95
4.3.1.10.1.1. General Supply Ratio of RBC.....	95
4.3.1.10.1.2. General Supply Ratio of DCs.....	95
4.3.1.10.2. DC Supply Ratios of RBC	95
4.3.1.11. Run-out Allocation.....	96
4.3.1.11.1. Run-out Allocation (Transfers to TCs)	96
4.3.1.11.1.1. TCs Supplied by RBC.....	96
4.3.1.11.1.2. TCs Supplied by DCs.....	97
4.3.1.11.2. Run-out Allocation (Transfers to DCs).....	97
4.3.1.12. Inventory Availability Indices of TCs	97
4.3.2. Descriptions of the Processes of the Simulation Model	98
4.3.2.1. Center Creation and Determining Run Characteristics Sub Model .	98
4.3.2.2. RBC Sub Model	98
4.3.2.2.1. Create Collections	102
4.3.2.2.1.1. Create Collection at Mobile Units.....	102
4.3.2.2.1.2. Create Collections at Center.....	102
4.3.2.2.2. Store in Quarantine Inventory	102
4.3.2.2.3. Test and Process of Blood Units	102
4.3.2.2.4. Disposal of Positive Units.....	103
4.3.2.2.5. Store in RBC Inventory.....	103
4.3.2.2.6. Dispose Outdated Units	103
4.3.2.2.7. Check Inventory levels of RBC, DCs and TCs.....	103
4.3.2.2.7.1. Inventory Check for Routine Deliveries	103
4.3.2.2.7.2. Inventory Check for Ad-Hoc Delivery	104

4.3.2.2.7.2.1. TCs	104
4.3.2.2.7.2.2. DCs.....	104
4.3.2.2.7.3. Inventory Check for Inter-Regional Delivery	104
4.3.2.2.8. Allocate Units to TCs and DCs.....	104
4.3.2.2.8.1. Calculation of the Amounts to be Sent	104
4.3.2.2.8.1.1. Ad-Hoc or Routine Deliveries to TCs.....	105
4.3.2.2.8.1.1.1. Allocation Method 0	105
4.3.2.2.8.1.1.1. Allocation Method 1	105
4.3.2.2.8.1.2. Ad-hoc Deliveries to DCs	106
4.3.2.2.8.1.2.1. Allocation Method 0	106
4.3.2.2.8.1.2.2. Allocation Method 1	106
4.3.2.2.8.1.3. Interregional Deliveries to Other Regions	107
4.3.2.2.8.1.4. Emergency Deliveries to TCs	107
4.3.2.2.8.2. Issuing Methods Used To Allocate Units	108
4.3.2.2.8.2.1. Ad-Hoc or Routine Deliveries to TCs.....	108
4.3.2.2.8.2.1.1. Issuing Method 0.....	108
4.3.2.2.8.2.1.2. Issuing Method 1.....	109
4.3.2.2.8.2.2. Ad-Hoc Deliveries to DCs	110
4.3.2.2.8.2.2.1. Issuing Method 0.....	110
4.3.2.2.8.2.2.2. Issuing Method 1.....	111
4.3.2.2.8.2.3. Interregional Deliveries to Other Regions	111
4.3.2.2.8.2.4. Emergency Deliveries to TCs	111
4.3.2.3. DC Sub Model	112
4.3.2.3.1. Create Collections	112
4.3.2.3.1.1. Create Collection at Mobile Units.....	112
4.3.2.3.1.2. Create Collections at the Center.....	112
4.3.2.3.2. Store in Quarantine Inventory	112
4.3.2.3.3. Test and Process of Blood Units	112
4.3.2.3.5. Store in DC Inventory	114
4.3.2.3.6. Disposal of Outdated Units	114
4.3.2.3.7. Check Inventory levels of DC and TCs	114
4.3.2.3.7.1. Inventory Check for Routine Deliveries	114

4.3.2.3.7.2. Inventory Check for Ad-Hoc Delivery to TCs.....	115
4.3.2.3.7.3. Inventory Check for Ad-Hoc Delivery to RBC	115
4.3.2.3.8. Allocate Units to TCs and RBC	115
4.3.2.3.8.1. Calculation of the Amounts to be Sent to Centers	115
4.3.2.3.8.1.1. Ad-Hoc or Routine Transfers to TCs.....	115
4.3.2.3.8.1.1.1. Allocation Method 0	115
4.3.2.3.8.1.1.1. Allocation Method 1	116
4.3.2.3.8.1.2. Ad-Hoc Transfers to RBC.....	117
4.3.2.3.8.1.3. Emergency Deliveries to TCs	117
4.3.2.3.8.2. Issuing Methods Used to Allocate Units.....	117
4.3.2.4. TC Sub Model.....	118
4.3.2.4.1. Create Physician Request.....	118
4.3.2.4.3. Store in TC Inventory	122
4.3.2.4.4. Disposal of Outdated Units	122
4.3.2.4.5. Add Units To TC Inventory	122
4.3.2.5. Squence of Events Related with the Inventory Control Processes	123
4.3.2.6. Calculate Statistics Sub Model.....	123
4.3.2.6.1. Calculation and Output of TCs' Statistics.....	123
4.3.2.6.2. Calculation and Output of DCs' Statistics	124
4.3.2.6.3. Calculation and Output of RBC's Statistics.....	125
4.3.2.6.4. Calculation and Output of Simulation Statistics	126
4.4. Calculation of the Performance Measures and Confidence Intervals	126
4.4.1. Mean Inventory Levels by Blood Group	127
4.4.1.1. Regional Performance Including DCs and RBC.....	127
4.4.1.2. Regional Performance Excluding DCs and RBC.....	127
4.4.1.3. Cities Performance Including DCs and RBC.....	127
4.4.1.4. Cities Performance Excluding DCs and RBC.....	128
4.4.1.5. RBC's Single Performance	128
4.4.1.6. DCs' Single Performances	128
4.4.1.7. TCs' Single Performances.....	129
4.4.2. Outdate Rates by Blood Group	129
4.4.2.2. Regional Performance Excluding DCs and RBC.....	129

4.4.2.3. Cities Performance Including DCs and RBC.....	130
4.4.2.4. Cities Performance Excluding DCs and RBC.....	130
4.4.2.5. RBC's Single Performance	130
4.4.2.6. DCs' Single Performances	131
4.4.2.7. TCs' Single Performances.....	131
4.4.3. Mismatch Rates by Blood Group.....	131
4.4.3.1. Regional Performance	131
4.4.3.2. Cities Performance	132
4.4.3.3. TCs' Single Performances.....	132
4.4.4. Shortage Rates by Blood Group.....	132
4.4.4.1. Regional Performance	132
4.4.4.2. Cities Performance	133
4.4.4.3. TCs' Single Performances.....	133
4.4.5. Numbers, Kilometers and Percentages of routine/ad-hoc/ emergency deliveries	133
5.EXPERIMENTAL ANALYSIS	134
5.1. Verification and Validation Issues of the Simulation Model.....	134
5.1.1. Data Validation	134
5.1.2. Conceptual Model Validation	135
5.1.3. Model Verification.....	136
5.1.4. Operational Validity.....	136
5.2. Design of Experiments.....	142
5.3. Results of the Experiments.....	144
5.3.1. Baseline Policy (Policy 0).....	144
5.3.2. Policy Group 1	145
5.3.3. Policy Group 2	148
5.3.4. Policy Group 3	149
5.3.5. Policy Group 4	153
5.3.6. Policy Group 5	155
5.3.7. Policy Group 6	159
5.3.8. Policy Group 7	163
5.3.9. Policy Group 8	167

5.3.10. Policy Group 9	167
5.4. Comparison of Best Policies of Groups with Baseline Scenario	170
5.5. General Observations about the Blood Supply Chain	172
5.5.1. Comparison of Performances of Blood Groups	172
5.5.2. Comparison of Performances of Different Sized Hospitals	174
5.6. Comparison of TC Performances with Previous Work.....	177
6.CONCLUSION AND FURTHER RESEARCH ISSUES	179
REFERENCES.....	184
APPENDICES	
A. SIMULATION MODEL INPUT FILE FORMATS AND VALUES USED IN BASELINE POLICY	198
B. SIMULATION MODEL OUTPUT FILE FORMATS AND SAMPLES FROM BASELINE POLICY	203
C. EXAMPLES OF THE OUTPUTS OF THE EXCEL FILE FOR BASELINE POLICY	207
D. VALUES OF PARAMETER USED FOR EACH POLICY	269
E. RESULTS OF SIMULATION ANALYSES AND COMPARISONS.....	275

LIST OF TABLES

Table 2.1. Decision Making Problems in Blood Management	9
Table 2.2. A General Categorization of the Prior Work.....	10
Table 2.3. Crossmatching Guide (numbers shown are priorities for using the oldest units).....	18
Table 3.1. Main Blood Groups in the ABO System.....	42
Table 3.2. The Range of Coordination/Control of the RBC.....	46
Table 3.3. Alternative Task Descriptions for RBC and Community Blood Center .	47
Table 3.4. Centers in the Pilot Region.....	54
Table 4.1. Blood Group Frequencies in Turkish Population.....	64
Table 4.2. Blood Disposal Parameters and Their Definitions	65
Table 4.3. Blood Transfer Parameters and Their Definitions	66
Table 4.4. Donation Center Parameters and Their Definitions	67
Table 4.5. SPSS Output of One-Sample Kolmogorov-Smirnov Test for DCs' Daily Whole Blood Collections	68
Table 4.6. Inventory and Allocation Parameters and Their Definitions.....	69
Table 4.7. Regional Blood Center Parameters and Their Definitions.....	71
Table 4.8. SPSS Output of One-Sample Kolmogorov-Smirnov Test for RBC's Daily Whole Blood Collections	72
Table 4.9. Simulation Run Parameters and Their Definitions.....	72
Table 4.10. Transfusion Center Parameters and Their Definitions.....	73
Table 4.11. Probabilities for the Size of Requests	75
Table 4.12. Statistics of the Hospitals in Other Regions Used for Regression Analysis (Source: The Annual Health Statistics Report 2006, The Ministry of Health).....	77
Table 4.13. Model Summary Output of the Regression.....	78
Table 4.14. Anova Table of the Model	78

Table 4.15. Coefficients Output of SPSS	79
Table 4.16. Forecasted numbers of daily requests of TCs in the West-Mediterranean Region	80
Table 4.17. Transfusion Process Parameters and Their Definitions	81
Table 4.18. Mismatch Compatible Blood Groups.....	122
Table 5.1. An Example of Degenerate Test Results.....	141
Table 5.2. Results of test problems	142
Table 5.3. Parameters Used to Construct Alternative Policies.....	145
Table 5.4. Selected Values of Routine Delivery Review Periods and Target Inventory Level Coefficients	160
Table 5.5. Target Inventory Level Coefficient Values of TCs Used In Policy 6.7.	161
Table 5.6. Summary of Percentage Change in Performance Measures Achieved With Best Policies of Groups.....	170
Table 5.7. Values Used to Construct the Best Policies of Policy Groups.....	171
Table 5.8. Performance Comparison of Similar Sized TCs with those in Katsaliaki and Brailford, 2006	178
Table A.1. File format of the “BDP.txt” File and Values Used in Baseline Policy	198
Table A.2. File Format of the “DC.txt” File and Values Used in Baseline Policy	198
Table A.3. File Format of the “IAPP.txt” File and Values Used in Baseline Policy	198
Table A.4. File Format of the “RBC.txt” File and Values Used in Baseline Policy	199
Table A.5. File Format of the “SRP.txt” File and Values Used in Baseline Policy	199
Table A.6. File Format of the “TPP.txt” File and Values Used in Baseline Policy	199
Table A.7. File Format of the “BTP.txt” File and Values Used in Baseline Policy	200
Table A.8. File Format of the “TC.txt” File and Values Used in Baseline Policy.	202
Table B.1. File format of the “TC.Out” File and a Sample from Output of Baseline Policy	203
Table B.2. File format of the “DC.Out” File and a Sample Output of Baseline Policy	204

Table B.3. File format of the “RBC.Out” File and a Sample Output of Baseline Policy	205
Table B.4. File format of the “SIM.Out” File and a Sample Output of Baseline Policy	206
Table C.1. TCs’ Single Performance Measures and Confidence Intervals – Mean Inventory Level by Blood Group	207
Table C.2. TCs’ Single Performance Measures and Confidence Intervals – Outdate Rates by Blood Group	208
Table C.3. TCs’ Single Performance Measures and Confidence Intervals – Mismatch Rates by Blood Group	209
Table C.4. TCs’ Single Performance Measures and Confidence Intervals – Shortage Rates by Blood Group	210
Table C.5. TCs’ Single Performance Measures and Confidence Intervals – Number of Added Units by Blood Group	211
Table C.6. TCs’ Single Performance Measures and Confidence Intervals – Number of Disposed Units by Blood Group	212
Table C.7. TCs’ Single Performance Measures and Confidence Intervals – Number of Mismatched Units by Blood Group	213
Table C.8. TCs’ Single Performance Measures and Confidence Intervals – Number of Shortage Units by Blood Group	214
Table C.9. TCs’ Single Performance Measures and Confidence Intervals – Number of Transfused Units by Blood Group	215
Table C.10. TCs’ Single Performance Measures and Confidence Intervals – Number of Requested Units by Blood Group	216
Table C.11. DCs’ Single Performance Measures and Confidence Intervals – Mean Inventory Levels by Blood Group	217
Table C.12. DCs’ Single Performance Measures and Confidence Intervals – Dispose Rates by Blood Group	218
Table C.13. DCs’ Single Performance Measures and Confidence Intervals – Deliveries Data	219

Table C.14. DCs' Single Performance Measures and Confidence Intervals – Number of Units Used or Disposed in Responsibility Area of DC by Blood Group	220
Table C.15. DCs' Single Performance Measures and Confidence Intervals – Number of Outdated Units by Blood Group	221
Table C.16. DCs' Single Performance Measures and Confidence Intervals – Delivery Percentages.....	222
Table C.17. RBC's Single Performance Measures and Confidence Intervals – Mean Inventory Levels by Blood Group	223
Table C.18. RBC's Single Performance Measures and Confidence Intervals – Deliveries Data.....	224
Table C.19. RBC's Single Performance Measures and Confidence Intervals – Number of Units Used or Disposed in Responsibility Area of RBC by Blood Group	225
Table C.20. RBC's Single Performance Measures and Confidence Intervals – Number of Outdated Units by Blood Group	226
Table C.21. RBC's Single Performance Measures and Confidence Intervals – Delivery Percentages.....	227
Table C.22. Cities (Excluding RBC and DCs) Performance Measures and Confidence Intervals – Mean Inventory Levels by Blood Group	228
Table C.23. Cities (Excluding RBC and DCs) Performance Measures and Confidence Intervals – Outdate Rates by Blood Group.....	229
Table C.24. Cities (Excluding RBC and DCs) Performance Measures and Confidence Intervals – Mismatch Rates by Blood Group	230
Table C.25. Cities (Excluding RBC and DCs) Performance Measures and Confidence Intervals – Shortage Rates by Blood Group	231
Table C.26. Cities (Excluding RBC and DCs) Performance Measures and Confidence Intervals – Number of Added Units by Blood Group	232
Table C.27. Cities (Excluding RBC and DCs) Performance Measures and Confidence Intervals – Number of Outdated Units by Blood Group	233
Table C.28. Cities (Excluding RBC and DCs) Performance Measures and Confidence Intervals – Number of Mismatched Units by Blood Group	234

Table C.29. Cities (Excluding RBC and DCs) Performance Measures and Confidence Intervals – Number of Shortage Units by Blood Group	235
Table C.30. Cities (Excluding RBC and DCs) Performance Measures and Confidence Intervals – Number of Transfused Units by Blood Group	236
Table C.31. Cities (Excluding RBC and DCs) Performance Measures and Confidence Intervals – Number of Requested Units by Blood Group.....	237
Table C.32. Cities (Including RBC and DCs) Performance Measures and Confidence Intervals – Mean Inventory Levels by Blood Group	238
Table C.33. Cities (Including RBC and DCs) Performance Measures and Confidence Intervals – Outdate Rates by Blood Group.....	239
Table C.34. Regional (Excluding DCs and RBC) Performance Measures and Confidence Intervals – Mean Inventory Levels by Blood Group	240
Table C.35. Regional (Excluding DCs and RBC) Performance Measures and Confidence Intervals – Outdate Rates by Blood Group.....	241
Table C.36. Regional (Excluding DCs and RBC) Performance Measures and Confidence Intervals – Mismatch Rates by Blood Group	242
Table C.37. Regional (Excluding DCs and RBC) Performance Measures and Confidence Intervals – Shortage Rates by Blood Group	243
Table C.38. Regional (Including DCs and RBC) Performance Measures and Confidence Intervals – Mean Inventory Level by Blood Group.....	244
Table C.39. Regional (Including DCs and RBC) Performance Measures and Confidence Intervals – Outdate Rates by Blood Group.....	245
Table C.40. Regional (Including DCs and RBC) Performance Measures and Confidence Intervals – Deliveries Data	246
Table C.41. Regional (Including DCs and RBC) Performance Measures and Confidence Intervals – Delivery Percentages	247
Table C.42. Summary Tables – Regional (Including DCs and RBC) Performance Measures Summary by Blood Group.....	248
Table C.43. Summary Tables – Regional (Including DCs and RBC) - Deliveries Data Summary by Blood Group.....	250
Table C.44. Summary Tables – Regional (Excluding DCs and RBC) Performance Measures Summary by Blood Group.....	252

Table C.45. Summary Tables – Comparison of Outdate Rates of Regional Performance of RBCs and DCs included. and Excluded Cases. And, TCs’ Single Performances Means	253
Table C.46. Summary Tables – Comparison of Mismatch Rates of Regional Performance (Excluding RBCs and DCs) and TCs’ Single Performances Means .	254
Table C.47. Summary Tables – Comparison of Shortage Rates of Regional Performance (Excluding RBCs and DCs) and TCs’ Single Performances Means .	255
Table C.48. Summary Tables – Comparison of Performances Between TCs	257
Table C.49. Summary Tables – Single TCs’ Performances Means - Comparison of Outdate Rates of Blood Groups	258
Table C.50. Summary Tables – Single TCs’ Performances Means - Comparison of Mismatch Rates of Blood Groups	258
Table C.51. Summary Tables – Single TCs’ Performances Means - Comparison of Mismatch Rates of Blood Groups	259
Table C.52. Summary Tables - Comparison of General Performance Measures of Cities (Including DCs and RBC)	259
Table C.53. Summary Tables - Comparison of Deliveries Percentages of Cities (Including DCs and RBC)	260
Table C.54. Summary Tables - Comparison of Deliveries Quantities of Cities (Including DCs and RBC)	261
Table C.55. Summary Tables - Comparison of Outdate Rates of Cities (Including DCs and RBC)	262
Table C.56. Summary Tables - Comparison of Outdate Rates of Cities (Excluding DCs and RBC)	263
Table C.57. Summary Tables - Comparison of Mismatch Rates of Cities	264
Table C.58. Summary Tables - Comparison of Shortage Rates of Cities	265
Table C. 59. Summary Tables - Comparison of Mean Inventory Levels of Cities Using TCs Single Performances	266
Table C. 60. Summary Tables - Comparison of Outdate Rates of Cities Using TCs Single Performances	267
Table C. 61. Summary Tables - Comparison of Mismatch Rates of Cities Using TCs Single Performances	267

Table C. 62. Summary Tables - Comparison of Shortage Rates of Cities using TCs Single Performances.....	268
Table C. 63 Summary Tables - Comparison of the outdate Rates of RBC. DCs and Region (Excluding RBC and DCs)	268
Table D.1. Configuration Parameters' Values Used for Each Policy	269
Table E.1. Cities Performances and Performance of Region Including DCs and RBC of Group 1 Policies	275
Table E.2. Delivery Performance Measures of Group 1 Policies	276
Table E.3. Selection Criterion Performance of Group 1 Policies	276
Table E.4. Single TC Performances of Group 1 Policies - Mean Inventory Levels	277
Table E.5. Single TC Performances of Group 1 Policies - Outdate Rates.....	278
Table E.6. Single TC Performances of Group 1 Policies - Mismatch Rates	279
Table E.7. Single TC Performances of Group 1 Policies - Shortage Rates	280
Table E.8. Cities Performances and Performance of Region Including DCs and RBC of Group 2 Policies	281
Table E.9. Delivery Performance Measures of Group 2 Policies	281
Table E.10. Selection Criterion Performance of Group 2 Policies	282
Table E.11. Single TC Performances of Group 2 Policies - Mean Inventory Levels	283
Table E.12. Single TC Performances of Group 2 Policies - Outdate Rates.....	284
Table E.13. Single TC Performances of Group 2 Policies - Mismatch Rates	285
Table E.14. Single TC Performances of Group 2 Policies - Shortage Rates	286
Table E.15. Cities Performances and Performance of Region Including DCs and RBC of Group 3 Policies	287
Table E.16. Delivery Performance Measures of Group 3 Policies	289
Table E.17. Selection Criterion Performance of Group 3 Policies	291
Table E.18. Regression Model Summary of Policy Group 3 - Outdate Rate of Region Including DCs And RBC.....	293
Table E.19. Regression Model Anova Table of Policy Group 3 - Outdate Rate of Region Including DCs And RBC.....	293

Table E.20. Regression Model Coefficient Table of Policy Group 3 - Outdate Rate of Region Including DCs And RBC	293
Table E.21. Regression Model Summary of Policy Group 3 - Mismatch Rate of Region Including DCs And RBC	294
Table E.22. Regression Model Summary of Policy Group 3 - Mismatch Rate of Region Including DCs And RBC	294
Table E.23. Regression Model Coefficient Table of Policy Group 3 - Mismatch Rate of Region Including DCs And RBC	294
Table E.24. Regression Model Summary of Policy Group 3 - Shortage Rate of Region Including DCs And RBC	295
Table E.25. Regression Model Anova Table of Policy Group 3 - Mismatch Rate of Region Including DCs And RBC	295
Table E.26. Regression Model Coefficient Table of Policy Group 3 - Shortage Rate of Region Including DCs and RBC	295
Table E.27. Regression Model Summary of Policy Group 3 - Sum of Main Performance Measures	296
Table E.28. Regression Model Anova Table of Policy Group 3 - Sum of Main Performance Measures	296
Table E.29. Regression Model Coefficient Table of Policy Group 3 - Sum of Main Performance Measures	296
Table E.30. Regression Model Summary of Policy Group 3 - Total Number of Deliveries	297
Table E.31. Regression Model Anova Table of Policy Group 3 -Total Number of Deliveries	297
Table E.32. Regression Model Coefficient Table of Policy Group 3 - Total Number of Deliveries	297
Table E.33. Cities Performances and Performance of Region Including DCs and RBC of Policies Derived From Policy 3.32	298
Table E.34. Delivery Performance Measures of Policies Derived From Policy 3.32.	298
Table E.35. Selection Criterion Performance of Policies Derived From Policy 3.32.	299

Table E.36. Single TC Performances of Policies Derived From Policy 3.32. - Mean Inventory Levels	300
Table E.37. Single TC Performances of Policies Derived From Policy 3.32. - Outdate Rates	301
Table E.38. Single TC Performances of Policies Derived From Policy 3.32. - Mismatch Rates.....	302
Table E.39. Single TC Performances of Policies Derived From Policy 3.32. - Shortage Rates.....	303
Table E.40. Cities Performances and Performance of Region Including DCs and RBC of Group 4 Policies	304
Table E.41. Delivery Performance Measures of Group 4 Policies	307
Table E.42. Selection Criterion Performance of Group 4 Policies	310
Table E.43. Regression Model Summary of Policy Group 4 - Outdate Rate of Region Including DCs And RBC	313
Table E.44. Regression Model Anova Table of Policy Group 4 - Outdate Rate of Region Including DCs and RBC	313
Table E.45. Regression Model Coefficient Table of Policy Group 4 - Outdate Rate of Region Including DCs and RBC.....	313
Table E.46. Regression Model Summary of Policy Group 4 - Mismatch Rate of Region Including DCs and RBC	314
Table E.47. Regression Model Summary of Policy Group 4 - Mismatch Rate of Region Including DCs and RBC	314
Table E.48. Regression Model Coefficient Table of Policy Group 4 - Mismatch Rate of Region Including DCs and RBC	314
Table E.49. Regression Model Summary of Policy Group 4 - Shortage Rate of Region Including DCs and RBC	315
Table E.50. Regression Model Anova Table of Policy Group 4 - Shortage Rate of Region Including DCs and RBC	315
Table E.51. Regression Model Coefficient Table of Policy Group 4 - Shortage Rate of Region Including DCs and RBC.....	315
Table E.52. Regression Model Summary of Policy Group 4 - Sum of Main Performance Measures	316

Table E.53. Regression Model Anova Table of Policy Group 4 - Sum of Main Performance Measures	316
Table E.54. Regression Model Coefficient Table of Policy Group 4 - Sum of Main Performance Measures	316
Table E.55. Regression Model Summary of Policy Group 4 - Total Number of Deliveries	317
Table E.56. Regression Model Anova Table of Policy Group 4 -Total Number of Deliveries	317
Table E.57. Regression Model Coefficient Table of Policy Group 4 - Total Number of Deliveries	317
Table E.58. Cities Performances and Perfomance of Region Including DCs and RBC of Group 5 Policies	318
Table E.59. Delivery Performance Measures of Group 5 Policies	320
Table E.60. Selection Criterion Performance of Group 5 Policies	322
Table E.61. Sum of Outdate, Shortage, and Mismatch Rates of TCs (Policy Group 5)	324
Table E.62. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group 0 + (Policy Group 5)	325
Table E.63. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group 0 - (Policy Group 5)	326
Table E.64. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group A + (Policy Group 5)	327
Table E.65. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group A - (Policy Group 5)	328
Table E.67. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group B - (Policy Group 5)	330
Table E.68. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group AB + (Policy Group 5).....	331
Table E.69. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group AB - (Policy Group 5)	332
Table E.70. Cities Performances and Perfomance of Region Including DCs and RBC of Group 6 Policies	333

Table E.71. Delivery Performance Measures of Group 6 Policies	333
Table E.72. Selection Criterion Performance of Group 6 Policies	334
Table E.73. Single TC Performances of Group 6 Policies - Mean Inventory Levels	335
Table E.74. Single TC Performances of Group 6 Policies - Outdate Rates.....	336
Table E.75. Single TC Performances of Group 6 Policies - Mismatch Rates	337
Table E.76. Single TC Performances of Group 1 Policies - Shortage Rates	338
Table E.77. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group 0 + (Policy Group 6)	339
Table E.78. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group 0 - (Policy Group 6)	340
Table E.79. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group A+ (Policy Group 6)	341
Table E.80. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group A- (Policy Group 6)	342
Table E.81. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group B+ (Policy Group 6)	343
Table E.82. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group B- (Policy Group 6)	344
Table E.83. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group AB+ (Policy Group 6).....	345
Table E.84. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group AB- (Policy Group 6)	346
Table E.85. Sum of Outdate, Shortage, and Mismatch Rates of TCs	347
(Policy Group 6).....	347
Table E.86. Cities Performances and Performance of Region Including DCs and RBC of Group 7 Policies	348
Table E.87. Delivery Performance Measures of Group 7 Policies	348
Table E.88. Selection Criterion Performance of Group 7 Policies	349
Table E.89. Single TC Performances of Group 7 Policies - Mean Inventory Levels	350
Table E.90. Single TC Performances of Group 7 Policies - Outdate Rates.....	351

Table E.91. Single TC Performances of Group 7 Policies - Mismatch Rates	352
Table E.92. Single TC Performances of Group 7 Policies - Shortage Rates	353
Table E.93. Cities Performances and Performance of Region Including DCs and RBC of Group 8 Policies	354
Table E.94. Delivery Performance Measures of Group 8 Policies	354
Table E.95. Selection Criterion Performance of Group 8 Policies	355
Table E.96. Single TC Performances of Group 8 Policies - Mean Inventory Levels	356
Table E.97. Single TC Performances of Group 8 Policies - Outdate Rates.....	357
Table E.98. Single TC Performances of Group 8 Policies - Mismatch Rates	358
Table E.99. Single TC Performances of Group 8 Policies - Shortage Rates	359
Table E.100. Cities Performances and Performance of Region Including DCs and RBC of Group 9 Policies	360
Table E.101. Delivery Performance Measures of Group 9 Policies	360
Table E.102. Selection Criterion Performance of Group 9 Policies	361
Table E.103. Single TC Performances of Group 9 Policies - Mean Inventory Levels	362
Table E.104. Single TC Performances of Group 9 Policies - Outdate Rates.....	363
Table E.105. Single TC Performances of Group 9 Policies - Mismatch Rates.....	364
Table E.106. Single TC Performances of Group 9 Policies - Shortage Rates	365
Table E.107. Comparison of City Performances of Best Policies of Groups	366
Table E.108. Comparison of Delivery Performances Measures of Best Policies of Groups.....	366
Table E.109. Comparison of Selection Criterion Performance of Best Policies of Groups.....	367
Table E.110. Percentage Change In City Performances Achieved with Best Policies of Groups.....	368
Table E.111. Percentage Change In Delivery Performance Measures Achieved with Best Policies of Groups.....	368
Table E.112. Percentage Change In Selection Criterion Performance Achieved with Best Policies of Groups.....	369

Table E.113. Comparision of Single TC Performances of Best Policie of Groups - Mean Inventory Levels	370
Table E.114. Comparision of Single TC Performances of Best Policie of Groups - Outdate Rates	371
Table E.115. Comparision of Single TC Performances of Best Policie of Groups - Mismatch Rates.....	372
Table E.116. Comparision of Single TC Performances of Best Policie of Groups - Shortage Rates.....	373
Table E.117. Comparision of Single TC Performances of Best Policie of Groups - Selection Criterion Values Rates	374
Table E.118. Percentage Change in Single TC Performances of Best Policie of Groups - Mean Inventory Levels	375
Table E.119. Percentage Change inSingle TC Performances of Best Policie of Groups - Outdate Rates	376
Table E.120. Percentage Change in Single TC Performances of Best Policie of Groups - Mismatch Rates.....	377
Table E.121. Percentage Change in Single TC Performances of Best Policie of Groups - Shortage Rates	378
Table E.122. Percentage Change inSingle TC Performances of Best Policie of Groups - Selection Criterion Values Rates	379

LIST OF FIGURES

Figure 3.1. Main Components from the Whole Blood.....	41
Figure 3.2. Blood Supply Chain Structures Discussed In the Literature	45
Figure 3.3. Hierarchical Regional Structure of Blood Services as Defined in the New Law	50
Figure 3.4. Selected RBC Regions and Their Locations.....	51
Figure 3.5. Flowchart of the Processes of RBC	55
Figure 3.6. Flowchart of the Processes of DC.....	58
Figure 3.7. Flowchart of the Processes of TC	59
Figure 4.1. Processes of the Modelling Approach	63
Figure 4.2. Histograms of Daily Whole Blood Collections of the DCs.....	67
Figure 4.3. Histograms of Daily Whole Blood Collections of the RBC.....	71
Figure 4.4. Matrix Scatter Graph of the Regression Variables	76
Figure 4.5. Class Diagram of the SiModel.....	82
Figure 4.6. Context Diagram of the Simulation Model.....	99
Figure 4.7. Level 1 Data Flow Diagram.....	100
Figure 4.8. Level 2 - Data Flow Diagram of RBC Sub-model.	101
Figure 4.9. Level 2 - Data Flow Diagram of DC Sub-model.....	113
Figure 4.10. Level 2 - Data Flow Diagram of TC Sub-model	120
Figure 4.11. Flowchart of the Assign Process.....	121
Figure 5.1. Effects of Cross-match Release Period on the Main Performance Measures	146
Figure 5.2. Effects of Cross-Match Release Period on TCs' Single Performances Means	147
Figure 5.3. Effects of Cross-match Release Period on the Sum of Main Performance Measures	148

Figure 5.4. Effects of Transfusion to Cross-Match on Outdate and Mismatch Rates of the Region Including DCs and RBC.....	150
Figure 5.5. Effects of Transfusion to Cross-Match Ratio on TCs' Single Performances Means	150
Figure 5.6. Effects of Transfusion to Cross-Match Ratio on the Sum of Main Performance Measures	151
Figure 5.7. Selection Criterion Performance of Issuing and Allocation Methods Combinations Where Routine Delivery Review Period is One Day	157
Figure 5.8. Selection Criterion Performance of Issuing and Allocation Methods Combinations Where Routine Delivery Review Period is Two Days	158
Figure 5.9. Selection Criterion Performance of Issuing and Allocation Methods Combinations Where Routine Delivery Review Period is Three Days	158
Figure 5.10. Change of Selection Criterion Values, Outdate Rates and Mismatch Rates of the Region Policies from 5.9 to 6.7	162
Figure 5.11. Effects of Ad-Hoc Delivery Coefficient of TCs on Region's Performance where Routine Delivery Coefficient of TCs is Equal to 1.....	163
Figure 5.12. Effects of Ad-Hoc Delivery Coefficient of TCs on Region's Performance where Routine Delivery Coefficient of TCs is Equal to 0.9.....	164
Figure 5.13. Effects of Ad-Hoc Delivery Coefficient of TCs on Region's Performance where Routine Delivery Coefficient of TCs is Equal to 0.8.....	164
Figure 5.14. Effects of Routine Delivery Coefficient of TCs on Region's Performance where Ad-hoc Delivery Coefficient of TCs is Equal to 0.5	165
Figure 5.15. Effects of Routine Delivery Coefficient of TCs on Region's Performance where Ad-hoc Delivery Coefficient of TCs is Equal to 0.4	166
Figure 5.16. Effects of Routine Delivery Coefficient of TCs on Region's Performance where Ad-hoc Delivery Coefficient of TCs is Equal to 0.3	166
Figure 5.17. Effect of Burdur DC's target inventory level coefficient on selection criterion value of the region and outdate, mismatch, and shortage rates of the city	168
Figure 5.18. Effects of Different Upper Inventory Limit and Excessive Amount Coefficients Pairs on Main Performance Measures and Selection Criterion Value	169
Figure 5.19. The Change in Main Performance Measure of Region Including DCs and RBC Achieved with the Best Policies of Policy Groups	172

Figure 5.20. Outdate Rates of Blood Groups for Region Including DCs and RBC for Policy 9.2	173
Figure 5.21. Mismatch Rates of Blood Groups for Region Including DCs and RBC for Policy 9.2.....	173
Figure 5.22. Outdate, Mismatch and Shortage Rates For Different Blood Group Frequencies for Region Including DCs and RBC for Policy 9.2	174
Figure 5.23. Shortage Rates of Blood Groups for the Region Including DCs and RBC for Policy 9.2	175
Figure 5.24. Comparison of Outdate Rates of Different Sized TCs for Policy 9.2.	175
Figure 5.25. Comparison of Mismatch Rates of Different Sized TCs for Policy 9.2.	176
Figure 5.26. Comparison of Shortage Rates of Different Sized TCs for Policy 9.2.	176
Figure C.1. Summary Graphics- Regional (Including DCs and RBC) - Mean Inventory Levels by Blood Group	248
Figure C.2. Summary Graphics- Regional (Including DCs and RBC) - Outdate Rates by Blood Group	249
Figure C.3. Summary Graphics- Regional (Including DCs and RBC) - Mismatch Rates by Blood Group	249
Figure C.4. Summary Graphics- Regional (Including DCs and RBC) - Shortage Rates by Blood Group	250
Figure C.5. Summary Graphics- Regional (Including DCs and RBC) - Quantities of Deliveries	251
Figure C.6. Summary Graphics- Regional (Including DCs and RBC) - Delivery Distances	251
Figure C.7. Summary Graphics- Regional (Excluding DCs and RBC) – Mean Inventory Levels	252
Figure C.8. Summary Graphics- Regional (Excluding DCs and RBC) – Outdate Rates.....	253

Figure C.9. Summary Graphics- Comparison of Outdate Rates of Regional Performance of RBCs and DCs included and excluded cases and TCs Single Performances Means	254
Figure C.10. Summary Graphics- Comparison of Mismatch Rates of Regional Performance (Excluding RBCs and DCs) and TCs' Single Performances Means .	255
Figure C.11. Summary Graphics- Comparison of Shortage Rates of Regional Performance (Excluding RBCs and DCs) and TCs' Single Performances Means .	256
Figure C.12. Summary Tables - Comparison of General Performance Measures of Cities (Including DCs and RBC)	260
Figure C.13. Summary Tables - Comparison of Delivery Percentages of Cities (Including DCs and RBC).....	261
Figure C.14. Summary Tables - Comparison of Delivery Quantities of Cities (Including DCs and RBC).....	262
Figure C.15. Summary Tables - Comparison of Outdate Rates of Cities (Including DCs and RBC)	263
Figure C.16. Summary Tables - Comparison of Outdate Rates of Cities (Excluding DCs and RBC)	264
Figure C.17. Summary Tables - Comparison of Mismatch Rates of Cities.....	265
Figure C.18. Summary Tables - Comparison of Shortage Rates of Cities	266

CHAPTER 1

INTRODUCTION

Blood is a circulating tissue which carries oxygen and nutrients to the tissues and carries waste products away. Blood is a highly specialized tissue composed of many different kinds of components. It is collected as a whole blood and whole blood is processed into several components such as red blood cells, platelets, fresh frozen plasma. Blood and blood components are perishable products with shelf lives changing from component to component. Blood appears in 8 major blood types whose frequencies vary from population to population.

Blood banking is an important main part of the health service systems and its applications have a major impact on the success of the medical treatment procedures. There is no alternative to meet the demand for blood in medical procedures as there is no substitute for human blood (blood is voluntarily supplied by donors). Therefore, blood should be considered as a scarce resource all over the world.

Many countries face the problem of increasing gap between blood need for transfusion (demand) and donor recruitment (supply). Cost of blood transfusion rises due to the new blood safety measures such as HIV testing. Therefore, efficient management of blood throughout the countries is of great economic importance, in addition to its major impact on medical operations.

Alternative network designs for blood supply chain to achieve both economies of scale and high quality is discussed in the literature. There has been much discussion about the issue of regionalization of blood banking systems. Different alternatives of structural forms of reorganization and different task descriptions for the

organizational units in blood supply chain are investigated. Most countries have established regionalized blood management systems.

The authorities in Turkey recognized that national blood banking and transfusion system has some deficiencies in terms of economies of scale, blood safety requirements, self-sufficiency, and service quality. Hospital blood banks (transfusion centers) still collect, process, test and store blood and blood components. However, this task description of hospital blood banks is not appropriate to achieve safe, reliable and efficient blood supply. Turkish Ministry of Health has prepared a Blood and Blood Products draft bill in 2005, which is restructuring tasks of all units related to the blood system. This bill has been approved by the Turkish parliament and the new Turkish law about national blood banking system has been published in 2007. This law states a distinctive network design, which is significantly different from the ones previously discussed in the literature. The main objective of our study is a detailed analysis of this unique blood supply chain network, to obtain a better understanding of the system, and to be able to manage it for the benefit of both parties (hospitals and TRCS) of the supply chain.

The primary responsible organization for the establishment of the new structure throughout the country is the Turkish Red Crescent Society (TRCS) in the new law. Therefore, TRCS has started a project for the reorganization of the blood centers (which is compatible with the structure proposed in the draft bill) throughout the country. Reorganization project is currently in the transition phase. Therefore, some irregularities still appear in the operations by the establishment of the new structure. TRCS divided its national blood services into 12 regions and selected 12 cities to locate the Regional Blood Centers (RBC), one RBC for each region. In this study, West-Mediterranean Region which consists of 1 RBC, 2 donation centers (DC) and 49 transfusion centers (TC) is considered. Some irregularities are also observed in the region as in others. Most of the TCs in the region still continue to collect blood and when their available inventory level becomes insufficient to satisfy the demand, they order blood from TRCS centers. A few hospitals in the region gave up blood collection and made a supply agreement with TRCS. Some of these hospitals order

blood from TRCS periodically, but order quantities are determined by the hospitals according to the experience and knowledge of the professionals in the hospitals. Inventories of the remaining few hospitals are monitored and replenished by TRCS periodically, but still a systematic policy to efficiently manage inventory of blood and blood resources has not been established yet. Within the scope of this work, we consider the inventory management, allocation and transportation aspects of the blood supply chain, under the assumption that all centers in the region operate in accordance with the new law. We ignore the irregularities in the region, assuming that all centers will be acting compatible with the new law in the near future. We analyze the effect of the alternative management policies on the performance measures determined for the region and try to find improved management policies to be adapted to the blood supply chain. Red blood cells, which are the most common components, are included in this study. They capture above 80% of the total blood units issued in hospitals. All components have different shelf lives and require different storage conditions. They are transported by different vehicles because of the requirement of different temperature conditions for storage. Therefore, managing the inventory of these components is separated in practice, and other components are excluded from our study. Although we include only the red blood cell component, we consider a multi-product environment due to the ABO and Rh classification (8 different products).

Blood supply management performance is usually characterized based on several conflicting objectives such as availability of blood to patient, and effective utilization of blood without disposing. Unavailability of blood increases the risk of mortality and morbidity for patients; conversely higher inventory levels increase the risk of outdated which results with high costs and the inefficient use of blood.

Special blood banking processes makes blood inventory management different from classical perishable inventory management problems. One of the main distinctions occurs because of the difference between demand and usage. Demand and usage refer to the requested blood units and the actually used (transfused) blood units, respectively. Another main difference is that blood inventory at the hospital level is

separated into two stages as assigned and unassigned inventories. Once a request for a patient is received at a hospital, the appropriate numbers of blood units of that type are removed from the unassigned inventory, and placed in assigned inventory for a particular patient. Any units that are not transfused for the patient are returned to the unassigned inventory after being reserved for a predetermined period of time. Modeling the process by which unused assigned units return to unassigned stock after having aged for some number of days, is another complexity of blood inventory management problems. In addition to the difficulties at the hospital level, some features of blood makes modelling the whole blood supply chain a complex task, such as multi-product and multi echelon nature of the problem. These aspects limit the usefulness of the analytical results on perishable inventory management to blood banking. The actual problem, even at the hospital level, seems to be too complex to be adequately described by a single mathematical model (Nahmias, 1982; Prastacos, 1984; Katsaliaki and Brailsford, 2006). Therefore, we used discrete event simulation to model the entire supply chain. The proposed modelling approach allows us to analyze the effects of alternative management policies and system parameters on the supply chain performance. Some difficulties also appear while modelling blood supply chain by simulation in terms of run time. Previous studies in the literature indicate that the time taken to perform one simulation run increases to a point that makes the use of simulation ineffective as supply chain grew in size (including more than one TC).

Within the scope of this study, we developed and used a tailored program (SiModel) for the simulation of the supply chain to solve the run time problem rather than using a general purpose simulation software package. We also made some simplifications in the modelling side to reduce the run time. Very good solutions are achieved in terms of run time.

As there is no fully implemented real life application of the analyzed structure, we constructed a baseline management policy by utilizing the generally used system parameter values in previous works. Alternative management policies are constructed using different system parameters, and the results are compared with

each other and the baseline policy. Important improvements are achieved in terms of selected performance measures such as outdate and shortage rates of the region. The effects of the system parameters on the supply chain performance measures, within the boundaries specified by the model configuration values, are also investigated in addition to the efforts to find improved policies.

The thesis includes six chapters. The concepts related to the blood supply chain management, and techniques used to solve problems observed in the blood supply chain are discussed in Chapter 2. Blood supply chain, and the unique network under consideration and its environment are defined in Chapter 3. In Chapter 4, difficulties related to modeling the problem and the modelling approach used are explained. Experimental results are presented in Chapter 5 and it is concluded in Chapter 6.

CHAPTER 2

BLOOD SUPPLY CHAIN MANAGEMENT AND THE RELATED LITERATURE

2.1. Blood and Blood Banking

Blood is a living tissue of unique medical value to the human body. It is the vehicle that carries oxygen, nutrients and chemicals to all parts of the body, and carries away all waste products. Blood appears in 8 major types whose frequencies vary from population to population. It is composed of many components (red cells, platelets, plasma, etc.), several of which can be routinely extracted from the whole blood through appropriate procedures. Each of these components serves a separate function of the human organism, and has a different use in the medical treatment of patients. All of these components are perishable with varying lifetimes.

Blood is collected in units at collection sites such as Regional Blood Center, Donation Center, a Hospital Blood Bank, or a mobile unit. When collected it undergoes a series of typing and screening tests, and may be separated into components. It is then shipped to a Hospital Blood Bank where it is available to satisfy demands for transfusion to patients.

The Hospital Blood Bank operates as an inventory location, storing and issuing the appropriate blood units to satisfy transfusion requests. During the course of a day the Blood Bank receives a random number of transfusion requests, each for a random number of units, for each blood type. Once a request for a patient is received, the appropriate numbers of units of that type are removed from free inventory

(unassigned inventory), and upon successful crossmatching, they are placed on reserve inventory (assigned inventory) for a particular patient. Cross-match is a test which to find out whether the donated blood is appropriate to transfuse the patient or not. Any units that are not transfused are returned to unassigned inventory that can be used to satisfy demand in the future. The time that elapses between the patients operation and the return of the unused units back to unassigned inventory is called crossmatch release period. Crossmatch-to-transfusion ratio is defined as the ratio of the number of crossmatched units to the number of transfused units. Demand and usage refer to the requested units and transfused units, respectively. Any units that are not used within their lifetime are considered outdated and discarded from inventory (Prastacos, 1984). If the same-group blood is not available within a pre-specified period for a request, the request is fulfilled by another compatible blood group. This procedure is called as mismatching and this period is called as mismatch activation period.

Blood banking is an important main part of the health service systems and its applications have a major impact on the success of the medical treatment procedures. Blood banking applications have attracted significant interest from the operations researchers, as well as the health professionals, especially in 70s and in early 80s. The main reasons that make blood banking popular in the literature can be summarized as follows:

- It has a major impact on the success of almost all medical treatment procedures.
- The gap between blood donations (supply) and the need for blood transfusion (demand) is increasing.
- Scarcity of blood and volunteer blood donors is a problem allover the world.
- Planning is complex the due to the special nature of the problem such as multi-item environment, cross-match release period, possible returns of untransfused units.
- The cost of safe blood is increasing.

The management of blood supplies can be examined at three hierarchically related levels; the individual hospital level, the regional level and the interregional level. At each of these levels, the decision maker faces a wide range of operational, tactical and strategic management problems. Table 2.1. outlines the main management problems at each hierarchical level of decision making (Prastacos, 1984).

The analytic modelling of these decision problems and the subsequent implementation of an efficient and effective inventory management system is a complex task. On the modelling side, the major difficulty stems from the two special features of blood: (i) the ageing and perishability, and (ii) the difference between demand and usage. Because of the ageing process, inventory has to be identified by a state vector whose dimension is equal to the lifetime of blood. This large dimensionality creates serious computational difficulties when trying to obtain optimal solutions. In addition to the above difficulties, a number of implementation issues complicates the accurate modelling of a blood management system. These include: (i) the crossmatch release period, (ii) the age of incoming units, (iii) the large variation in hospital needs and practices, (iv) multiproduct nature of the problem, and (v) the hierarchical nature of the problem. Blood inventory management is also characterized by some of the features of a typical healthcare management problem. For example, its performance is usually characterized based on several criteria, such as availability of blood to the patients, utilization of blood, and age of blood when transfused to patients (Kendall, 1980). Some of these criteria are conflicting, such as the availability and utilization of blood. Also some of them involve costs that are very difficult to calculate, such as unavailability of blood at a Hospital Blood Bank, since it might involve medical complications for the patient (Prastacos, 1984).

Researchers have made meaningful contributions to the literature concerning the decision making processes listed in Table 2.1. A general categorization of the prior work, investigated within the scope of this study, is given in Table 2.2. The relevant studies are discussed below within the framework as given in Table 2.2.

Table 2.1. Decision Making Problems in Blood Management

Decision Maker			
Level of Decision	Hospital Blood Bank	Regional Blood Center	Inter-Regional Blood Program
Operational	Schedule and coordinate: • Ordering • Collections • Processing • Issuing	Schedule and coordinate: • Collections • Delivery shipments • Delivery routes • Testing methods	Schedule (at each participating Regional Center), and coordinate: • Collections • Transshipments • Other daily activities
Tactical	Determine: • Inventory levels • Collections levels • Issuing policies • Processing policies	Determine: • Optimal Allocations to Hospitals and Centers • Distribution parameters • Collection targets • Processing policies	• Set policy parameters for relations between regions (collections, transshipments, prices) • Establish uniform standards (in handling, processing, reporting and pricing of blood resources)
Strategic	• Set objectives/targets of performance • Determine policies/sources of blood supply • Decide to join, or not join, a regional system	• Set objectives/targets of performance • Design management and pricing policies • Design network configuration • Determine policies/sources of blood supply • Decide to accept/keep or not, a hospital in the regional system • Decide to join or not join an Inter-Regional Blood Program	• Set objective/targets of Blood Program • Set objectives/constraints of relations between regions • Design interregional blood management system

Table 2.2. A General Categorization of the Prior Work

Subject	Prior Work on the Subject
Statistical Analysis of Demand, Usage, Donor Arrival, Blood Age and Production	Elston and Pickrel (1963), Rockwell et al. (1963), Rabinowitz and Valinsky (1970), Frankfurth et al. (1974), Yen (1975), Brodheim and Prastacos (1980), Owens et al. (2001), Pereira (2004), Bosnes et al.(2005), Raat et al. (2005), Veihola et al. (2006)
Evaluation of the Use of Alternative Storing Procedures and Alternative Therapies and Their Impact on Blood Supply Chain	Cumming (1976), Pegels et al.(1977), Kahn et al.(1978), Bodily (1979), Prowse (1999), Hess (2004)
Crossmatching Policies	Rabinowitz and Valinsky (1970), Freidman et al. (1976), Dumas and Rabinowitz (1977), Cohen and Pierskalla (1979), Brodheim and Prastacos (1980), Pierskalla and Roach (1981), Chan et al. (1996)
Economies of Scale In Blood Banking; Efficiency and Cost Issues	Varney and Guest (2003), Kros and Pang (2004), Pitocco and Sexton (2005), Pereira (2006)
Regionalization of Blood Banking	Pierskalla (1979), Or and Pierskella (1979), Xu (1999), Şahin, Süral and Meral (2007)
Perishable Inventory Management	Nahmias and Pierskalla (1973), Nandakumar and Morton (1993), Fries (1975), Nahmias (1975), Cohen (1976), Nahmias (1976), Chazan and Gal (1977), Nahmias (1978), Parlar (1984), Goh et al. (1993), Ishii et al. (1996), Liu and Lian (1999), Perry and Stadje (2000), Cooper (2001), Tekin et al. (2001), Kalpakam and Shanthi (2001), Chen and Lin (2002), Omosigho (2002), Ketzenberg and Ferguson (2003), Sawaki (2003), Deniz et al. (2004), Ferguson and Ketzenberg (2004), Ferguson and Koenigsberg (2004), Sana and Chaudhuri (2004), Lystad and Ferguson (2006), Williams and Patuwo (1999)
Applications of the Perishable Inventory Theory in Blood Banking and Analytical Models to Manage Blood Inventory	Millard (1960), Jennings (1968), Pegels and Jelmert (1970), Jennings (1973), Cohen and Pierskalla (1975), Brodheim et al. (1976), Prastacos (1978), Cohen and Pierskalla (1979), Brodheim and Prastacos (1979), Kendall and Lee (1980), Jagannathan and Sen (1991), Angelis et al. (2001), Blake et al. (2003), Kopach, Balcioglu and Carter (2006)
Simulation in Healthcare	Kwak et al. (1976), Standridge et al. (1978), Hindle, et al. (1978), Klee, et al. (1980), Dumas (1984), Vissilacopoulos (1985), Dumas (1985), Wright (1987), Mahacek (1992), Lowery and Martin (1992), Butler et al. (1992), Chan and Metzger (1993), Brown-Standridge et al. (1993), McGuire (1994), Lopez-Valcarcel and Perez (1994), Pritsker et al. (1995), Standridge and Brown-Standridge (1995), Garcia et al. (1995), Steward and Standridge (1996), Dittus et al. (1996), Evan et al. (1996), Darzi et al. (1998), Centeno et al. (2000), Baesler and Sepulveda (2001), Blasak et al (2003)
Simulation in Blood Bank Inventory Management	Elston and Pickrel (1965), Jennings (1968), Rabinowitz and Valisky (1970), Jennings (1973), Yen (1975), Brodheim et al. (1976) Cohen and Pierskalla (1979), Freidman et al (1982), Katz et al. (1983), Sirelson and Brodheim (1991), Hesse et al (1997), Kopach et al. (2004), Pereira (2005), Haijema et al (2006), Katsaliaki and Brailsford (2006), Mustafee et al. (2006), Brailsford et al (2006), Haijema et al. (2007)

2.1.1. Statistical Analysis of Demand, Usage, Donor Arrival, Blood Age and Production

Since the demand and usage of blood are stochastic, a fundamental part of every hospital's effort for improved blood inventory management is understanding the statistical pattern of demand and usage of blood (through statistical analysis of collected data) in order to forecast their patterns better. These patterns are determined by the behavior of three random variables for each blood type: the number of daily requests (N) arriving at the blood bank, the size of requisition (R), and the usage (number of units used) of a requisition (U), (Prastacos, 1984).

A significant amount of work has addressed the behavior of these random variables. Elston and Pickrel (1963), using data from North Carolina hospital, found N to be a Poisson random variable, and R a lognormal random variable

$$P(n) = P(N=n) = \exp(-\lambda) \lambda^n / n!, \quad n = 0, 1, \dots \quad \text{and} \\ Q(r) = P(R=r) = -p^{r-1} / ((1-p) \ln(1-p)), \quad r = 1, 2, \dots$$

where λ and p are hospital parameters, n representing the number of daily requests (N) arriving at the blood bank, respectively.

Model defining number of daily requests, has since been repeatedly validated (Rabinowitz and Valinsky, 1970; Yen, 1975), whereas alternative models have appeared in the literature for the size of a requisition. They all indicate that a peak appears for requests of size two. Rabinowitz and Valinsky (1970), on the basis of data from a New York hospital, found that $Q(r)$ followed a modified geometric distribution:

$$Q(r) = \hat{O}(2) g(r) + (1 - \hat{O}(2))(1-p)^{r-1}, \quad r = 1, 2, \dots,$$

where $\hat{O}(2)$ is the observed frequency of the requisitions of size two, $g(2) = 1$ and $g(r \neq 2) = 0$, and p is a hospital parameter. Similarly, Yen (1975), on the basis of data

from a Chicago hospital, found that the total daily demand behaved like a Neyman A random variable, thus implicitly accepting a Poisson distribution for the size of the request.

Brodheim and Prastacos (1980), on the basis of data collected from eight hospitals in the New York and Philadelphia areas, compared the previous models and determined that the size of a requisition could best be described by a modified lognormal distribution:

$$Q(r) = \hat{O}(1)h(r) + (1 - \hat{O}(1))(1-h(r))(-p^{r-1})/(r-1)\ln(1-p), \quad r = 1, 2, \dots$$

where $h(1) = 1$ and $h(r \neq 1) = 0$, $\hat{O}(1)$ is the observed frequency of the requisition of size one, and p is a parameter approximately equal to 0.67 for all hospitals (Prastacos, 1984).

Pereira (2004), on the basis of data from Hospital Clinic Blood Bank in Barcelona, suggested an autoregressive integrated moving average (ARIMA) method for predicting red blood cell transfusion demand. Three time-series methods were investigated in the study: ARIMA, the Holt-Winters family of exponential smoothing models, and one neural-network based method. He divided the time series, which consisted of the monthly demand for Red Blood Cells from January 1988 to December 2002, into two segments: the older one was used to fit or train the models, and the younger to test for the accuracy of predictions. He compared the performance across forecasting methods by calculating goodness-of-fit statistics, the percentage of months in which forecast-based supply would have met the red blood cell demand (coverage rate), and the outdate rate. He resulted that, the red blood cell transfusion series are best fitted by a seasonal ARIMA(0,1,1)(0,1,1)₁₂ model. His data indicated that over 2-year time horizons, exponential smoothing largely outperforms the other methods. As a conclusion of his work, over 1-year time horizons, predictions of red blood cell demand generated by ARIMA or exponential smoothing are accurate enough to be of help in the planning of blood collection

efforts. For longer time horizons, exponential smoothing outperforms the other forecasting methods.

The behavior of the usage random variable (U) appears to be more complex. In fact, this is probably the reason why usage models are commonly reported in the form of a table (e.g. Rabinowitz and Valinsky, 1970).

Elston and Pickrel (1963) and Rockwell et al. (1963), on the basis of data from North Carolina and Ohio hospitals, respectively, suggested that daily usage of blood could be approximated by a lognormal (Elston and Pickrel, 1963) or a Poisson (Rockwell et al., 1963) random variable. Neither of these models, however, agrees with the results of Brodheim and Prastacos (1980), which were derived from a significantly larger database.

Brodheim and Prastacos (1980) were interested in determining the conditional probability of usage $V(u, r)$ (i.e., the probability that u units are used out of request of size r). Their data indicated that this probability is characterized by three peaks; two around the end points, and one around the middle point. They reasoned that the end-point peaks arise from transfusion requests for operations where the usage is mostly all-or-nothing, whereas the middle point peak arises from the requests for the other operations. On the basis of this, they proposed that:

$$V(u, r) = \alpha V_1(u, r) + (1 - \alpha) V_2(u, r)$$

where $V_1(u, r)$ is an inverted triangular distribution, $V_2(u, r)$ is a (truncated at the point r) Poisson distribution, and α is the percentage of hospital operations of the all-or-nothing category. Their analysis validated this model and demonstrated that α is approximately equal to 0.50 for all hospitals (Prastacos, 1984).

Frankfurter et al. (1974) developed an inventory level projection system that consists of various submodels. The primary purpose of the system was to alert blood center management to the short-term inventory level of blood supplies, so that they

could take corrective actions to either reduce or increase blood collections. The system projects daily inventory levels for fourteen days into the future. On the basis of these projected inventory levels, appropriate management action is taken when necessary. The inventory projection for each day is done by the system using the given formula below:

$$\textit{Beginning Inventory} - \textit{transfusion forecasts} - \textit{predicted expiration} + \textit{forecasted collections} = \textit{ending inventory}$$

They used a positive exponential function in the model to fit the relationship between expirations and past collections of blood. They developed a user interface for the health professionals to enter daily blood collections forecasts into the system. They used an exponential smoothing model with a weekly cycling component to forecast the daily transfusions. They implemented the system to a regional blood center in New York. They made a benefit/cost analysis of the developed forecast system using the results obtained from the implementation. Their data indicated that a forecasting model which provides estimates of future blood inventory conditions has the potential of producing a high benefit/cost ratio.

Bosnes et al. (2005), on the basis of data from Oslo Blood Bank, fitted a regression model for predicting the number of donors that will arrive on a given day in order to get valuable information for reducing the waiting time at blood donation. They collected information about candidate explanatory variables for all blood donation appointments made in a 971-day period (179,121 appointments). They fitted a logistic regression model for the prediction of blood donor arrival. They concluded that among 18 explanatory variables; the most important ones are the time from appointment making to appointment day; the contact medium used; the donor age and total number of donations made by the donor so far; and the number of no-shows, arrivals, and deferrals during the preceding 2 years.

In the past decade, studies suggesting reduced oxygen delivery by stored red blood cells have initiated a discussion about the use of fresh versus old blood. Raat et al.

(2005), on the basis of data from a main Dutch University Hospital, analyzed the age of stored red blood cells at the time of transfusion. They determined whether old red blood cell represents an important part of the total red blood cells issued. They determined the age of red blood cell at the time of transfusion in 74,084 units during a 5-year period in the study. Some of the numerical results of their analysis are given below:

- The mean ($\pm$ standard deviation) storage time of the total number of transfused red blood cells was found 19.4 ± 7.0 days, and 37% were older than 3 weeks.
- The median of the storage time was 19 days, the mode was 15 days and the lower and upper quartile boundaries were 14 and 24 days, respectively.

They subdivided storage time of the red blood cell units according to ABO and rhesus blood group systems in the study. Their data indicated that the mean storage time varies depending on ABO and rhesus blood group. They found that, the longest storage time is for blood group AB_{neg} with 24.4 ± 8.9 days and the shortest for blood group O_{pos} with 17.4 ± 6.0 days. They categorized Red Blood Cell storage time into 5 weeks. They found that percentage of the transfused units for the first, second, third, fourth, and fifth weeks to all transfused units are 3.0, 23.1, 36.6, 25.5 and 11.8%, respectively,

A similar study was carried out by Owens et al. (2001). They, on the basis of data from a tertiary care hospital in Ontario, evaluated the average age of the red blood cell units in the inventory on any given day to determine whether the extended expiry (In 1998, the expiry date of red blood cells was extended from 35 to 42 days) would affect blood availability and to determine the feasibility of using blood at different ages for various purposes. They selected 20 days for review, over a 6-month duration. Then they categorized units according to ABO group and Rh type and analyzed for age within certain categories. They found that the average age of the blood in inventory is 1 to 2 weeks. They also calculated that the probability of having units less than 1-week old is the highest for Group O and zero for Group B_{pos} and Group AB_{pos}. Their data indicated that the age of units in inventory varies with respect to ABO group, Rh type, and weekday, and in practice, the stock rarely

reaches 42 days of age. They suggested that future studies on the effects of age of blood on patient outcome must consider the logistics of supply and the availability of blood of each group. They emphasized that transfusion of large numbers of units of the same age and of a specific blood group and type may not be always possible.

Veihola et al. (2006), on the basis of data from 17 blood centers in 10 European countries, evaluated the platelet (PLT) production and discards between centers of different size and nationality to provide a basis for more efficient PLT inventory management. Their data showed that mean annual production volume of PLTs varies greatly, from 3,34 to 103,64 units, with an increase of 5.6 percent from 2000 to 2002. Their results showed that three-year mean discard rates of the analyzed centers vary between 6.7 and 25 percent. Their data indicated that PLT discard rates are relatively high in the European blood centers. They suggested gathering detailed information on specific causes for high discard rates in order to improve efficiency of PLT management.

2.1.2. Evaluation of the Use of Alternative Storing Procedures and Alternative Therapies and Their Impact on the Blood Supply Chain

Red blood cells can be frozen in glycerol solutions and stored for many years. Freezing red blood cells is a way of alleviating shortages caused by seasonal drops in supply, or unusually high demand for rare blood types. In addition, the techniques of freezing-thawing have been shown to provide red cells superior in oxygen transport capability to those of fresh blood (Rowe, 1970). However, freezing is very expensive, and, if implemented on a significant portion of the fresh units, increases the operation costs considerably (Practacos, 1984).

Pegels et al.(1977), Bodily (1979), Cumming (1976), and Kahn et al.(1978), have conducted extensive simulation runs to examine the effect of freezing policies on the hospital's blood inventory behavior. Their studies showed that the main effect of the freezing policy is a more stable operation of the Hospital Blood Bank with outdated remaining approximately constant. Hess (2004) also evaluated the effect of red

blood cell freezing on the blood supply chain. Prowse (1999) evaluated the alternative therapies (i.e. modified donor red cells, hemoglobin solutions, etc.) that are being developed, whether they provide viable solutions and what impact they might have on blood banking and transfusion practice.

Neither alternative therapies nor alternative storing procedures has a wide range of use in practice, because of either being costly or having some medical complications.

2.1.3. Crossmatching Policies

One of the most important policies in blood banking is crossmatching policy. This is the rule according to which blood units are selected from inventory, and are assigned to patient requests. Since units are perishable, and all units issued are not eventually transfused, this procedure influences outdating. For example, assigning an old unit to a patient demand that is unlikely to use it rather than to a more likely demand significantly increases the chance that the assigned unit will outdate (Prastacos, 1984).

Under the assumption that all units crossmatched are used, the crossmatching policy reduces to an issuing policy. For this case it was shown by Pierskalla and Roach (1981) that, under certain conditions, issuing the oldest units first (FIFO) minimizes the average quantities short and outdated.

Brodheim and Prastacos (1980) took into account the difference between demand and usage, and developed an algorithm for selecting units in a decreasing age from inventory (i.e. FIFO), and assigning each unit sequentially to the request that maximizes the likelihood of using it. They showed that this “FIFO selection-Maximum Likelihood to be Used assignment” policy (FIFO-MLU) minimizes expected outdates and shortages. Simulation experiments that were conducted for a large range of hospital parameters indicated an improvement of approximately 5-10% over the FIFO assignment policy. Because of the computational difficulty of

the FIFO-MLU algorithm, optimal crossmatching policies were computed for a large range of hospital parameters (Brodheim and Prastacos, 1980). The optimal policy remains approximately the same over the range that covers most hospitals examined, and, therefore can be used as a general guide. This policy is shown on Table 2.3. The entries of the table indicate the priority with which the oldest units should be sequentially assigned to the requests of various sizes. From the table it can be seen that the unit assigned to a request of size one should not be older than the first unit assigned to a request of size two, etc.

Table 2.3. Crossmatching Guide (numbers shown are priorities for using the oldest units)

Request Size	Unit Number					
	1	2	3	4	5	6
1	2					
2	1	2				
3	1	1	2			
4	1	1	2	3		
5	1	1	2	2	4	
6	1	1	2	2	3	4

Another crossmatching policy that is used in practice is double-crossmatching. According to this policy, two patients of the same type share at least one unit on reserve (the unit shared is the one with a small priority for both patients). This way, the number of units sent to the operating room is less than the number demanded. Given that the crossmatch release period is an important factor in outdating (Cohen and Pierskalla, 1979), this policy should perform well. It was analyzed by Rabinowitz and Valinsky (1970) through simulation, using data from a New York

hospital. They found out that outdating was reduced by approximately 10% over pure FIFO (Prastacos, 1984).

Another policy, called “negative-to-positive” policy is used by Dumas and Rabinowitz (1977). This policy involves using Rh-negative blood to Rh-positive patients under certain blood-age conditions when medically feasible. They measured and compared the performance of three different policies (double crossmatching, negative-to-positive and the simultaneous use of both policies) by wastage-cost effectiveness over a range of demand levels and by blood type. They found that double cross-matching is effective in reducing wastage of both positive and negative blood, with some additional crossmatching work. They also found that the negative-to-positive policy can substantially reduce negative blood waste without affecting either work or positive waste, with some additional usage of negative blood. Their data indicate that the most effective reduction in waste of positive and negative blood can be achieved by combining the double cross-matching and negative-to-positive policies.

Freidman et al. (1976) developed a blood ordering schedule called maximum surgical blood order schedule (MSBOS) to reduce the amount of time blood units spend in assigned or crossmatched status. The suggested approach aims to permit efficient use of blood stocks and reduce blood wastage due to outdating. They analyzed the blood transfusion need for 50 common primary surgical procedures and presented a basis for defining maximum blood order for each procedure. Their data showed that a valuable reduction in the number of crossmatched units can be achieved with the MSBOS. Chan et al. (1996) developed computer supported cross-matching system that overcomes the shortcomings of the MSBOS. By using this system, the patient blood request can be electronically crossmatched with all group-identical units in the blood inventory. They found that 100% reduction in the number of blood units issued for surgery, but not transfused, can be achieved by electronic-crossmatch system.

2.1.4. Economies of Scale in Blood Banking

Varney and Guest (2003), on the basis of the data from UK National Health Service (NHS), made a detailed cost analysis of the blood banking and blood transfusion services nationwide. They found that the annual cost of provision and transfusion of blood products increased by 256% in real terms from 1994/1995 to 2000/2001 (£ 898 million) in England, whereas whole blood donations increased by 2%. They estimated the NHS costs for blood components. The cost for an adult transfusion is £635 for red blood cells, £ 378 for fresh frozen plasma, £347 for platelets according to their analysis. They found that blood donors incurred an annual direct cost of £8.1 million and 3.1 million hours of used leisure time. They calculated indirect cost arising from lost productivity as £7.2 million annually. Their results showed that blood banking and transfusion services deserve more attention in terms of economic aspects as it does in terms of public health.

Kros and Pang (2004) developed a decision support system (DSS) that allows users to analyze input, and output data derived from blood banking operations. The system provides information, models, and data manipulation tools to assist users in the quantitative measurement of the operational efficiency in a blood collection facility. They tested and validated the system at a blood collection facility by using real life situations. Their results indicated that DSS is an effective and practical tool to analyze operational efficiency.

Pitocco and Sexton (2005) used data envelopment analysis to analyze the efficiency of 70 blood centers to determine the extent to which operational efficiency can be improved, and management strategies that would lead to such improvements. They found that roughly half of the 70 blood centers studied are efficient and the remaining blood centers collectively can both increase outputs and decrease some inputs. They concluded that there is an opportunity to increase systemwide output of platelets by 17%, plasma by 10%, red blood cells by 7%, by removing half of the inefficiencies of the center that was found inefficient in the study. Their results

indicate that efficiency improvements would help to alleviate the nation's persistent blood shortages.

Pereira (2006), on the basis of data from 71 blood centers in the USA, also used an input oriented data envelopment analysis (DEA) to calculate the technical efficiency scores of blood centers, and to determine whether they are operating under increasing returns to scale (IRS), constant returns to scale (CRS) or decreasing returns to scale (DRS). They also analyzed the correlation between the blood center efficiency score and the demographic and socioeconomic characteristics of the service area. They found that six centers (8%) are operating under CRS, 29 under IRS (55%), and 26 (37%) operated under DRS. Their data indicated that efficiency scores are unrelated to any demographic or socioeconomic characteristics of the blood center service area.

2.1.5. Regionalization of Blood Banking

There has been much discussion about the issue of regionalization of blood banking systems to achieve economies of scale and high quality in 1970s. Pierskalla (1979) analyzed and compared the advantages and disadvantages of three main alternatives of hierarchical structural forms of regionalization. He presented some selection rules, based on the red blood cell production of the service area, for deciding the appropriate structural form. Their results indicate that while making a decision to select one of the structural forms for a region, some factors as the history of trust-mistrust in the region, the capabilities and leadership of regional blood bankers, the commitment of interested parties (including the providers and consumers of blood and blood components) should also be considered.

Or and Pierskalla (1979) analyzed the transportation, location, allocation aspects of the regionalization. They presented algorithms to decide how many blood banks to set up, where to locate them, how to allocate the hospitals to the banks, and how to route the periodic supply operation, so that the total of transportation costs and the system costs is minimum. They developed a blood transportation-allocation model,

and heuristic solution procedures for the model. They tested the algorithms on the data from Chicago area and obtained very good results in terms of solution time and system costs.

Xu (1999) considered a location model for selecting regional blood centers and allocating hospitals to regional blood centers. He developed a joint inventory location model which minimizes the sum of fixed costs, transportation costs, and risk pooling inventory effect. He solved the model using a substitution algorithm with a small set of test data, then presented the resulting feasible solutions. This substitution algorithm is able to generate solutions rapidly and provide a starting point in the search for optimal solutions.

Şahin, Süral and Meral (2007), formulated several mathematical problems to address the location-allocation aspects of regionalization of blood services of the Turkish Red Crescent Society. They formulated a pq -median location model that minimizes the total of population-weighted distances among the service facilities and between the service facilities and demand points. This model gives the location of q RBCs to provide services to p blood centers that serve demand points. They formulated a set-covering model that locates the supporting facilities, like blood stations. Finally they formulated an integer-programming model to ensure a homogeneous distribution of mobile units among the service regions so as to maximize the total regional population-weighted fleet sizes. They reported computational results for 64 different scenarios, based on the real data, and presented alternative solutions.

2.1.6. Perishable Inventory Management and Blood Banking Applications

2.1.6.1. Perishable Inventory Management

Most of the work on inventory problems for perishable goods focuses on ordering policies to minimize operating costs, under a single demand stream. The problem is very difficult: unlike the standard inventory control theory, where generally the only information needed is the inventory position, the optimal ordering policy for

perishables requires information about the amount of inventory of every age. Therefore, the state space (and problem complexity) grows with the lifetime of the product (Deniz et al., 2004).

For a two-period lifetime problem, Nahmias and Pierskalla (1973) determined some of the properties of the stationary, state-dependent optimal policy; this was extended by Fries (1975) and Nahmias (1975), independently, to the general m -period lifetime problem. They characterized some properties of the optimal ordering policy, but its exact structure was not found. This difficulty motivated exploration of the heuristic methods. Cohen (1976), Nahmias (1976) and Chazan and Gal (1977) proposed the fixed-critical number (order-up-to) policy, in which orders are placed at the end of each period to bring the total inventory summed across all ages to a specific level, S (total Inventory to S policy –TIS). For the two-period lifetime problem, Cohen (1976) found a closed-form solution method for computing the optimal order-up-to level.

Still for a single demand stream, Nahmias (1976, 1977) and Nandakumar and Morton (1993) showed that order-up-to policies perform very well compared to other methods; they developed and analyzed heuristics to choose the best order-up-to level. Cooper (2001) provided further analysis of the properties of the TIS policy, while Nahmias (1978) showed that when the ordering cost is high, an (s, S) type heuristic is better than order-up-to policies. Liu and Lian (1999) analyzed such an (s, S) continuous review inventory system. More recent papers on inventory management of perishables are by Ketzenberg and Ferguson (2003), and Ferguson and Ketzenberg (2004); they focus on information sharing in a supply chain.

There are a few papers that model multiple types of customers or demand streams for perishables. Ishii and Nose (1996) focused on two types of customers (high and low priority), items of different ages with different prices, and only a single-period decision horizon. High priority customers only buy the freshest products, so the freshest products are first sold to the high priority customers and the remaining items are issued according to a FIFO policy. They provided the optimal ordering

policy under a warehouse capacity constraint. Parlar (1984) considered a perishable product that has two-periods of lifetime, where a fixed proportion of unmet demand for new items is fulfilled by unsold old items (and vice-versa). Goh et al. (1993) considered a two-stage perishable inventory problem. Their model has random supply and separate demand modeled as a Poisson process. They compared a restricted policy and an unrestricted policy. Considering only shortage and outdated costs, they concluded that the unrestricted policy is less costly, unless the shortage cost for fresh units is very high. Ferguson and Koenigsberg (2004) studied a problem which is in a two-period setting with pricing and internal competition between new and old items.

Deniz et al. (2004) considered a discrete-time supply chain for perishable goods where there are separate demand streams for items of different ages. They proposed two practical replenishment policies: replenishing inventory according to order-up-to level policies based on either (i) total inventory in system or (ii) new items in stock. Given these policies, they concentrated on four different ways of fulfilling demand: (1) demand for an item can only be satisfied by an item of that age (No-Substitution); (2) demand for new items can only be satisfied by new ones, but excess demand for old items can be satisfied by new ones (Downward-Substitution); (3) demand for old items can only be satisfied by old ones, but excess demand for new items can be satisfied by old ones (Upward-Substitution); (4) both downward and upward substitution are employed (Full-Substitution). They compared these substitution options analytically in terms of the infinite horizon expected costs, providing conditions on cost parameters that determine when (if at all) one substitution option is more profitable than the others, for an item with a two-period lifetime. They proved that inventory is “fresher” whenever downward substitution is employed. Their results are based on sample-path analysis, and as such make no assumptions on demand.

Lystad and Ferguson (2006) studied the problem of determining stocking levels for fixed-life perishable products in a two-echelon supply chain. They considered both serial chains and distribution networks consisting of a warehouse and n non-

identical retail locations. In the problem environment analyzed, inventory retains constant utility throughout its lifetime, lead-times are deterministic, there are no fixed ordering costs, and unmet demand is backlogged. They provided single-stage heuristics for determining the stocking levels for two-echelon supply chains. They used these heuristics to develop insight and intuition into the proper management of perishable inventory. Their heuristics are robust, easy-to-use, and simple enough to be implemented using spreadsheet applications.

Kalpakam and Shanthi (2001) analyzed a lost sales ($S-I, S$) perishable system, under Poisson demands and exponential lifetimes, in which the reorders are placed at every demand epoch so as to take the inventory position back to its maximum level S . They considered a problem environment in which the items are replenished one at a time and the resupply time has arbitrary distribution. They obtained various operating characteristics using Markov renewal techniques. They also developed a matrix recursive scheme to determine the stationary distribution of the underlying Markov chain. Their computational experience indicates that their method results in considerable saving in terms of cpu time especially in computation of optimal parameters.

Perry and Stadje (2000) considered a Poisson inventory model for perishable goods in which the items have random lifetimes and are scrapped either when reaching the end of their lifetime or a fixed constant expiration age. They described this system as the virtual death process ($W(t) \ t > 0$), where $W(t)$ is the residual waiting time after time t until the next 'death' of an item if there were no demand arrivals after t . They derived its stationary law in closed form and determined the distribution of the number of items in the system (also in the steady state).

Sawaki (2003) dealt with the problem of a fixed number of units of a certain perishable commodity, which cannot be carried over and is not storable for consumers, over a continuous time horizon. He applied semi-Markov decision processes over a finite time horizon and showed that there is an optimal policy that is simple and stationary.

Omosigho (2002) examined the fixed lifetime perishable inventory system and obtained an estimator for the probability that an item will be sold in a period. The estimator for the probability that an item will be sold is given by W/S , where W is the average demand per period and S is the inventory level at the start of a period. This probability is equivalent to the cross-match transfusion ratio in the case of blood inventory. He used the probability to derive outdate and shortage quantities. He also obtained shortage–outdate operating curve.

Tekin et al., (2001) investigated the impact of modified lot size-reorder control policy for perishables which bases replenishment decisions on both the inventory level and the remaining lifetimes of items in stock. They derived the expressions for the key operating characteristics of a lost sale perishable inventory model, operating under the proposed age-based policy, and examined the sensitivity of the optimal policy parameters with respect to various system parameters. The proposed policy is in spirit a modified reorder point ordering quantity (Q,r) policy; therefore, they referred to it as a (Q,r,T) policy, where T corresponds directly to an age threshold for reorder. They compared the performance of the suggested policy to that of the classical (Q,r) type policy through a numerical study over a wide range of system parameters. Their results indicate that the age-based policy is superior to the stock level policy for slow moving perishable inventory systems with high service levels.

Sana and Chaudhuri (2004) developed a stock-review inventory model for perishable items with uniform replenishment rate and stock-dependent demand where the deterioration function per unit time is a quadratic function of time. The main purpose of their model is to reduce the inventory cost and deterioration at the optimal level. They optimized the associative cost function under some constraints due to the limitation of storage capacity.

Chen and Lin (2002) considered the inventory replenishment problem for deteriorating items with normally distributed shelf life, continuous time-varying demand, and shortages under the inflationary and time discounting environment. They formulated the problem as a dynamic programming model and solved by

numerical search techniques. The solutions of the model determine the optimal replenishment schedule over a finite planning horizon so that the present worth of the future costs associated with the system is minimized. They validated the model, demonstrated the optimal replenishment schedule and lot-size, and carried out a comparative study to ascertain its contribution. Their results show that the deteriorating problem solved by an appropriate model can save the total cost up to 2% approximately. Their data indicate that the magnitudes of purchase cost per unit and demand rate are the most important parameters that affect the replenishment decisions and cost.

Williams and Patuwo (1999) derived the necessary conditions to determine optimal incoming quantity for a single product with a useful lifetime of two periods, subject to a known positive order lead time and a lost sales policy. They computed optimal order quantities for lead times up to four periods for different levels of demands and for different demand distributions. Their experimental results indicate that the order quantity is a function of the order lead time and the quantity of goods on-hand and on order.

2.1.6.2. Applications of the Perishable Inventory Theory and Analytical Models in Blood Inventory Management

Researchers have made a great effort to apply perishable inventory models to blood banking, especially in 70s and 80s. Millard (1960) seems to have been the first to recognize that inventory models could be applied to managing the stocking of whole blood.

Jennings (1968, 1973) appears to have been the first to realize the importance of distinguishing between the assigned and unassigned inventories. Brodheim et al. (1976) used operational data to develop curves relating whole blood/red blood cell inventory levels and mean daily demand for various specific shortage rates. Cohen and Pierskalla (1975, 1979) developed an approach which involves variety of different factors as demand rates, crossmatching and return of unused assigned

blood to unassigned inventory. A Markov chain model of the blood inventory process was constructed by Pegels and Jelmert (1970) primarily for the purpose of comparing the effects of various issuing policies. Brodheim and Prastacos (1979) reported on an operating system for blood management implemented in Long Island. This system utilizes results concerning optimal allocation policies described in Prastacos (1978).

Kendall and Lee (1980) analyzed the rotation policies of blood. They developed a goal programming model to attain multiple goals. Their model includes goal constraints related to inventory levels, the availability of fresh blood, blood outdating, the age of blood, and the cost of collecting blood. They applied the methodology to a large urban-rural region. Their data indicate that the amount of blood needed to be collected in the considered region can be reduced by 5%.

Jagannathan and Sen (1991) developed a model for determining outdates and shortages for cross-matched blood using generally accepted parameters, such as proportion of crossmatched blood that is actually transfused, and the number of days after which cross-matched blood is released if not transfused. The model provides the blood bank administrator a method of determining desired free inventory levels.

Angelis et al. (2001) developed a multi-product, multi-period, multi-objective linear programming model to determine the best assignment of blood resources to demand, which minimizes the quantity of blood imported from outside the system and stabilizes the quantities assigned daily.

Blake et al. (2003) described a methodology for determining local inventory ordering policies for platelet suppliers. The model is based on a dynamic programming approach to a perishable inventory problem and the assumption of a market-free supply chain for blood and blood products.

Kopach et al. (2006) developed an analytical model which determines an optimal policy to support modeling trade-offs between the following criteria: multiple

demand levels (emergency and discretionary), service levels, costs, as well as the traditional objectives of minimizing shortages and outdates. They compared the model with current control techniques using simulation. They conduct a case study using the data from a regional blood center and found that the proposed method dominates the current policy of the center.

Although many of the existing theoretical perishable inventory models discussed in the perishable inventory management section have been suggested for handling the blood banking problems; the actual problem, even at the hospital level, seems to be too complex to be adequately described by a single mathematical model. The aspects of the problem that are difficult to model include: (1) accounting for the assigned and unassigned inventories, separately, (2) modeling the process by which the unused assigned units return the unassigned stock after having aged for some number of days (3) dealing with some practical constraints on the issuing policy (4) accounting for the substitutability relationships of the various blood types (Nahmias, 1982; Prastacos, 1984; Katsaliaki and Brailsford, 2006). These aspects limit the usefulness of the analytical results on perishable inventory theory to blood banking. Hence, lots of empirical results, obtained by the use of simulation in blood inventory management, have been reported in the literature.

2.1.7. Simulation and Blood Banking Inventory Management

Simulation is simply the use of a computer model to “mimic” the behavior of a complicated system and thereby gain insight into the performance of that system under a variety of circumstances. Simulation is often used to determine how some aspects of a system should be setup or operated (Thesen and Travis, 1991).

2.1.7.1. Simulation in Healthcare

Several characteristics of simulation make this technology uniquely applicable in the health care arena: (i) Computer simulation models conform both to system structure

and to available system data, (ii) Simulation supports experimentation with systems at relatively low cost and little risk, (iii) Variation matters (Standridge, 1999).

Simulation modeling is a powerful method for modeling both small and large populations to inform policy makers in the provision of health care. Fone et al. (2003) carried out a narrative systematic review of the literature from 1980 to 1999, searching Medline, INSPEC, Embase, HealthSTAR, Science Citation Index, CINAHL, MathSci, INFORMS Online and SIGLE databases. Papers were included if they contained a computer simulation model of individuals in a stochastic system and the topic or setting related to population health or health service delivery. A total of 182 papers were found which met the inclusion criteria specified in the study. Their results indicate that simulation modeling has been undertaken in a wide range of health care topic areas, including hospital scheduling and organization, communicable disease, screening, costs of illness, economic evaluation, etc.

In this section, sample simulation applications in healthcare are presented.

Standridge et al. (1978) described a simulation model for projecting the number of physicians, nurse practitioners, and physician's assistants in Indiana from 1975 through 2000 as well as the demand for primary health care. The model supported decisions concerning the number of students admitted to the medical school and other practitioner training programs in the state of Indiana. A companion model assessed the availability of primary health care in 99 service areas in Indiana at any single point in time. It was used to help identify under-served areas (Hindle, et al., 1978).

Pritsker, et al. (1995) described a simulation project to help establish national policy for allocating donor livers to patients needing transplants. The model helps compare alternative policies using performance measures such as percentage of patients receiving transplants for each liver disease status, patient waiting time for a transplant by disease status and region of residence, and the number of pediatric

transplants. They made sophisticated statistical analysis of patient demographic, disease status and transplant data to estimate model parameters.

Standridge and Brown-Standridge (1995), as well as Brown-Standridge, Standridge and Poole (1993), described the use of simulation to assess a new family therapy process called Brief Systems Family Therapy (BSFT). Steward and Standridge (1996) described a simulator for helping to establish the resource requirements of a small animal veterinary practice (Standridge, 1999).

McGuire (1994) used simulation technology to test alternatives and chose a solution to significantly reduce the length of stay for patients in the Emergency Department. He tested five alternatives for effectiveness with the simulation model: (i) the addition of a registration clerk during the peak hours of the day, which is defined as the 3 p.m. to 11 p.m. shift, (ii) extending the hours of operation of the fast-track and pediatric clinic hours of operation, (iii) seeing what the impact on patient's length of stay would be if the ancillary departments could meet comparative times (compared to similar departments in similar hospitals) for turnaround times (time from the order until the results are ready), (iv) the case in which the patients in the emergency department wait in the treatment rooms for the results of ancillary tests and for a hospital bed to become available, if the patient is being admitted, (v) the case in which the fast-track patient's length of stay was 123 minutes.

Darzi et al. (1998) used a simulation and flow model to evaluate the flow of patients within a geriatric department. They also analyzed the length of stay problem, but they considered the problem as a queuing system to assess the effect of blockage on the flow of patients. They used What-if analysis to allow a greater understanding of bed requirements and effective utilization of resources. Their results show that the flow model and the unconstrained simulation are equally viable tools to measure bed occupancy in a geriatric department. They used different constrained simulation configurations to model the internal process and measure its effectiveness. They derived some statistics such as emptiness, waiting time and rejected number of patients.

Blasak et al (2003) presented a simulation model of the operations in the Emergency Department (ED) and Medical Telemetry (Med Tele) units at Rush North Shore Medical Center. The model allows management to see the operations of both units as well as how the processes of each unit impact the other. This model depicts the current operations and evaluates possible alternatives to reduce the length of stay in the ED and improve operations. Their results indicate that there are several problems in the ED, but also reveal that the main problem was process related, not resource dependent.

Centeno et al. (2000) created an animated simulation model of the Radiology Department at Jackson Memorial Hospital. They identified several inefficiencies in the processes of the department and explored suggestions for improvement. They made analysis based on six scenarios: (i) Current system, (ii) Modeling each procedure to take place with the assistance of only one technologist, (iii) Modeling each procedure to take place with the assistance of two technologists, (iv) Addition of a new Neurological operating room, (v) Addition of a designated preholding area for the patients comfort, and (vi) One-day extension in the weekly operating schedule. Their results identified that under scenario (ii) (one technologist), the total time in the system is lower than the current system and scenario (iii) (two technologists). However, their results also indicate that scenario (ii) gives the lowest utilization rate for the eight technologists and the lowest utilization rate for the operating rooms. They made several other recommendations to improve efficiency.

Baesler and Sepulveda (2001) presented a case study application of a cancer treatment center facility. They created a simulation model and integrated to a multi-objective optimization heuristic with the purpose of finding the best combination of control variables that optimize the performance of four different objectives. They applied a new approach for solving multi-objective simulation optimization problems. Four control variables and four different objectives were considered in the study. They compared solutions of alternatives to the existing configuration of the system. They found that all the alternatives generated by the methodology are better

in terms of its fitness value than the as-is situation. The level of improvement of these solutions ranges from 18 to 25 percent.

There are many other applications of simulation to operational policies of health care providers. Typical projects are reported by Butler et al. (1992), Chan and Metzger (1993), Dittus et al. (1996), Dumas (1984, 1985), Evan et al. (1996), Klee, Standridge, and Nath (1980), Kwak et al. (1976), Lopez-Valcarcel and Perez (1994), Lowery and Martin (1992), Mahacek (1992), Vissilacopoulos (1985) and Wright (1987). Garcia et al. (1995) presented an application of simulation to emergency room operating policies. At issue was the excessive length of time non-urgent patients waited for care in an emergency room at a non-profit hospital. Current policy gave such patients the lowest priority for service. An alternative policy was proposed whereby staff and emergency room resources were dedicated to the care of non-urgent patients (Standridge, 1999).

2.1.7.2. Simulation in Blood Bank Inventory Management

The first empirical results, obtained by simulation, were reported by Elston and Pickrel (1965), who used demand and usage data from a North Carolina hospital. They ran excessive simulation tests in order to derive desirable inventory levels and test another management policy.

Jennings (1968, 1973) also used simulation to evaluate hospital blood bank performance. Using data from a Massachusetts hospital, he was the first to derive trade-off curves showing outdates vs. shortages as functions of inventory level. He also examined the regional performance as the number of hospitals in a region is changed and the proportion of regional supply to regional demand remains constant. He showed that between two regions with a different number of “identical” hospitals, the one with the larger number of hospitals is expected to perform better, since it can better equalize the daily fluctuations of demand among hospitals.

Simulation experiments using empirical data have also been performed by Rabinowitz and Valisky (1970) and Yen (1975) for New York and Chicago hospitals, respectively. Brodheim et al. (1976) followed a different approach. They collected daily demand data of almost each blood type from eight hospitals. Through a statistical analysis of these data they showed that the inventory required to meet the daily demand at least $(100-s)$ percent of the time is given by $I(s)=A(s) + B(s) ED$ where ED is the mean daily demand, and $A(s)$ and $B(s)$ are functions of the shortage rate s . This model has repeatedly been validated for additional hospitals, and has been adopted as an inventory guide by a number of hospitals and regions (Brodheim et al., 1976).

Cohen and Pierskalla (1979) assigned unit costs to shortages and outdates, ran extensive simulation tests, and used search techniques to derive optimal inventory levels as functions of all the hospital parameters that affect outdating and shortages. They found that the three most important parameters for setting inventory levels are the mean daily demand ED , the crossmatch-to-transfusion ratio r (estimated by the total yearly crossmatches divided by the total yearly transfusions), and the crossmatch release period T (the time until an unused unit returns back free to inventory), and that the optimal inventory level is a Cobb-Douglas function of the form $I = a_0(ED)^{a_1}(r)^{a_2}(t)^{a_3}$ where a_i are constants that are common for all hospitals (Prastacos, 1984).

Freidman et al. (1982) described the use of simulation to set inventory levels for red blood cells under the assumption of an extended 35-day shelf life. Describing blood management policies from a clinician's standpoint, they argued against the setting of shortage rates common in the operations research literature. Instead they suggested an empirical approach to inventory policy in which safety stocks are gradually reduced.

Sirelson and Brodheim (1991) used simulation to test platelet ordering policies for a blood bank, based on average demand and a fixed base stock level. They showed that a base stock level based on a mean demand plus a multiple of standard deviation

can be used to reduce the current outdate and shortage rates. They also showed that, on a regional level, low shortage and outdate rates can be achieved; however, within individual hospitals low outdate and shortage rates are more difficult to achieve. Katz et al. (1983) reported similar results.

Hesse et al. (1997) described an application of inventory management techniques to platelets in a system in which a centralized Blood bank supplies 35 client hospitals. They adopted the framework of a periodic review model and developed (s, S, t) policies for each of the client institutions. They used dynamic programming approach, and tested the results using a simulation model. Noting the complexity of a dynamic programming approach, the authors aggregated institutions into risk pools and developed, via an enumerative process, an (s, S, t) policy for each pool (Blake et al., 2003).

Haijema et al., (2007) presented a combined Markov dynamic programming (MDP) and simulation approach, and then applied to a real life case of a Dutch blood bank. Their approach consists of 5 steps: (i) they provided a MDP formulation for the blood platelet problem, (ii) they down-sized the state space and the demands, (iii) they showed that for this down-sized situation, optimal policy can be quite complicated, but a double-level replenishment rule is nearly optimal, (iv) they applied a heuristic simulation-based search procedure to find the best single and double level order-up-to policy (with one level corresponding to 'young' platelets and one to the total inventory), (v) They evaluated the quality of these order-up-to rules using MDP. They obtained a number of useful observations by executing these steps for the realistic data of a Dutch blood bank: (i) The 'optimal' production rule for platelet production is complicated and not practical to implement, (ii) 'Nearly optimal' rules, however, can be found in the class of simple order-up-to rules, (iii) Single level order-up-to rules may perform quite well. Double level order-up-to rules provide a further improvement and can be proven to be 'nearly optimal' when distinguishing demand for 'fresh' and 'any' platelets.

Haijema et al. (2006) presented an extension of MDP-simulation combined approach described in Haijema et al., (2007) to provide answers to a dominant question which still remains: “How to anticipate irregular production breaks like at Easter and Christmas?”. They applied the steps of the approach to the stationary case as well. Their results indicate that a simple order-up-to rule remains to be nearly optimal for the breaks like Easter and Christmas.

Kopach et al. (2004) described a study to develop prototype simulation models to predict the likelihood, and assess the subsequent medical consequences of blood product shortages. The models account for uncontrollable factors such as random donation and patient demand, as well as policies controlling blood product expiries. They conducted the studies in three settings: urban, semi-urban and rural. The model they developed quantifies the hourly inventory patterns of blood centers and specific hospitals, as well as predicting the risks of shortages and subsequent medical consequences of these shortages. They validated the model against inventory levels and outdates. Their results indicated that the model is sufficiently accurate for use as a decision support tool.

Pereira (2005) used a simulation model that simulates the routine operation of a hospital blood bank inventory over a finite number of days. They analyzed several factors for their influence on outdate and shortage rates: (i) the mean (MEAN) in daily transfusion, (ii) the variation (CVAR) in daily transfusion, (iii) the remaining shelf life of blood units shipped from the supplier (RSL), (iv) the number of days between consecutive shipments (INT). His results showed that outdate and shortage rates grew exponentially with CVAR, an effect that could be partially counterbalanced by increasing RSL. He found that the variables, MEAN and INT, have a little influence on the inventory, provided that blood stocks shipped from the supplier are targeted at the expected average demand for transfusion and RSL is greater than INT. He concluded that in hospitals that do not hold cross-matched inventories, CVAR is the major parameter in determining the blood inventory performance and hospitals with large CVAR must be supplied with young red blood cell units, whereas hospitals with smaller CVAR perform well with older stocks.

Katsaliaki and Brailsford (2006) analyzed policies for managing the blood inventory system of a typical UK hospital. The objective of the study is to improve procedures and outcomes by modelling the entire supply chain for that hospital, from a donor to a recipient. A vertical section of the supply chain, which consists of a hospital blood bank (Transfusion center) and a regional blood center, is considered. They broke down the supply chain of blood products into material flows and information flows. They used discrete-event simulation to determine ordering policies leading to reductions in shortages and outdates, increased service levels, improved safety procedures and reduced costs, by employing better system coordination. They used a baseline policy to make comparison with the alternative policies. The baseline policy they used is given below in detail:

- Hospital keeps 5 days of stock for all blood groups except B-negative and no B-negative stock
- Routine orders to the hospital done by the regional center at 08.00 o'clock only
- One routine delivery to the hospital is done in a day and arrives at 11.00 o'clock next day
- The crossmatch to transfusion ratio is 2
- The crossmatch release period is 24 h
- Ad-hoc delivery (additional to routine deliveries) is done to the hospital if it places an order. Orders are done when either platelets or rare red blood cells are requested, or red blood cells stock is less than 50% of the optimal level.

They developed alternative policies and compared results by the ones obtained by the baseline policy. They developed an improved policy which is a combination of alternative policies. Improved policy they obtained is given below:

- 4 days of stock of all groups
- Routine orders at 08.00 and 16.00 o'clock
- Two routine deliveries at 11.00 and 15.00 o'clock
- Crossmatch to transfusion ratio is (10/7)
- Cross-match release period is 24 h

- Ad-hoc orders when either platelets or rare RBC is requested, or RBC stock is 35 % of optimal level
- Blood bank uses FIFO for new units and LIFO for return units

Improvements which can be achieved (according to the results of simulation experiments) by the use of the improved policy are reported in the study:

- 89% less RBC outdates and 8% cost savings in the hospital budget
- 47% less shortages from the Regional Blood Center
- 88% less mismatching
- 29% less ad-hoc and emergency orders from the hospital with 29% savings in transportation costs for the Regional Blood Center

Katsaliaki and Brailsford (2006) discovered that as the model grew in size with the addition of more hospitals, the time taken to perform one simulation run increases to a point that makes the use of simulation impossible.

Mustafee et al. (2006) and Brailsford et al (2006) considered the same problem by extending it to the two-hospitals, three-hospitals, four-hospitals and sixteen-hospitals cases. They used distributed simulation approach to solve the increasing simulation run time problem. This is a technique where models are implemented over many computers in a parallel or distributed fashion with the goals of reducing the execution time of a single simulation run, sharing the memory needs of a simulation across several computers and the linking of simulations sited in different locations. Mustafee et al. (2006) showed that distributed simulation performs better than its stand-alone, conventional counterpart as the number of hospitals increases. Their results showed that the conventional model with one hospital took approximately 14 minutes to run for a whole simulated year. The run time goes up to 78 minutes when the model ran with two hospitals and to approximately 17.5 hours with three hospitals. The addition of the fourth hospital increases the execution time to 35.8 hours. The distributed model with one National Blood Services supply center (Regional Blood Center) and one hospital run in approximately 8.5 hours, with two hospitals in 9.8 hours, with three hospitals in 12.7 hours and with four hospitals in

16.5 hours. Although distributed simulation performs better, simulation run times are still huge for making several runs to analyze the effect of inventory management parameters to the whole supply chain. Also the number of hospitals considered in this study remains much lower than the actual number of hospitals in real life. The technical details of the methodology used to create distributed simulation model are discussed in Brailsford et al (2006). They extended the model to sixteen hospitals case, but not reported the run time performance of the study.

All of the prior work discussed in this chapter deals with the decision processes of either a single hospital or a blood supply chain consisting of a regional blood center and a few hospitals.

In this study, management issues of a new regional blood supply chain structure, consisting of three-echelons, are considered. This structure is defined in the new Turkish Blood and Blood Products Law, which is accepted in 2007.

None of the related papers in the literature considers all of the following blood supply chain characteristics together which our approach proposed in this study does:

- Three-echelon structure (One Regional Blood Center, two Donation Centers and 49 Transfusion Centers)
- Multi-product (All blood groups corresponding to 8 products)
- Cross-match to transfusion ratio
- Transfusion release period
- Mismatching of requests with different blood groups
- Age of incoming units
- Different delivery alternatives such as routine, ad-hoc and emergency deliveries to hospitals

CHAPTER 3

BLOOD SUPPLY CHAIN AND THE CASE STUDY

3.1. Blood, Blood Components and Blood Groups

3.1.1. Blood and Blood Components

Blood is a circulating tissue which carries oxygen and nutrients to the tissues and carries waste products away. Blood is a highly specialized tissue composed of many different kinds of components. Blood is collected as a whole blood and whole blood is processed into several components such as red blood cells, platelets, fresh frozen plasma and 115 other products. These components are derived from the main blood components after extra tests or processing. Some of the processes can change the shelf life of the components. Production of the main components from whole blood is shown in Figure 3.1.

- *Whole Blood:* It is rarely given to patients, because it is wasteful and sometimes harmful to give a patient blood components that he/she does not need.
- *Red Blood Cells:* They carry oxygen and they are needed by surgical patients or those with anemia or kidney disease.
- *Platelet Rich Plasma:* It is an intermediate stage in the production of platelet concentrate and plasma components.
- *Platelet Concentrates:* They are fragile blood cells needed by leukemia and other cancer patients to control bleeding.
- *Plasma:* It is the yellow liquid portion of blood. It is also a source of proteins that stop bleeding by forming blood clots.

- *Fresh Frozen Plasma*: It is used mainly for people with bleeding complications.
- *Frozen Plasma*: It is to be manufactured into derivatives, it is stored and shipped in the frozen state.

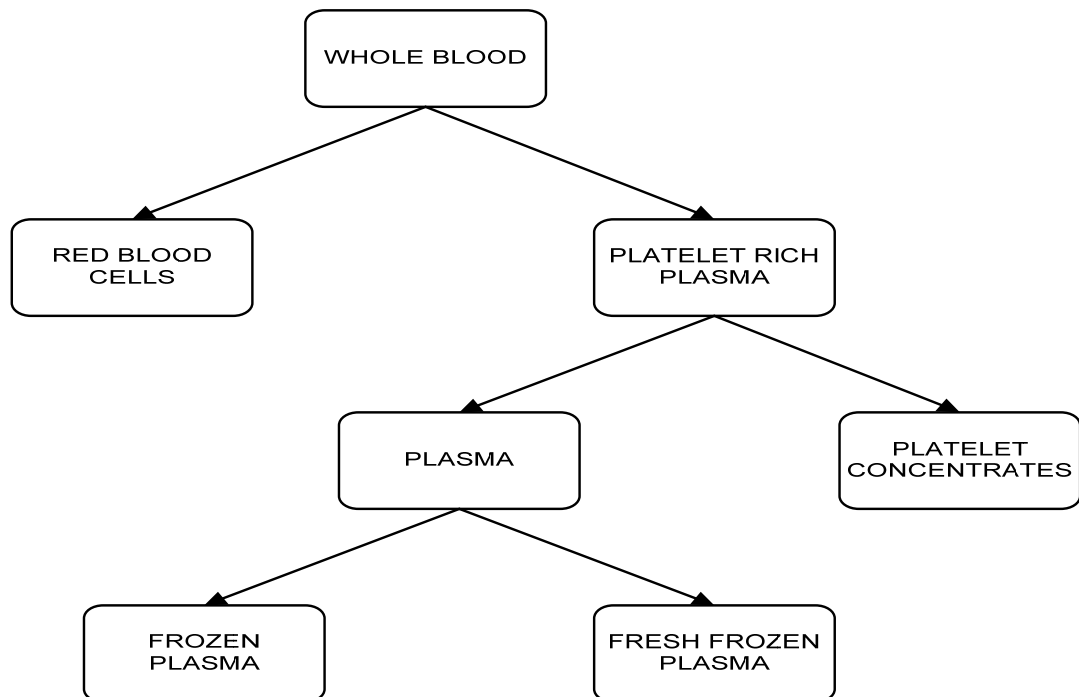


Figure 3.1. Main Components from the Whole Blood

Red blood cells, which are the most common components, are included in this study. Red blood cells capture above 80% of the total units issued in hospitals in England (Katsaliaki and Brailsford, 2006). All components have different shelf lives and require different storage conditions with respect to temperature. They are transported by different vehicles because of the requirement of different temperature conditions for storage. Therefore, managing of the inventory of these components is separated in practice, and other components are excluded from our study.

3.1.2. ABO Blood Typing

All people belong to one of four inherited blood groups: A, B, AB, and O. The letters A and B refer to the kind of antigen found on an individual's red blood cells. An antigen is a protein on the cell which triggers an immune response, such as the formation of antibodies, against the antigens which the red cell lacks.

There are four basic blood groups in the ABO system. Blood groups in ABO system and their characteristics are given in Table 3.1.

Table 3.1. Main Blood Groups in the ABO System

Group A	Blood has A antigen on the red cells, and anti-B antibody in its plasma.
Group B	Blood has B antigen on the red cells, and anti-A antibody in its plasma.
Group AB	Blood has both A and B antigens on the red cells, but neither anti-A antibody nor anti-B antibody in its plasma. AB blood cannot cause the clumping of the red cells of any other groups, and therefore persons with AB blood are called universal <u>recipients</u> .
Group O	Blood has neither A nor B antigens on the red cells, and both anti-A antibody and anti-B antibody in its plasma. Group O blood cannot be clumped by any human blood, and therefore persons with Group O are called universal <u>donors</u> .

3.1.3. Rh Factor

Most people also have an inherited condition of the red blood cells known as the Rh factor, or antigen D. When the D antigen is present, a person's blood type is designated Rh positive. When antigen D is missing, the blood type is classified Rh negative. In general, Rh negative blood is given to Rh negative patients and Rh positive blood to Rh positive patients.

3.1.4. Crossmatch

Before a transfusion is given to a patient, it is important to know which blood group a person has, because the blood plasma contains strong antibodies, called anti-A and anti-B, that react against the red cells with A or B antigens. If anti-A antibody came in contact with A antigen (or if anti-B antibody met B antigen), the result could be a dangerous, possibly fatal transfusion reaction. Although the patient blood and the donated blood belong to the same blood group, such reactions can occur due to the rarely shown antigens and antibodies instead of ABO and Rh. To prevent such reactions, Medical Technologists "crossmatch" the patient blood with the donated blood. A sample of patient blood and samples from donated blood are tested to make sure that they are compatible.

As a result of the ABO and Rh classification, Blood appears in 8 major blood types whose frequencies vary from population to population: (i) A negative, (ii) A positive, (iii) B negative, (iv) B positive, (v) AB negative, (vi) AB positive, (vii) O negative, and (viii) O positive. Although we include only red blood cells component, we consider a multi-product environment due to the ABO and Rh classification. Each of the 8 blood groups corresponds to a different product.

3.2. Blood Supply Chain Network

3.2.1. Alternative Blood Supply Chain Networks

There has been much discussion about the issue of regionalization of blood banking systems to achieve economies of scale and high quality in 70s. Pierskalla (1979) analyzed and compared three main alternatives of structural forms of regionalization: (i) the single center model (SC): a single community blood center which serves the entire needs of the hospital in a particular region; (ii) the multiple independent centers (MIC) model: a collection of communicating community blood centers under independent control which serve the blood needs of the hospitals in the region; and (iii) the coordinated multiple centers model (CMC), a regional blood center which either coordinates or controls the activities of a collection of community blood centers which in turn fulfill the needs of the hospitals in the region. A schematic view of the models analyzed is given in Figure 3.2.

3.2.1.1. SC Model

In this model single community blood center provides all the blood services for a network of hospitals in a specified geographical region. The major activities of the community blood center are to handle donor services, blood collection, processing, testing, inventory allocation and control, delivery to hospitals, consultation, accounting, data processing and administration.

3.2.1.2. MIC Model

In this model, there are more than one community blood centers (CBC) in the region and each has the same major activities described in the SC model for their responsibility area. Although CBCs are independent from each other, they can cooperate in situations where shortages occur in one of CBC's responsibility area.

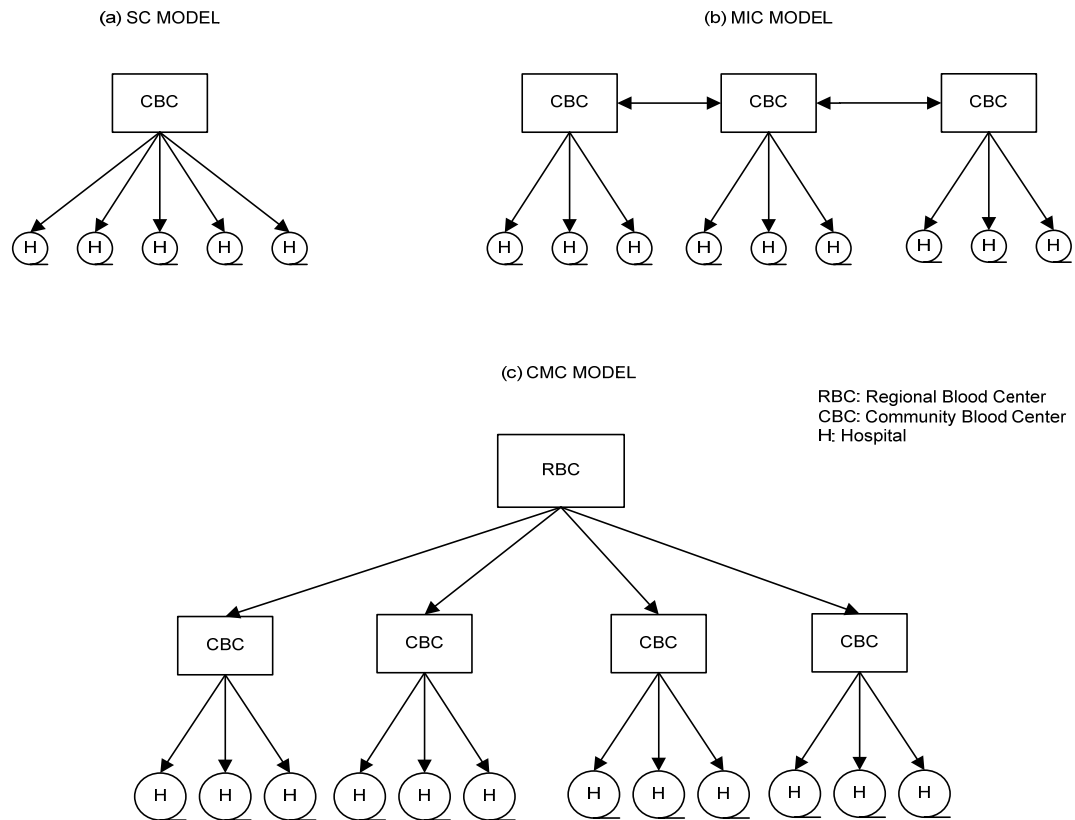


Figure 3.2. Blood Supply Chain Structures Discussed In the Literature

3.2.1.3. CMC Model

This regional model is an extremely flexible organizational structure with regard to the work location of the functional areas and the degrees of control/coordination exercised by the Regional Blood Center (RBC). The RBC could be simply a shared service for such functions as unified donor recruitment, information data processing and/or educational training programs. At another extreme, the RBC could carry full authority for the operations of the entire system. Table 3.2. illustrates some of the range of coordination/control of the RBC.

Within this generic structure, in addition to the differing authority structures, the work locations of the various blood banking functions can also differ from one

region to another at the RBC and others at the Community Blood Center. Table 3.3. illustrates the locations of functions for different feasible ways of dividing up the work.

Table 3.2. The Range of Coordination/Control of the RBC

Degree of the Authority	Activities
Coordination	• Gather data and disseminate to Community Blood Centers • Conduct Educational Training Programs for Community Blood Centers and hospitals • Hold periodic meetings for Community Blood Centers' directors for evaluating the performance of the region , etc.
Full Control	• Determine and enforce donor services policies at all levels • Hire all Community Blood Centers' directors • Approve all Community Blood Centers' budgets • Determine all Community Blood Centers' functions • Plan and initiate all regional changes to meet needs

Although one of the hierarchical structure alternatives discussed in Pierskalla (1979) includes a three-echelon supply chain, both analytical models and empirical studies in the literature consider the two-level blood supply chain configuration as a supply chain with the maximum number of hierarchical levels. The considered cases in the blood inventory management literature are as follows:

- A single Hospital Blood Bank
- An RBC (which acts as a community blood center described in SC Model) and a hospital supplied by the RBC

- An RBC (which acts as a community blood center described in SC Model) and a few hospitals supplied by the RBC

The hierarchical structure of blood banking services in Turkey has significant differences from the ones discussed in the blood inventory management literature and also the ones analyzed in Pierskalla (1979).

Table 3.3. Alternative Task Descriptions for RBC and Community Blood Center

Alternative	Functions at RBC	Functions at Community Blood Center
1	Information Systems	All Donor Services, Blood Collection, Processing, Inventory Handling and Distribution
2	Information Systems and Donor Services	All Blood Collection, Processing, Inventory Handling, and Distribution
3	Information Systems, Donor Services, and Mobile Blood Collection	Blood Collection at Community Blood Center, Processing, Inventory Handling, and Distribution
4	Information Systems, Donor Services, Mobile Blood Collection, and Processing	Blood Collection at Community Blood Center, Inventory Management, and Distribution
5	Information Systems, Donor Services, All Blood Collection and Processing	Inventory Management and Distribution

3.3. Blood Supply Chain Structure in Turkey and the New Blood and Blood Products Law

The authorities recognized that national blood banking and transfusion system in Turkey has some deficiencies in terms of economies of scale, self-sufficiency in blood and blood products, blood safety requirements, and service quality. Hospital blood banks (transfusion centers) collect, process, test and store blood and blood components. However, this task description of hospital blood banks is not appropriate to achieve safe and reliable blood supply. The main problems about this system can be summarized as follows:

1. Hospital blood banks collect blood from the patient relatives. However, according to the prior academic works in this area and the international blood banking standards (AABB, FDA, CE, WHO), blood should be collected from volunteer donors to obtain safe blood. To organize volunteer donor recruitment programs has a great impact on the costs for hospital blood banks. Volunteer donor recruitment programs should be organized on regional basis to accomplish in the long term self-sufficiency and also to achieve economies of scale (Popovsky, 1997).
2. Most of the Blood Transfusion Transmitted Diseases (HIV, Hepatitis) have a window period in which diseases can not be detected by the traditional test methods. Window period of these diseases is between 3 to 5 months when less costly traditional test methods are used. However, using special test device and method, called PCR, this period can be shortened to 3-5 days. PCR tests are very costly for blood centers, which have a low collection activity, so it is economically impossible to use PCR technique at the hospital blood banks. Test and collection procedures should be regionalized to achieve safe blood and economies of scale.
3. The operating activities (collection, manufacturing/processing, quality control, inventory management, quality assurance, etc.) needed to achieve safe and reliable blood supply causes a high cost increase for hospital blood banks, which have a low blood collection activity. Because of these reasons, most of the hospital

blood banks in Turkey can not satisfy the safety blood requirements defined in international blood banking standards and regulations.

If all of these costs and quality factors are considered, it is unlikely that cost reduction can be achieved through hospitals blood collections. Turkish Ministry of Health has prepared a Blood and Blood Products draft bill in 2005, which restructures tasks of all units related to the blood system. This bill has been approved by the Turkish parliament and the new Turkish law about the national blood banking system was published in 2007. This law restructures a blood center as either a Regional Blood Center (RBC), or a Donation Center (DC), or a Transfusion Center (TC) and redefines their tasks. The new task description of the RBCs, DCs and TCs can be summarized as follows:

Regional Blood Center (RBC): is the unit that manages blood and blood collection activities within its area of responsibility, carries out blood safety tests within the facility, keeps blood by separating it into its components, stores blood, distributes acquired blood and blood components to donation and transfusion centers within its area of responsibility through realizing inventory control. Regional blood center is responsible for supplying ready-to-use blood and blood components to all donation and transfusion centers within its area of responsibility.

Donation Center (DC): is the unit that manages blood and blood components collection activities within its area of responsibility, keeps blood by separating it into its components, stores blood and distributes acquired blood and blood components to transfusion centers within its area of responsibility through realizing inventory control. Donation Center is responsible for supplying ready-to-use blood and blood components to all transfusion centers within its area of responsibility and transferring excessive blood and blood components to the Regional Blood Center to which it is affiliated.

Transfusion Center (TC): is the center responsible for managing crossmatching tests required for transfusion, acquiring appropriate blood and/or blood components for

patients, either from donation center or regional blood center, storing blood components, managing the surveillance of the patient during the usage of blood components and keeping the relevant records.

A schematic view of the hierarchical regional structure defined in the new law is given in Figure 3.3.

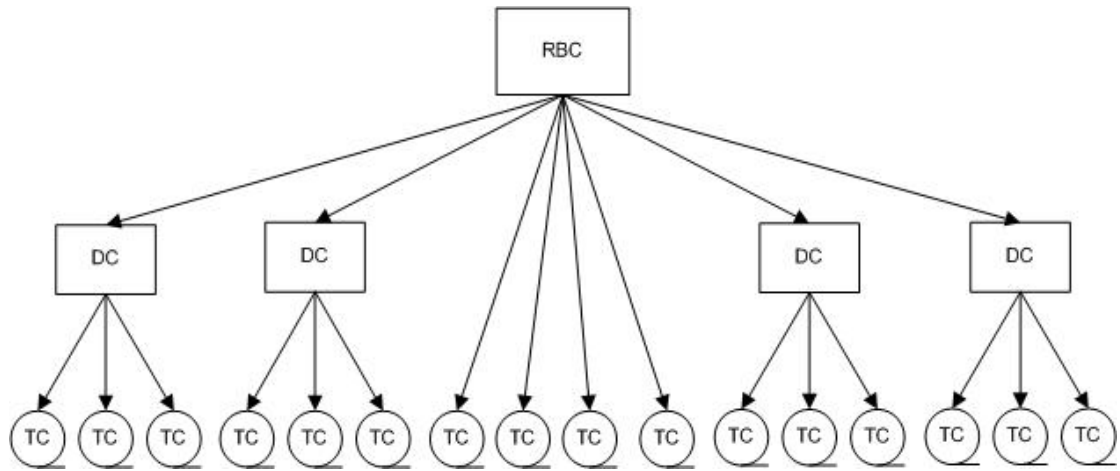


Figure 3.3. Hierarchical Regional Structure of Blood Services as Defined in the New Law

3.4. The Case Study

3.4.1. Turkish Red Crescent Society Blood Banking Services Reorganization Project

The primary responsible organization for the establishment of the new structure throughout the country is defined as the Turkish Red Crescent Society (TRCS) in the new law. Therefore, TRCS has started a project for the reorganization of the blood centers (which is compatible with the structure proposed in the draft bill)

throughout the country. The number and the locations of RBCs are determined by the TRCS. TRCS divided its national blood services into 12 regions and selected 12 cities to locate the RBCs, one RBC for each region. According to the reorganization project, TRCS establishes a DC in each city except the ones where RBCs are located. RBCs and DCs are responsible for fulfilling the blood and blood component needs of the TCs (Hospital Blood Banks) in the city where they are located. RBCs are also responsible for fulfilling the blood and blood component needs of the DCs in their regions. DCs are also responsible for transferring excessive blood and blood components back to the RBC to which it is affiliated. Figure 3.4. shows the selected 12 regions, locations of RBCs and the coverage area of RBCs on the map.

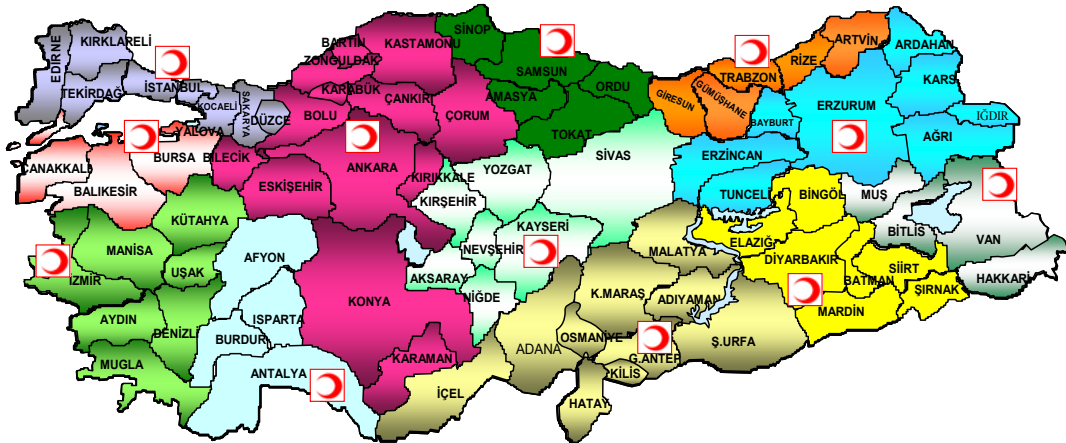


Figure 3.4. Selected RBC Regions and Their Locations

Despite the fact that the TRCS started to make supply agreements with the TCs located in the regions, the reorganization project is currently in the transition phase. Therefore, some irregularities still appear in the operations by the establishment of the new structure. For example, many hospitals in some regions still continue to collect blood and it seems that they may continue to do so for a while. Also in some

regions, while a few hospitals are supplied by a DC or a RBC, most continue to collect blood and when they fail to achieve self-sufficiency, they are supplied by the TRCS blood centers.

In this study, a pilot region (West-Mediterranean Region) is considered. Some irregularities are observed in the region as in the others. Most of the hospitals in the region still continue to collect blood and when their available inventory level becomes insufficient to satisfy the demand, they order blood from TRCS blood centers. A few (approximately 15%) hospitals in the region gave up blood collection and made a supply agreement with TRCS. Some of these hospitals order blood from TRCS periodically, but order quantities are determined by the hospitals according to the experience and knowledge of the professionals in the hospitals. Inventories of the remaining few hospitals are monitored and replenished by TRCS periodically, but still a systematic policy to efficiently manage inventory of blood and blood resources has not been established yet.

We considered the West-Mediterranean Region under the assumption that none of the hospitals in the cities where either an RBC or a DC is located collect blood, as stated by the new law. We ignored the current operational irregularities described above, because all centers will be acting compatible with the new law after completion of the re-organization project. Within the scope of the new law, hospitals will not be collecting blood any more, but they will be supplied by either DCs or RBCs. Effective and efficient inventory management, blood allocation and transfer policies will be essential for the regional/national success of the new structure. Within the scope of this work, we consider the inventory management, allocation and transportation aspects of blood. We analyze the effect of the alternative management policies on the performance measures determined for the region.

3.4.2. The Pilot Region Considered in the Study

We considered the West-Mediterranean Region which includes West-Mediterranean Regional Blood Center in Antalya, Burdur Donation Center, Isparta Donation Center

and 49 hospitals located in Antalya, Burdur and Isparta. Despite the fact that Afyon is also in the region, we excluded Afyon from the study, because TRCS has not located a DC in Afyon yet. Table 3.4. gives a list of the centers considered in the pilot region.

3.4.3. Description of the Main Processes in the Centers

3.4.3.1 Regional Blood Center

The main activities of an RBC are; volunteer donor recruitment and education, blood collection, component preparation, testing, disposing, storing units, and monitoring inventory levels of the TCs and DCs in the region, and allocating/transferring units to TCs and DCs. The flow diagram (Figure 3.5.) shows the processes of the RBC.

Blood Collections: Blood is collected either in mobile drives or in the center. A unit of 400 ml is the quantity taken from a donor in a single session. If blood is collected in mobile drives, the blood is then transported to the center for processing.

Processing and Testing: Blood is processed into components such as red blood cells, platelets and fresh frozen plasma. Components are stored in the quarantine inventory until they are tested against infectious diseases. The units found positive after testing are disposed. Also the donor's blood sample is tested for ABO and Rhesus grouping.

Storing in the Inventory: Testing of the donated units is completed in the next day. Then negative units are sent to inventory. After these procedures, the units are ready for use. The age of units in the inventory is checked everyday and the outdated units are disposed.

Table 3.4. Centers in the Pilot Region

TRCS Centers	TCs in the Responsibility Area of TRCS Centers	
West-Mediterranean RBC, Antalya	Mediterranean University Hospital	Private Manavgat Sevgi Hospital
	Başkent University Hospital	Antalya State Hospital
	Mediterranean Health Hospital	Atatürk State Hospital
	Private Mediterranean Hospital	Alanya State Hospital
	Private Anatolian Hospital	Akseki State Hospital
	Private Antalya Anatolian Hospital	Elmalı State Hospital
	Private An-Deva Hospital	Finike State Hospital
	Private An-Deva Hayat Hospital	Gazipaşa State Hospital
	Private Belek Anatolian Hospital	Demre State Hospital
	Private Bilgi Hospital	Kaş State Hospital
	Private Hayat Hospital	Korkuteli State Hospital
	Private Kemer Yaşam Hospital	Kumluca State Hospital
	Private Lara Hospital	Manavgat State Hospital
	Private Antalya Yaşam Hospital	Kemer State Hospital
	Private Alanya Can Hospital	Serik State Hospital
	Private Aspendos Hospital	
Burdur DC	Burdur State Hospital	Gölkhisar State Hospital
	Pediatric Disorders Hospitals	Yeşilova State Hospital
	Bucak State Hospital	Private Lider Hospital
Isparta DC	Isparta State Hospital	Şarkıkaraağaç State Hospital
	Childbirth and Pediatric Dispensary	Uluborlu State Hospital
	Gülkent State Hospital	Yalvaç Childbirth and Pediatric Dispensary
	Eğirdir State Hospital	Yalvaç State Hospital
	Keçiborlu State Hospital	Süleyman Demirel University Hospital
	Senirkent State Hospital	Private Isparta Hospital

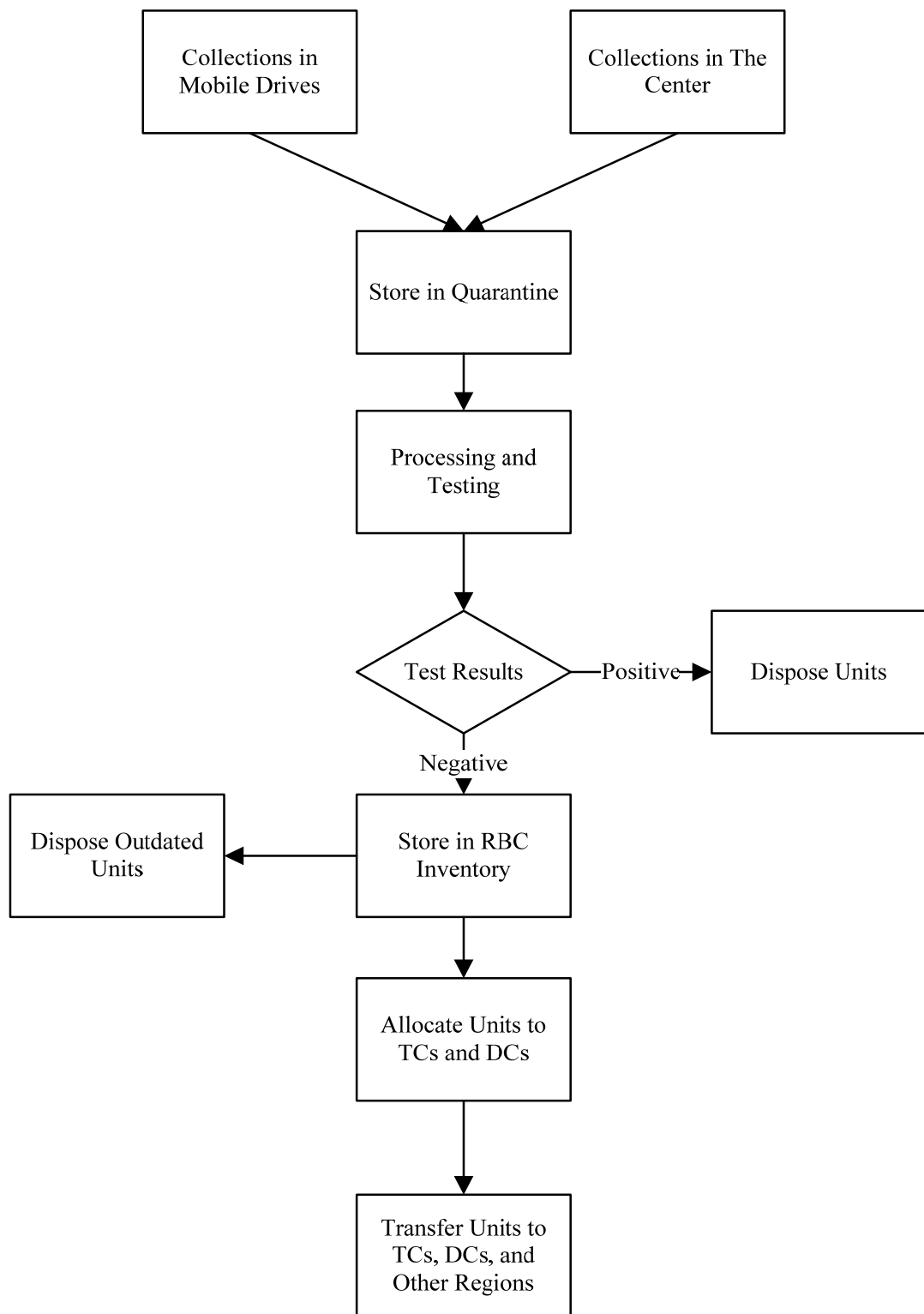


Figure 3.5. Flowchart of the Processes of RBC

Monitoring Inventory Levels of TCs and DCs: RBC controls the inventory levels of TCs every hour and DCs everyday and determines the number of units needed to be transferred to each TC and DC for each blood group.

Allocating Red Blood Cells: If available inventory in RBC is equal to or higher than the total number of units needed to be transferred to all TCs and DCs, RBC allocates units so as to satisfy the need of each center completely. Otherwise, the size of the units to be transferred to each center is determined in order to allow RBC to share the risk of outdating and having shortages among TCs.

Transfer of Excessive Units to RBC: Inventory check for transferring excessive units to other regions is done each day and the excessive amount is transferred to other regions.

3.4.3.2. Donation Center

The main activities of a DC are; blood collection, component preparation, disposing, storing units, and monitoring inventory levels of the TCs in the region, and allocating/transferring units to TCs, and transferring excessive units to the Regional Blood Center to which it is affiliated. The flowchart (Figure 3.6.) shows the processes of a DC.

Blood Collections: Blood is collected either in mobile drives or in the center. A unit of 400 ml is the quantity taken from a donor in a single session. If blood is collected in mobile drives, the blood is then transported to the donation center for processing.

Processing and Testing: Blood is processed into components such as red blood cells, platelets and fresh frozen plasma. Blood samples of donated units are sent to RBC and they are tested against infectious diseases in RBC. Components are stored in the quarantine inventory until the test results are obtained. The units found positive after testing are disposed. The donor's blood sample is tested for ABO and Rhesus grouping in DC.

Storing in the Inventory: Tests are resulted in two days. Then negative units are sent to inventory. After these procedures, the units are ready for use. The age of units in the inventory is checked periodically and the outdated units are disposed.

Monitoring Inventory Levels of TCs and DCs: DC controls the inventory levels of TCs periodically and determines the number of units needed to be transferred to each TC for each blood group.

Allocating Red Blood Cells: If available inventory in DC is equal to or higher than the total number of units needed to be transferred to all TCs, DC allocates units so as to satisfy the need of each center completely. Otherwise, the size of the units to be transferred to each center is determined in order to allow DC to share the risk of outdated and having shortages among TCs.

Transfer of Excessive Units to RBC: Inventory check for transferring excessive units to RBC is done each day and the excessive amount is transferred to RBC.

3.4.2.3. Transfusion Center

Medical doctors at hospitals are responsible for determining the quantity of blood products required and consumed for each patient in the hospital. Following a request from a doctor for blood for a particular patient, crossmatching takes place in the TC. Crossmatched units are termed as “assigned inventory”. However, these units are not always transfused because of over-ordering or postponed operations in practice. Any untransfused crossmatched blood remains assigned to that patient for a certain time in case complications arise, but it is eventually returned to the hospital blood bank as “released inventory”. The elapsed time between assigning blood to a named patient and returning any unused units as released inventory is called the crossmatch release period. Duration of this period is the same for all types of medical operations. The flowchart shows the processes of a TC (Figure 3.7.).

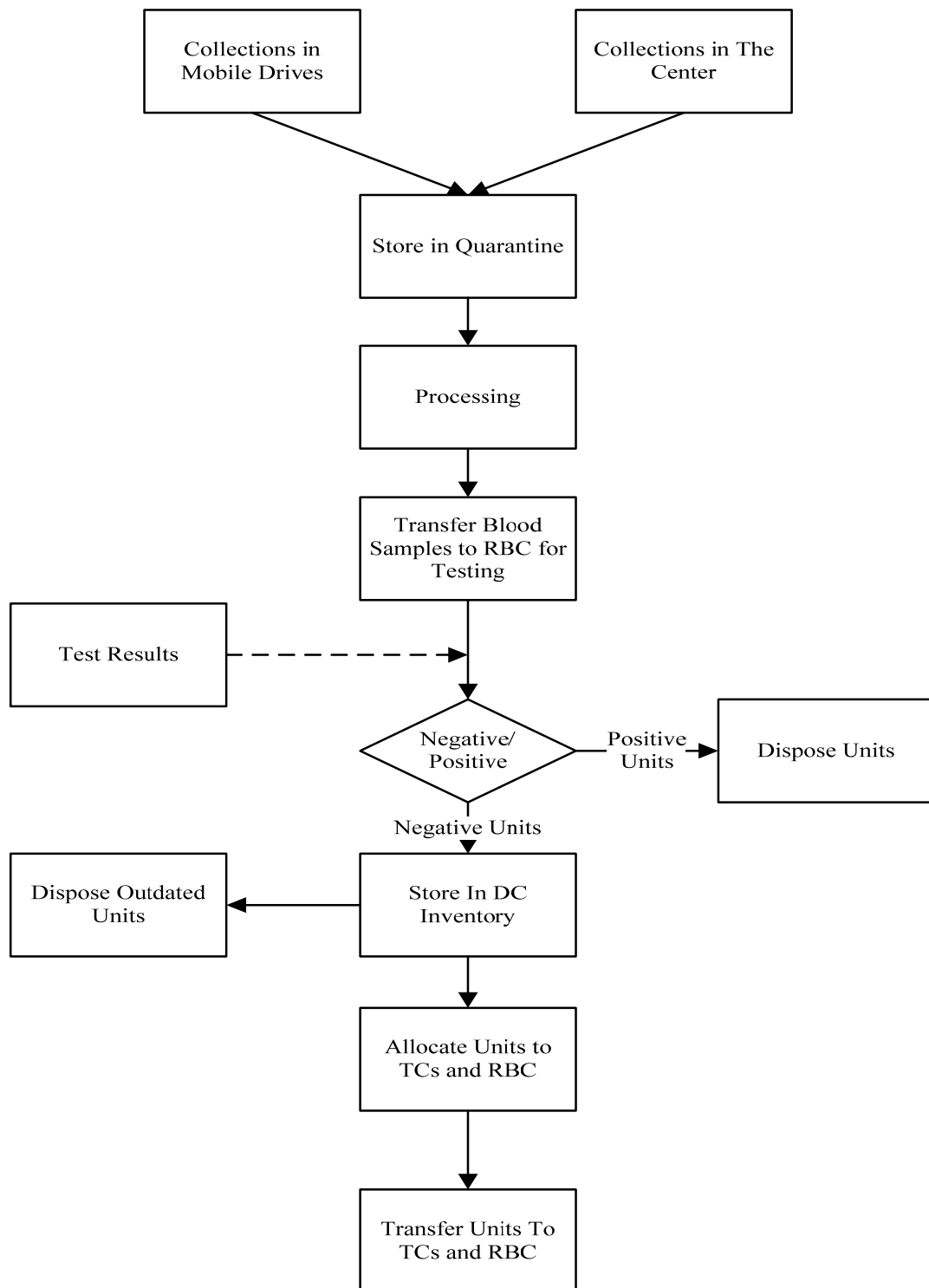


Figure 3.6. Flowchart of the Processes of DC

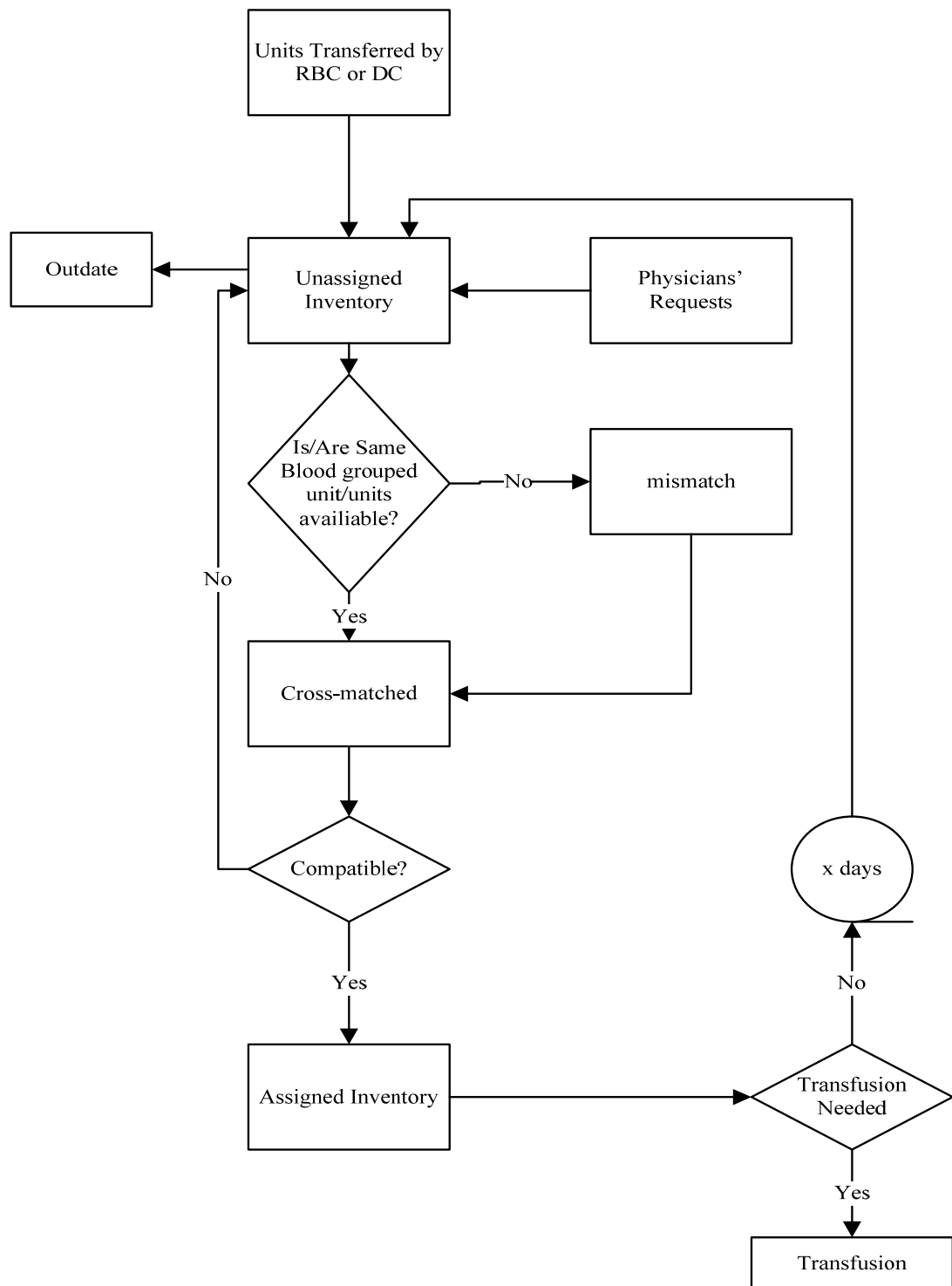


Figure 3.7. Flowchart of the Processes of TC

Another interesting issue in the transfusion process is the substitution or mismatching. Ideally, a patient should be transfused with the same blood group as his/her own, but this is not always possible. When a patient's blood group at the time of request is unavailable, a compatible blood group must be provided. For example, patients with group A positive can receive blood from group A negative or O positive. In general, mismatching is undesirable, because it is risky for the patient.

Units transferred from RBC or DC are stored in TC's "unassigned inventory". Each day the ages of stored units in unassigned and assigned inventory are checked and outdated units are disposed.

CHAPTER 4

THE PROPOSED APPROACH

4.1. The Modelling Approach

Some aspects of the blood inventory management, that appear difficult to model, limit the usefulness of the analytical results to blood banking. The actual problem, even at the hospital level, seems complex to be adequately described by any single mathematical model (Nahmias, 1982; Prastacos, 1984; Katsaliaki and Brailsford, 2006). Within the scope of this work, we consider the entire blood supply chain which makes modelling even harder. Hence, we used discrete event simulation to model the entire supply chain. Our proposed modelling approach allows us to analyze the effects of alternative management policies and system parameters on the supply chain performance.

However, we still have some difficulties while modelling the blood supply chain via simulation in terms of the run time. Katsaliaki and Brailsford (2006) analyzed a vertical section of blood supply chain that consists of a transfusion center (TC) and a regional blood center (RBC). They discovered that as the supply chain grew in size with the addition of more hospitals, the time it takes to perform one simulation run increased to a point that makes simulation modelling almost impossible. Mustafee et al. (2006) considered the same problem by extending it to the two-hospital, three-hospital and four-hospital cases. They used “distributed simulation” approach to solve the increasing simulation run time problem. They built the model using simulation software called Simul8. Their results showed that the conventional model with one hospital took approximately 14 minutes to run for a whole simulated year.

The run time rises to 78 minutes when the model is run with two hospitals and to approximately 17.5 hours with three hospitals. The addition of the fourth hospital increases the execution time to 35.8 hours. The distributed model with one National Blood Services supply center (Regional Blood Center) and one hospital runs in approximately 8.5 hours (this increase from 14 minutes occurs due to the distributed simulation technique), with two hospitals in 9.8 hours, with three hospitals in 12.7 hours and with four hospitals in 16.5 hours. Although distributed simulation performs better, simulation run times are still huge for making several runs to analyze the effect of different management policies and parameters for the whole supply chain. The studied scenarios include at most four hospitals and one RBC. Simulation run time is still a problem even for these scenarios. Brailsford et al. (2006) extended their model to sixteen-hospital case, but did not report the run time performance.

The pilot region we consider in this study includes one RBC, two DCs and 49 TCs (hospitals), which is extremely larger than the cases analyzed in the previous works. This supply chain also includes some additional processes and requires additional analysis such as the blood transfers between RBC and DC, performance analysis of the RBC and DCs, etc. We developed and used a tailored program that we named as SiModel for the simulation of the supply chain to solve the run time problem rather than using a general purpose simulation software package such as Simul8, Arena, etc. The developed system does not include any interfaces (animated or not). We made some simplifications in the system to reduce the run time, such as defining the shelf life of the entities in terms of day rather than minute as in the previous works, and checking inventory levels of the centers on an hourly basis rather than the minute-basis.

As the system does not include any interface, model configuration parameters are defined in input files. System reads the files that are in txt format, and simulates the supply chain according to the parameters defined in these files. System does not calculate the performance measures directly. It only records the necessary figures to calculate the performance measures later, after the run is completed. After

simulation of the supply chain is completed, the system creates output files which include only the figures such as the number of outdated, mismatched, and shortage units at TCs. These output files are put in a pre-designed MS Excel document. This Excel document is designed using MS Excel functions to calculate the performance measures, confidence intervals, and to create summary tables and graphics. These processes are repeated when one or more simulation parameters are changed by the analyst to analyze the effect of the changes. If the analyst wants to change the model parameters, s/he re-defines the parameters in txt files, and then starts the simulation again. As the performance measures are computed out of the system, the effect of the computations on simulation run time is eliminated. Figure 4.1. shows the processes of the modelling approach.

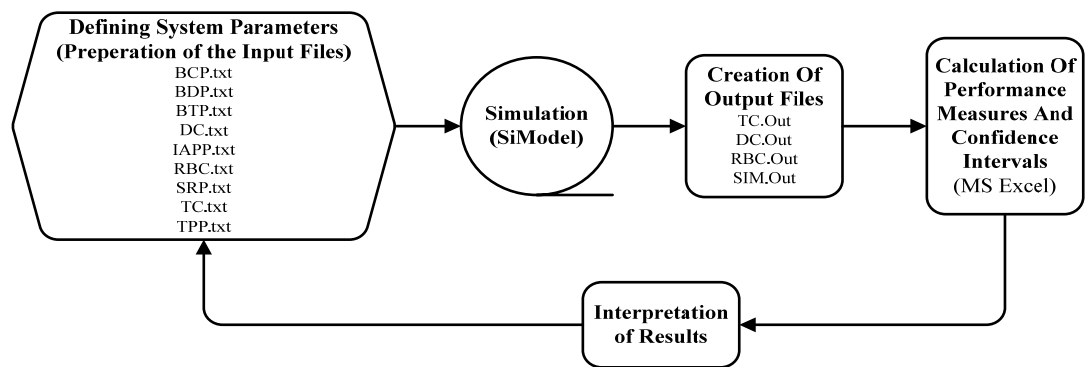


Figure 4.1. Processes of the Modelling Approach

4.2. Inputs of the Simulation

SiModel has got such characteristics that make it as flexible as possible, and allows the user to analyze different regions possibly in different countries. In addition to defining different values for the parameters that affect the performance of the supply chain, model allows the analyst to define the supply chain's hierarchical structure, as well as the characteristics of the centers in the chain. There are nine different txt

files (“BCP.txt”, “BDP.txt”, “BTP.txt”, “DC.txt”, “IAPP.txt”, “RBC.txt”, “SRP.txt”, “TC.txt”, “TPP.txt”) used by SiModel. These model configuration files and parameters included are described below in the following sections.

4.2.1. Blood Collection Parameters (BCP)

Blood Group Frequencies (BGF) of the population are defined in “BCP.txt” file. The observed frequencies of ABO and Rhesus blood types can change from population to population. For example, the frequencies of 0 positive blood type in Turkey and UK populations are 0.29 and 0.38, respectively. One can change the BGF to analyze a region located in a different country. BGF values of the Turkish population are given in Table 4.1. The values in the table are obtained from the Blood Services Report of Turkish Red Crescent Society in 2004.

Table 4.1. Blood Group Frequencies in Turkish Population

Blood Groups							
0 (+)	0 (-)	A (+)	A (-)	B (+)	B (-)	AB (+)	AB (-)
0.29	0.04	0.38	0.05	0.14	0.02	0.07	0.01

4.2.2. Blood Disposal Parameters (BDP)

These parameters define the disposal criterion of blood and the age restrictions in transferring blood between centers. The expiry date of red blood cells was extended from 35 to 42 days in 1998. There can still be a potential to extend its lifetime more, so the disposal age of units is also defined as a controllable parameter. The blood disposal parameters are defined in “BDP.txt” file. Table 4.2. shows the parameters and definitions. File format of the “BDP.txt” file and values used in the baseline policy are given in Appendix A, Table A.1.

Table 4.2. Blood Disposal Parameters and Their Definitions

File Name	Parameter	Definition
BDP	TDR	Test Disposal Rate of Blood Units: Blood is tested against some infectious diseases. If a unit of blood is found positive, it is disposed after testing. Ratio of positive blood units to all tested units is called test disposal rate. The test disposal ratio of 0.029 is used in the model. This value is obtained from the Blood Services Report of Turkish Red Crescent Society, 2004.
BDP	DATC	Disposal Age of Units at TCs (in days): Units are disposed at TCs, when their age reached the DATC.
BDP	DADC	Disposal Age of Units at DCs and RBC (in days): Units are disposed at DCs and RBC, when their age reached the DADC.
BDP	MASD	The maximum age of the units to be transferred to DCs (in days): RBC does not transfer units, which are older than a pre-determined age, to DCs not to increase the risk of outdateding. RBC can only transfer units, which are younger than MASD, to DCs
BDP	MASR	The maximum age of the units that can be transferred from DCs to RBC (in days): DC does not transfer the units, which are older than a pre-determined age, to RBC not to increase the risk of outdateding. DC can only transfer units, which are younger than MASR, to RBC.
BDP	MASI	The maximum age of the units that can be transferred from an RBC to another RBC (in days): RBC does not transfer the units, which are older than a pre-determined age, to other regions (RBCs) not to increase the risk of outdateding. RBC can only transfer units, which are younger than MASR, to other regions.

4.2.3. Blood Transfer Parameters (BTP)

These parameters define the distances and transfer durations between centers. Transfer durations are assumed to be deterministic in the model. Transfer durations between centers are calculated by assuming that for each kilometer, transfer of units takes thirty seconds for inter-city transfers, and one minute for intra-city transfers. It is assumed that ad-hoc and emergency deliveries are directly done from source center to target center, and routine deliveries are done by milk runs. Sample routes are constructed for routine deliveries and the same routes are used for all policies. Blood Transfer Parameters are defined in “BTP.txt” file. Table 4.3. shows the parameters and their definitions. File format of the “BTP.txt” file and the values used in experiments are given in Appendix A, Table A.7.

Table 4.3. Blood Transfer Parameters and Their Definitions

File Name	Parameter	Definition
BTP	Start	Shows the name of the center which transfers blood units to another center
BTP	End	Shows the name of the center which receives blood units from the center defined in BTP_Start.
BTP	TD_{se}	Transfer distance from the starting center s to the ending center e in kilometers.
BTP	TTR_{se}	Transfer time between center s and e for routine deliveries in hours.
BTP	TTA_{se}	Transfer time between center s and e for ad-hoc and emergency deliveries in hours.

4.2.4. Donation Center Parameters (DCP)

The names of donation centers, statistical distribution parameters of their mobile and center collections, and DCs' target inventory level coefficients are defined in "DC.txt" file. Table 4.4. shows the parameters and definitions. File format of the "DC.txt" file and values used in baseline policy are given in Appendix A, Table A.2.

Historical blood donation data of Isparta and Burdur DCs are obtained from the information system (Hemonline Blood Bank Information Management System) used by TRCS. Data were fit to distributions to describe daily whole blood collections. Daily whole blood collections of both mobile drives and centers are found to follow a normal distribution, by visually inspecting the data and conducting Kolmogorov-Smirnov tests at 0.05 level of significance.

4.2.4.1. Analysis of the Historical Data of Isparta and Burdur DCs

We first visually checked the data to see whether normality exists or not. We created histograms of the daily whole blood collection of the DCs both at mobile drives and at centers. The histograms are given in Figure 4.2. These histograms do not appear to have a perfect bell-shaped pattern, however we do not expect it (we are only looking at a sample, not the entire population). There is more data in the middle of

the histograms, and less toward the two extremes. Additionally, it appears that about half of the data in the histograms are above and half are below the means. Also, there are not any unusually large or small values at either extreme. Based on these observations, the assumption of normality appears reasonable.

Table 4.4. Donation Center Parameters and Their Definitions

File Name	Parameter	Definition
DC	NameD _a	The name of the DC
DC	NameR	The name of the RBC which supplies blood to DC
DC	SDMMD _a	Statistical distribution-mean for mobile collections of DC
DC	SDSMD _a	Statistical distribution-standard deviation for mobile collections of DC
DC	SDMD _a	Statistical distribution-mean for center collections of DC
DC	SDSD _a	Statistical distribution-standard deviation for center collections of DC
DC	AD _a	Target inventory level coefficient of DC for red blood cells

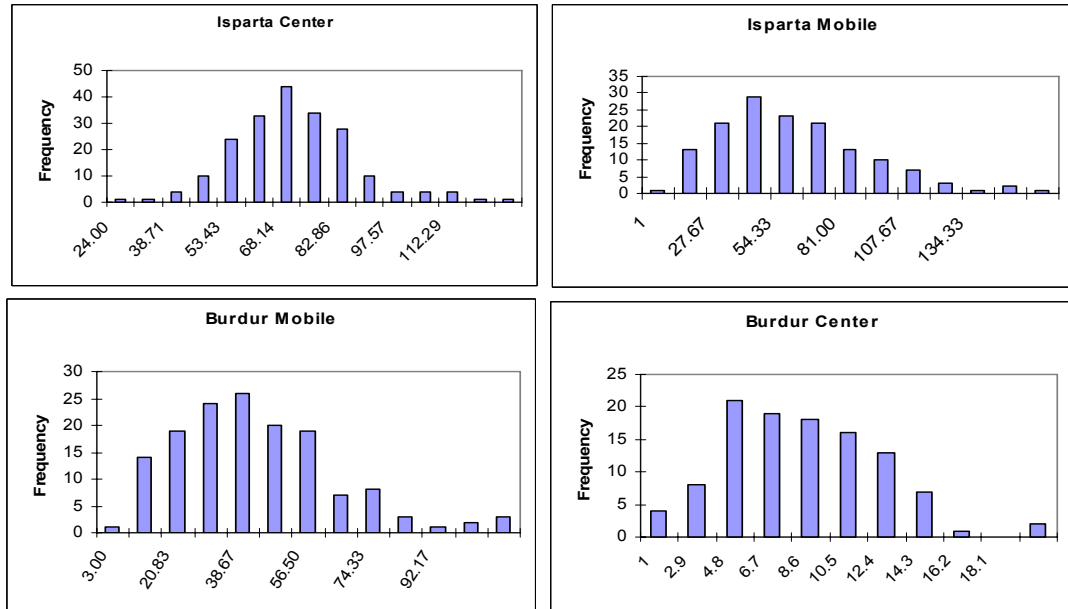


Figure 4.2. Histograms of Daily Whole Blood Collections of the DCs

We conducted Kolmogorov-Smirnov tests to check the normality assumptions, using SPSS. Table 4.5. shows the SPSS output of the one-sample Kolmogorov-Smirnov Test for DCs’ daily whole blood collections. As the asymptotic significance (2 tailed) values are greater than 0.05, there is insufficient evidence to conclude that the distributions are not normal. These results show us that we can proceed with the assumption of normality.

4.2.5. Inventory and Allocation Parameters (IAPP)

These parameters define general inventory and allocation parameters which are the same for all centers belonging to the same hierarchical level. Some of the parameters in the “IAPP.txt” file, such as IAPP_APN and IAPP_IPN, are also used for selecting the one to be applied in the simulation, among the alternative policies. Table 4.6. shows the parameters and their definitions. File format of the “IAPP.txt” file and values used in baseline policy are given in Appendix A.3.

Table 4.5. SPSS Output of One-Sample Kolmogorov-Smirnov Test for DCs’ Daily Whole Blood Collections

		Isparta Center	Isparta Mobile	Burdur Center	Burdur Mobile
N		203	145	110	147
Normal Parameters	Mean	66.49	50.99	7.27	37.89
	Std. Deviation	16.03	30.85	3.94	22.42
Most Extreme Differences	Absolute	.07	.087	.09	.08
	Positive	.07	.087	.09	.08
	Negative	-.04	-.059	-.06	-.06
	Kolmogorov-Smirnov Z	.99	1.05	1.04	.97
Asymptotic Significance (2-tailed)		.27	.21	.22	.29

Table 4.6. Inventory and Allocation Parameters and Their Definitions

File Name	Parameter	Definition
IAPP	ADPT	Ad-hoc delivery coefficient for TCs; This coefficient is used to calculate the reorder points of TCs for ad-hoc deliveries for the red blood cells. These limits are used to determine whether an ad-hoc delivery should be done to a TC or not.
IAPP	ADPD	Ad-hoc delivery coefficient for DCs; This coefficient is used to calculate the reorder points of DCs for ad-hoc deliveries for red blood cells. These limits are used to determine whether an ad-hoc delivery should be done to a DC or not.
IAPP	Hd	Upper Inventory Limit Coefficient of DCs; This coefficient is used to calculate upper limits for DCs' red blood cells inventory levels.
IAPP	Sd	Excess Amount Coefficient for DCs; This coefficient is used to determine the number of excess units to be transferred to RBC from DCs. If inventory level of a DC is higher than its upper limit, DC sends excess units to RBC to be used in other cities. The main reasons of sending excess units are reducing outdates and fulfill the need of other cities.
IAPP	RHd	Upper Inventory Limit Coefficient of RBC; This coefficient is used to calculate upper limits for RBC's red blood cells inventory levels.
IAPP	RSd	Excess Amount Coefficient for RBC; This coefficient is used to determine the number of excess units to be transferred to other regions from an RBC. If inventory level of a RBC is higher than its upper limit, RBC sends excess units to another RBC to be used in other regions. The main reasons of sending excess units are reducing outdates and fulfill the need of other regions.
IAPP	APN	Blood Allocation Method Parameter; This parameter shows the number (code) of the allocation method to be used.
IAPP	IPN	Blood Issuing Method Parameter; This parameter shows the number (code) of red blood cells issuing method to be used while allocating blood to TCs.
IAPP	RDP	Routine Delivery Coefficient for TCs; This coefficient is used to calculate the reorder points of TCs for routine deliveries. These limits are used to determine whether a routine delivery should be done to a TC or not.

Different values of ADPT and ADPD correspond to different inventory control policies. When we set ADPT to 1, it corresponds to the periodic review (S-1, S) inventory control policy for ad-hoc deliveries to TCs. When we set ADPT to a value which is less than 1, it corresponds to a periodic review (s,S) policy for ad-hoc deliveries to TCs. Inventory control policy to be used in the experiments can be

defined similarly for DCs, using different ADPD values. In simulation experiments, we use values which are less than 1 for ADPD and ADPT for both TCs and DCs. Review period for TCs is one hour, and review period for DCs is one day. Ad-hoc deliveries are done to handle the possible fluctuations in blood demand due to the emergency cases such as traffic accidents and disasters.

Inventory control policy used for routine deliveries is also similar. The case where RDP is set to 1 corresponds to a periodic review (S-1, S) inventory control policy for routine deliveries, and smaller RDP values correspond to a periodic review (s,S) policy. In experiments, we try both policies to be adapted to the supply chain. Review period for routine deliveries can be defined individually for each hospital. We try different review periods for each TC in the experiments.

4.2.6. Regional Blood Center Parameters (RBCP)

The name of RBC, statistical distribution parameters of its mobile and center collections, delivery preparation duration and RBC's target inventory level coefficients are defined in "RBC.txt" file. Delivery preparation duration is assumed to be deterministic and the same for all DCs and RBC. Table 4.7. shows the parameters and their definitions. File format of the "RBC.txt" file and values used in baseline policy are given in Appendix A, Table A.4.

Historical blood donation data of West-Mediterranean RBC is obtained from the information system (Hemonline Blood Bank Information Management System) used by TRCS. Distributions were fitted to the data to describe daily whole blood collections. Daily whole blood collections of both mobile drives and centers are found to follow a normal distribution.

4.2.6.1. Analysis of the Historical Data of the West-Mediterranean RBC

Visual inspection and Kolmogorov-Smirnov test are applied to the West-Mediterranean RBC historical data to check the normality assumption. Histograms

of the daily whole blood collection of the RBC and SPSS output of the one-sample Kolmogorov-Smirnov Test for RBC's daily whole blood collections are given in Figure 4.3. and Table 4.8., respectively.

Table 4.7. Regional Blood Center Parameters and Their Definitions

File Name	Parameter	Definition
RBC	NameR	The name of the RBC
RBC	SDMMR	Statistical distribution-mean for daily mobile collections of RBC
RBC	SDSMR	Statistical distribution-standard deviation for daily mobile collections of RBC
RBC	SDMR	Statistical distribution-mean for daily center collections of RBC
RBC	SDSR	Statistical distribution-standard deviation for daily center collections of RBC
RBC	DPDR	Routine and ad-hoc delivery preparation duration in hours
RBC	LLC	RBC lower limit coefficient for the transfers to the DCs. If RBC's inventory is greater than or equal to its lower inventory limit, transfers are made to DCs, else not. Lower inventory limit is calculated by using LLC.
RBC	AR	Target inventory level coefficient of RBC for red blood cells

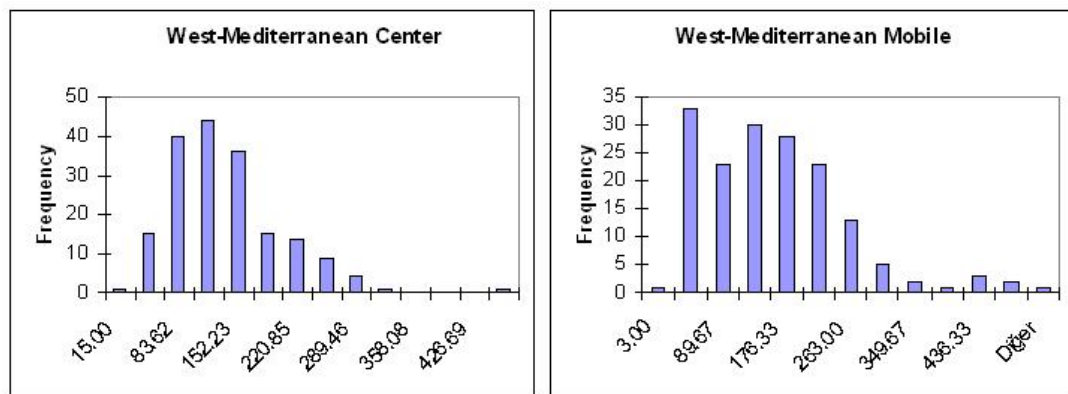


Figure 4.3. Histograms of Daily Whole Blood Collections of the RBC

Based on the visual observations, the assumption of the normality appears reasonable. As the asymptotic significance (2 tailed) values in Table 4.8. are greater than 0.05, there is insufficient evidence to conclude that the distributions are not normal. These results show that the normality assumption holds.

4.2.7. Simulation Run Parameters (SRP)

Run length of each run, the number of replications of each policy and the duration to reach steady state are specified in “SRP.txt” file. Table 4.9. shows the parameters in the file and their definitions. File format of the “SRP.txt” file and values used in experiments are given in Appendix A, Table A.5.

Table 4.8. SPSS Output of One-Sample Kolmogorov-Smirnov Test for RBC’s Daily Whole Blood Collections

		West Mediterranean Center	West Mediterranean Mobile
N		180	165
Normal Parameters	Mean	121.14	137.98
	Std. Deviation	64.86	98.26
Most Extreme Differences	Absolute	.09	.08
	Positive	.09	.08
	Negative	-.06	-.08
	Kolmogorov-Smirnov Z	1.20	1.08
Asymptotic Significance (2-tailed)		.10	.18

Table 4.9. Simulation Run Parameters and Their Definitions

File Name	Parameter	Definition
SRP	RQ	The number of replications of each policy
SRP	SS	Number of days needed to reach steady-state
SRP	RL	Run length of each run in days

4.2.8. Transfusion Center Parameters (TCP)

TCs in the supply chain, RBC or DC which the TCs are affiliated, with routine delivery periods of TCs, demand and target inventory level coefficients of TCs are defined in “TC.txt” file. Table 4.10. shows the parameters in “TC.txt” file and their definitions. File format of the “TC.txt” file and values used in the baseline policy are given in Appendix A, Table A.8.

As there is no available historical request data for the TCs in the region, we use a forecasting technique to forecast the size of physician requests and number of daily requests.

Table 4.10. Transfusion Center Parameters and Their Definitions

File Name	Parameter	Definition
TC	NameT _b	The name of the TC
TC	NameRDT _b	The name of the DC or RBC which supplies the TC
TC	DPT _b	Periodic review period for routine deliveries to TC
TC	SDMT _b	Average of daily requests of physicians at the TC
TC	ATb _{0pos}	Target Inventory Level Coefficient of the TC for 0+ red blood cells
TC	ATb _{0neg}	Target Inventory Level Coefficient of the TC for 0- red blood cells
TC	ATb _{Apos}	Target Inventory Level Coefficient of the TC for A+ red blood cells
TC	ATb _{Aneg}	Target Inventory Level Coefficient of the TC for A- red blood cells
TC	ATb _{Bpos}	Target Inventory Level Coefficient of the TC for B+ red blood cells
TC	ATb _{Bneg}	Target Inventory Level Coefficient of the TC for B- red blood cells
TC	ATb _{ABpos}	Target Inventory Level Coefficient of the TC for AB+ red blood cells
TC	ATb _{ABneg}	Target Inventory Level Coefficient of the TC for AB- red blood cells

4.2.8.1. Forecast for Number of Daily Requests and Size of the Requests

4.2.8.1.1. Size of the Requests

Demand patterns are determined by the behavior of the two random variables: the number of daily requests (N) arriving at the blood bank, the size of requisition (R) (Prastacos, 1984). Elston and Pickrel (1963) found N to be a Poisson random variable, and R a lognormal random variable, such that the probabilities are defined as follows:

$$P(n) = P(N=n) = \exp(-\lambda) \lambda^n / n!, \quad n = 0, 1, \dots, \quad (1)$$

and

$$Q(r) = P(R=r) = -p^{r-1} / ((1-p) \ln(1-p)), \quad r = 1, 2, \dots, \quad (2)$$

where n represents the number of daily requests, λ and p are TC parameters.

This model has since been repeatedly validated (Rabinowitz and Valinsky, 1970; Yen, 1975), whereas alternative models have appeared in the literature for the size of a requisition. Brodheim and Prastacos (1980) compared the previous models and determined that the size of a requisition could best be described by a modified lognormal distribution:

$$Q(r) = \hat{O}(1) h(r) + (1 - \hat{O}(1)) (1 - h(r)) (-p^{r-1}) / ((r-1) \ln(1-p)), \quad r = 1, 2, 3, \dots, \quad (3)$$

where $h(1) = 1$ and $h(r \neq 1) = 0$, $\hat{O}(1)$ is the observed frequency of the requisition of size one, r is the size of request, and p is a parameter approximately equal to 0.67 for all TCs.

We used the formula (3) to construct the probability distribution of the size of requests. We analyzed one and a half year data of a university hospital to calculate the frequency of the requisition of size one, $\hat{O}(1)$. $\hat{O}(1)$ is found to be equal to 0.295913734 for the hospital analyzed. We assumed that $\hat{O}(1) = 0.295913734$ and $p =$

0.67 for all hospitals in the region and calculated the probabilities for the size of requests by using the formula (3) . Table 4.11. illustrates the probabilities calculated for the size of requests.

Table 4.11. Probabilities for the Size of Requests

Size of the Requests	Probability	Size of the Requests	Probability
1	0.296	6	0.017
2	0.426	7	0.010
3	0.146	8	0.005
4	0.064	9	0.003
5	0.032	10	0.002

4.2.8.1.2. Number of Daily Requests

We assumed that demand (request) at the TC arrivals follow a Poisson distribution and used a regression model to forecast mean daily red blood cells demand of TCs in the region. We used two years historical data of 80 hospitals in İzmir, İstanbul and Ankara, and calculated their annual red blood cells demand. We obtained the bed numbers (BedNum), annual numbers of major (MajorS), moderate (ModerateS) and minor (MinorS) surgeries and fill rates of these hospitals from The Annual Health Statistics Report 2006, Turkish Ministry of Health. Fill rate is the ratio of annual patient-days to available annual bed-days in the hospital. Table 4.12. shows the statistics of the hospitals in other regions.

We developed a multiple regression equation to predict annual red blood cells demand at the hospitals. Regression analysis is done using SPSS 14.0. We first visualized the data to have an idea about the relation between variables. Figure 4.4. illustrates the scatter graphs of the variables. It seems like there is a linear and

positive relation between demand and bed number, and also between demand and major surgery.

We made regression analysis to confirm our observations, using stepwise method. Resulting model summary output of SPSS is given in Table 4.13.

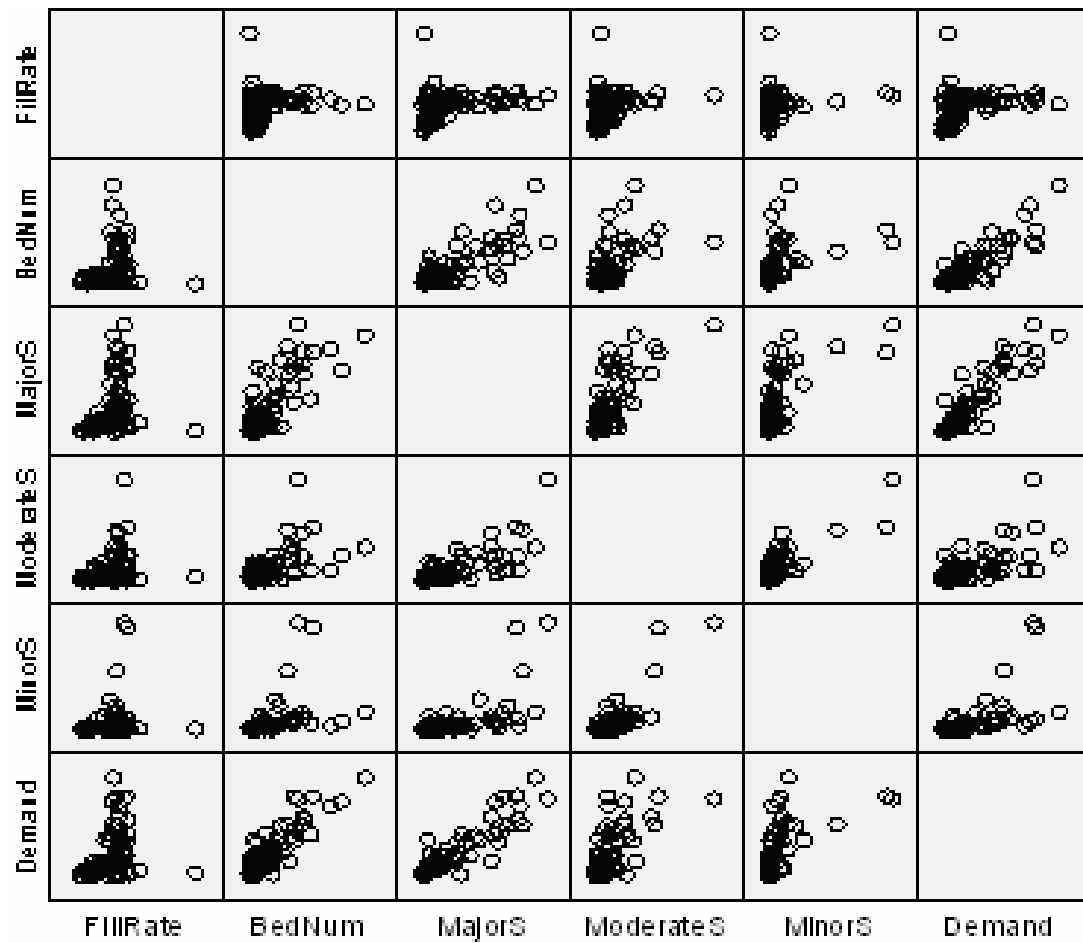


Figure 4.4. Matrix Scatter Graph of the Regression Variables

Table 4.12. Statistics of the Hospitals in Other Regions Used for Regression Analysis (Source: The Annual Health Statistics Report 2006, The Ministry of Health)

Hospital Number	Number of Beds	Major Sur.	Moderate Sur.	Minor Sur.	Fill Rate (%)	Yearly Red Blood Cell Demand	Hospital Number	Number of Beds	Major Sur.	Moderate Sur.	Minor Sur.	Fill Rate	Yearly Red Blood Cell Demand
1	811	6315	6812	6921	75	15524	41	180	3735	1958	881	61	7235
2	27	845	948	294	56	1100	42	50	267	204	66	8	345
3	50	71	58	113	12	2350	43	65	2338	311	134	66	3962
4	78	713	441	362	78	1625	44	975	12526	10137	7070	76	25631
5	48	730	1307	148	20	3524	45	155	208	457	38	11	3125
6	31	965	1152	298	97	1559	46	88	1903	313	428	41	3251
7	96	1416	3117	246	32	3862	47	540	15405	2170	14008	72	21884
8	60	400	581	929	24	702	48	295	3866	3306	3671	90	9865
9	180	2632	677	324	27	6210	49	593	1183	384	3571	85	10235
10	253	4187	1731	703	72	6832	50	51	1821	403	103	56	6753
11	7	401	1004	413	216	2251	51	250	2581	2954	5808	37	4325
12	264	1210	159	533	92	3869	52	795	9666	5900	3640	79	17751
13	43	701	1093	1024	35	1635	53	292	2507	1675	368	74	8215
14	157	1103	1221	650	32	2531	54	1109	7106	2389	3200	63	18199
15	28	385	299	208	20	2310	55	956	14558	5281	9606	67	22354
16	101	465	1081	254	10	1152	56	311	2197	1353	1952	75	5404
17	153	13783	3718	1241	91	15324	57	1153	16985	11312	59830	92	34268
18	154	2707	2057	517	59	4217	58	432	5423	733	509	82	9897
19	32	3099	332	186	49	4306	59	62	1540	509	1022	24	2849
20	133	1666	491	100	55	3652	60	49	5586	2488	162	69	8623
21	49	5409	1071	705	88	6853	61	201	1169	4104	8038	50	4075
22	161	2749	963	805	56	4235	62	89	1000	576	571	52	16253
23	73	2077	3847	516	45	3256	63	43	618	47	36	29	1776
24	508	7848	4220	1671	82	15365	64	168	1468	486	712	53	4215
25	114	318	759	1436	24	1086	65	472	10272	3781	17671	61	15983
26	114	221	381	319	33	1354	66	113	1441	417	299	59	3245
27	281	12952	3304	5399	92	18653	67	63	3923	805	292	82	5705
28	457	7687	1683	1976	80	13685	68	200	1340	346	1547	27	4210
29	133	2228	2939	534	81	4836	69	272	5491	2772	3383	68	9258
30	419	1055	644	25	88	6235	70	120	3318	1291	1228	78	3865
31	54	10	1	17	68	1065	71	123	5206	733	534	75	7538
32	1466	17540	2314	1861	78	30125	72	469	4229	2216	9581	74	12016
33	1668	13169	5401	4661	65	32015	73	170	4512	668	577	41	7040
34	808	13471	1510	3437	70	20354	74	966	17200	5262	6040	94	24315
35	815	14733	2232	5813	73	34200	75	364	1592	321	562	77	6350
36	34	409	1507	707	77	532	76	216	6424	3029	3153	71	8265
37	426	6963	5598	2240	95	1285	77	732	12473	7383	4526	78	7245
38	62	8663	386	82	73	9366	78	694	18188	10688	34705	73	22315
39	189	1481	1023	405	54	5432	79	2090	20424	7157	10269	67	42360
40	49	2156	352	478	115	3069	80	883	22673	21434	62814	86	33256

Table 4.13. Model Summary Output of the Regression

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.94	.89	.89	3085.97

Adjusted R square value in Table 4.13. shows that 89% of the variation is explained by the model, that is bed number and major surgery can define 89% of the variability in the value of demand. The multiple regression model is statistically significant. Anova table of the model is given in Table 4.14. Since significance (Sig.) value in the table is smaller than 0.05, at least one coefficient in the model is different from zero.

Table 4.14. Anova Table of the Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6480306745.88	2	3240153372.94	340.23	.000
	Residual	733291925.31	77	9523271.75		
	Total	7213598671.20	79			

The following multiple regression equation is obtained to predict the annual red blood cells demand of a hospital;

$$y = 1065.953239 + 10.3978207 x_r + 0.931209602 x_t, \quad (4)$$

where y is the annual red blood cells demand, x_r is the number of beds, and x_t is the number of major surgeries. The coefficients output of SPSS is given in Table 4.15. All the significance (sig.) values in the table are smaller than 0.05. These values show that the number of beds and the number of major surgeries have a significant

contribution on the annual red blood cells demand. Our regression analyses indicate that other variables have no significant contribution on the annual red blood cells demand.

Table 4.15. Coefficients Output of SPSS

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Constant	1065.95	473.94		2.24	.03
	BedNum	10.39	1.39	.44	7.45	.00
	MajorS	.93	.09	.55	9.38	.00

Annual red blood cells demands of the TCs in the West-Mediterranean region are forecasted using equation (4). Forecasted mean daily demands (requests) of the TCs are calculated. The expected value of each requisition size, $E(r)$, is calculated using the probabilities given in Table 4.11. Forecasted numbers of daily requests (mean daily demand) of TCs are calculated by using the following equation:

$$\text{Forecasted number of daily requests} = (\text{Forecasted Annual Demand}) / (365 * E(r))$$

Forecasted numbers of daily requests of TCs in the West-Mediterranean Region are given in Table 4.16.

4.2.9. Transfusion Process Parameters (TPP)

Values of transfusion processes parameters are defined in “TPP.txt” file. Table 4.17 shows the parameters and their definitions. File format of the “TPP.txt” file and sample values are given in Appendix A, Table A.6.

Table 4.16. Forecasted numbers of daily requests of TCs in the West-Mediterranean Region

TC Name	TC No	Number of Beds	Number of Major Surgery	Forecasted Yearly Red Blood Cell Demand	Forecasted Number of Daily Requests
Mediterranean University Hospital	1	700	8013	15806.21	19.16
Başkent University Hospital	2	120	1536	3744.03	4.54
Mediterranean Health Hospital	3	50	880	2405.31	2.92
Private Mediterranean Hospital	4	43	330	1820.36	2.21
Private Anatolian Hospital	5	42	194	1683.32	2.04
Private Antalya Anatolian Hospital	6	93	760	2740.67	3.32
Private An-Deva Hospital	7	35	662	2046.34	2.48
Private An-Deva Hayat Hospital	8	17	739	1930.88	2.34
Private Belek Anatolian Hospital	9	29	145	1502.52	1.82
Private Bilgi Hospital	10	45	370	1878.40	2.28
Private Hayat Hospital	11	90	419	2391.93	2.90
Private Kemer Yaşam Hospital	12	28	59	1412.03	1.71
Private Lara Hospital	13	33	78	1481.72	1.80
Private Antalya Yaşam Hospital	14	70	1641	3321.92	4.03
Private Alanya Can Hospital	15	49	410	1957.24	2.37
Private Aspendos Hospital	16	38	189	1637.07	1.98
Private Manavgat Sevgi Hospital	17	42	9	1511.04	1.83
Antalya State Hospital	18	872	19412	28209.49	34.19
Atatürk State Hospital	19	659	4436	12048.96	14.60
Alanya State Hospital	20	265	3898	7451.23	9.03
Akseki State Hospital	21	36	1	1441.21	1.75
Elmalı State Hospital	22	90	367	2343.51	2.84
Finike State Hospital	23	128	1515	3807.66	4.62
Gazipaşa State Hospital	24	66	680	2385.43	2.89
Demre State Hospital	25	39	231	1686.58	2.04
Kaş State Hospital	26	25	16	1340.80	1.63
Korkuteli State Hospital	27	74	1626	3349.54	4.06
Kumluca State Hospital	28	100	833	2881.43	3.49
Manavgat State Hospital	29	200	4295	7145.06	8.66
Kemer State Hospital	30	26	67	1398.69	1.70
Serik State Hospital	31	87	2479	4279.03	5.19
Burdur State Hospital	32	266	3167	6780.91	8.22
Pediatric Disorders Hospitals	33	82	145	2053.60	2.49
Bucak State Hospital	34	263	3835	7371.77	8.94
Göhlhisar State Hospital	35	45	106	1632.56	1.98
Yeşilova State Hospital	36	15	11	1232.16	1.49
Private Lider Hospital	37	47	729	2233.50	2.71
Isparta State Hospital	38	411	7585	12402.68	15.03
Chilbirth and Pediatric Dispensary	39	184	1041	3948.54	4.79
Gülkent State Hospital	40	223	3686	6817.11	8.26
Eğirdir State Hospital	41	389	1964	6939.60	8.41
Keçiborlu State Hospital	42	25	0	1325.90	1.61
Senirkent State Hospital	43	36	2	1442.14	1.75
Şarkıkaraağaç State Hospital	44	50	297	1862.41	2.26
Uluborlu State Hospital	45	40	10	1491.18	1.81
Yalvaç Chilbirth and Pediatric Dispensary	46	30	0	1377.89	1.67
Yalvaç State Hospital	47	75	187	2019.93	2.45
Süleyman Demirel University Hospital	48	565	2472	9242.67	11.20
Private Isparta Hospital	49	26	0	1336.30	1.62

Table 4.17. Transfusion Process Parameters and Their Definitions

File Name	Parameter	Definition
TPP	CM	Cross-match release period in hours
TPP	CMTX	Transfusion to cross-match ratio: The ratio of transfused units to all compatibly cross-matched units
TPP	MA	Mismatch Activation Period
TPP	CCR	Cross-match compatibility ratio: The ratio of cross-match compatible units to all cross-matched units

4.3. The Simulation Model (SiModel)

A special computer simulation program has been developed. The simulator is an event-based simulation system written in C++ programming language. Object-oriented programming paradigm is used that uses "objects" and their interactions. Figure 4.5. illustrates the main classes of the model and their interactions. The simulator consists of the following modules (each module has one or more classes):

- bldMain: Program entry point.
- bldSim: Contains the Simulation class which simulates the entire chain.
- bldParams: Reads the parameters to be used by the simulation system.
- bldSimObj: Ancestor of all classes in the simulation system.
- bldBlood: Simulates the blood and some utility classes such as bloodBag.
- bldCenter: Base class of the RBC, DC and TC classes simulating the operation of RBCs, DCs and TCs respectively.
- bldRBC: Simulates the behavior of the RBCs.
- bldDC: Simulates the behavior of the DCs.
- bldTC: Simulates the behavior of the TCs.
- bldAlloc: Allocation of bloods to be transferred to DCs and TCs.
- bldPhysician: Simulates the physicians and their behavior.
- bldRequest: Requests waiting to be satisfied.
- bldStat: Statistics to be collected.
- bldRandom: Random number generators used in the program.

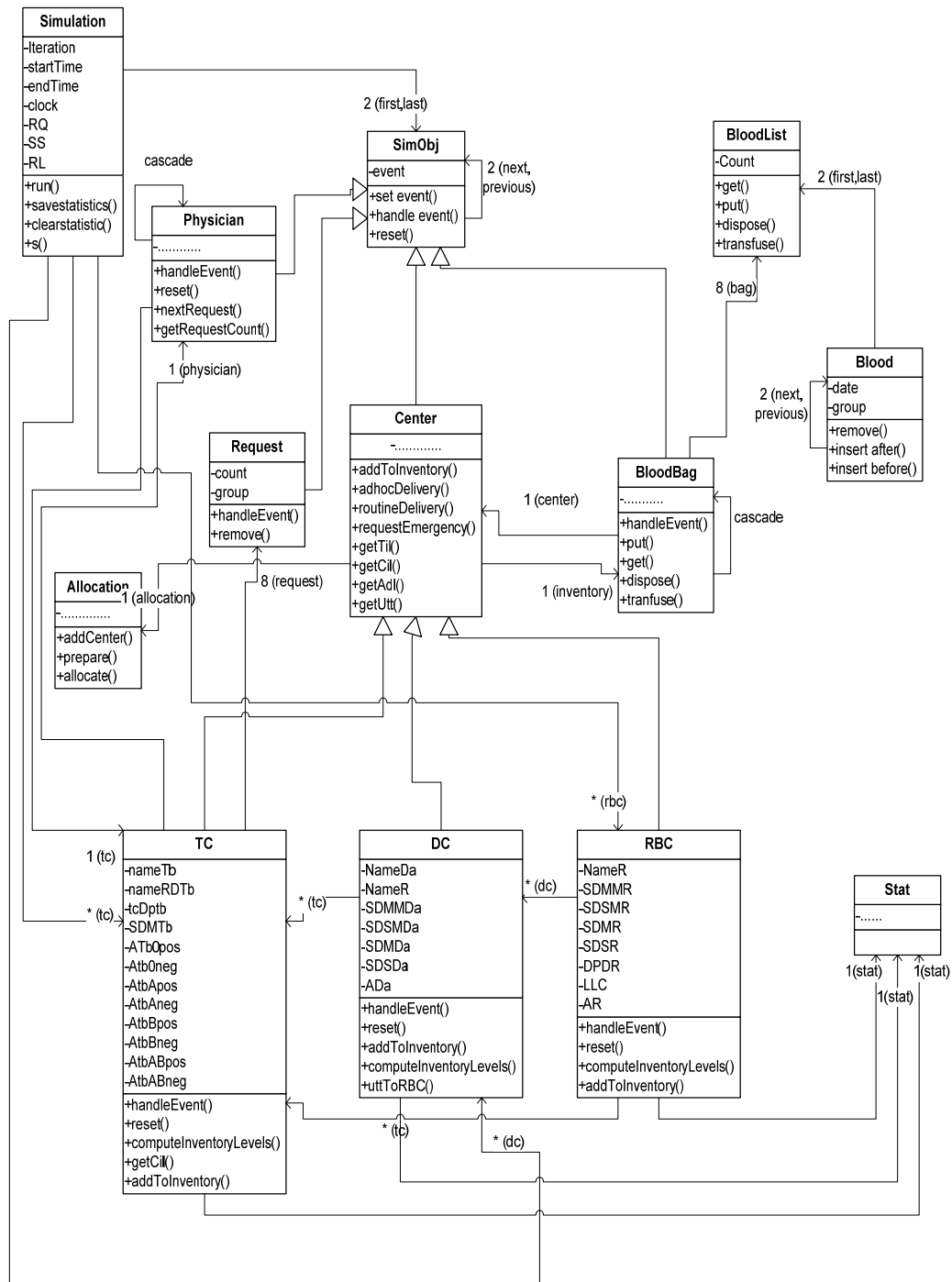


Figure 4.5. Class Diagram of the SiModel

4.3.1. Calculation of Commonly Used Values

We need the following inventory-related definitions first.

- *Inventory position*: The amount of inventory on-hand plus the amount of units sent to the center, but not arrived yet minus backordered quantities. While calculating the amount of inventory on_hand for TCs, assigned units are not taken into account. Similarly, amount of inventory on-hand for DCs and RBC are calculated by excluding the donated units that are not tested, yet.
- *Net inventory*: The amount of inventory on-hand, excluding the assigned units and not-tested units, minus backordered quantities.
- *Target inventory level*: Desirable highest inventory level. Actually, it is an 'order up to' inventory level generally used in a periodic review system.

The formulas used to calculate the parameters in the simulation model are defined in the following sections.

4.3.1.1. Target Inventory Levels

4.3.1.1.1. Target Inventory Levels of TCs

Target inventory levels of red blood cells are calculated separately for each blood group and for each TC, using the following formula:

$$TL_{bj} = [(TC\_SDMT_b) * E(r) * (BCP\_BCF_j) * TC\_At_{bj}] \quad (5)$$

where $b=1,2,\dots,49$, $j=1,\dots,8$, TL_{bj} is the target inventory level of the b^{th} TC for the j^{th} blood group, TC_SDMT_b is the average of daily requests of physician's of the b^{th} TC, $E(r)$ is the expected value of the request size, BCP_BCF_j is the blood group frequency of the j^{th} blood group, and TC_At_{bj} is the target inventory level coefficient of the b^{th} TC for the j^{th} blood group.

Actually target inventory level is the mean demand multiplied by a constant. Target inventory level is determined as an integer multiple of the daily mean blood requests of hospitals also in Katsaliaki and Brailsford (2006). Furthermore, in practice hospitals keep several days of stock in England. We try different values for TC_Atbj in simulation experiments to determine the target inventory levels at which system performs better. All request arrivals represent a doctor's orders for an individual patient. Hence, each request is for a single blood group. The distribution of requested blood groups also follows the Turkish population frequency of blood groups. Therefore, we multiply the blood group frequency with the average daily requests of physicians for all blood groups.

4.3.1.1.2. Target Inventory Levels of DCs

Target inventory levels of red blood cells are calculated separately for each blood group and for each DC, using the following formula:

$$TL_{aj} = \lceil DC\_AD_a * E(r) * \sum_{b \in S_a} [(TC\_SDMT_b) * (BCP\_BCF_j)] \rceil \quad (6)$$

where $a=1, 2, j=1, \dots, 8$, S_a is the set of TCs supplied by DC_a , TL_{aj} is the target inventory level of the a^{th} DC for the j^{th} blood group, TC_SDMT_b is the daily mean of physician's red blood cell requests of the b^{th} TC, $E(r)$ is the expected value of the request size, BCP_BCF_j is the blood group frequency of the j^{th} blood group, and DC_AD_a is the target inventory level coefficient of the a^{th} DC for the j^{th} blood group.

4.3.1.1.3. Target Inventory Levels of RBC

Target inventory levels of red blood cells are calculated separately for each blood group, using the following formula:

$$TL_j = \lceil \sum_{b \in R} [(TC\_SDMT_b) * E(r) * (BCP\_BCF_j)] * RBC\_AR \rceil \quad (7)$$

where $j=1,\dots,8$, R is the set of TCs supplied by the RBC , TL_j is the target inventory level of RBC for the j^{th} blood group, TC_SDMT_b is the daily mean of physician's red blood cell requests of the b^{th} TC, $E(r)$ is the expected value of the request size, BCP_BCF_j is the blood group frequency of the j^{th} blood group, and RBC_AR is the target inventory level coefficient of RBC for the j^{th} blood group

4.3.1.2. Reorder Points for Ad-hoc Deliveries

The reorder points for ad-hoc deliveries define the limits for replenishment of inventory for ad-hoc deliveries.

4.3.1.2.1. Reorder Points of TCs for Ad-hoc Deliveries

Reorder points for ad-hoc deliveries are calculated separately for each blood group and for each TC, by using the formula given below:

$$AHL_{bj} = TL_{bj} * IAPP\_ADPT \quad (8)$$

where $b=1,2,\dots,49$, $j=1,\dots,8$, AHL_{bj} is the reorder point of the b^{th} TC for the j^{th} blood group for ad-hoc deliveries, TL_{bj} is the target inventory level of the b^{th} TC for the j^{th} blood group, and $IAPP\_ADPT$ is the ad-hoc delivery coefficient for TCs and gets values between 0 and 1.

4.3.1.2.2. Reorder Points of DCs for Ad-Hoc Deliveries

Reorder points for ad-hoc deliveries are calculated separately for each blood group and for each DC, by using the formula given below:

$$AHL_{aj} = TL_{aj} * IAPP\_ADPD \quad (9)$$

where $a=1,2$, $j=1,\dots,8$, AHL_{aj} is the reorder point of the a^{th} DC for the j^{th} blood group for ad-hoc deliveries, TL_{aj} is the target inventory level of the a^{th} DC for the j^{th}

blood group, and $IAPP\_ADPD$ is ad-hoc delivery coefficient for DCs and gets values between 0 and 1.

4.3.1.3. Reorder Points of TCs for Routine Deliveries

The reorder points for routine deliveries define the limits for replenishment of inventory for routine deliveries. Reorder points are calculated separately for each blood group and for each TC, by using the formula given below:

$$RDL_{bj} = TL_{bj} * IAPP\_RDP \quad (10)$$

where $b=1,2,\dots,49$, $j=1,\dots,8$, RDL_{bj} is the reorder point of the b^{th} TC for routine deliveries for the j^{th} blood group, TL_{bj} is the target inventory level of the b^{th} TC for the j^{th} blood group, and $IAPP\_ARDP$ is the routine delivery coefficient for TCs and gets values between 0 and 1.

4.3.1.4. Upper Inventory Limits

DCs send excess units to RBC, and RBC sends excess units to another region, when their inventory levels reach the upper inventory limits.

4.3.1.4.1. Upper Inventory Limits of DCs for Transfers to RBC

Upper inventory limits of DCs are calculated separately for each blood group, for each DC, by using the formula given below:

$$UIL_{aj} = TL_{aj} * IAPP\_Hd \quad (11)$$

where $a=1,2$, $j=1,\dots,8$, UIL_{aj} is the upper inventory limit of the DC_a for the j^{th} blood group, TL_{aj} is the target inventory level of the DC_a for the j^{th} blood group, and $IAPP\_Hd$ is the upper inventory limit coefficient of DCs .

4.3.1.4.2. Upper Inventory Limits of RBC for Transfers to Other Regions

Upper inventory limits of RBCs are calculated separately for each blood group, by using the formula given below:

$$UIL_j = TL_j * IAPP\_RHd \quad (12)$$

where $j=1,\dots,8$, UIL_j is the upper inventory limit of RBC for the j^{th} blood group, TL_j is the target inventory level of RBC for the j^{th} blood group, and $IAPP\_RHd$ is the upper inventory limit coefficient of RBC.

4.3.1.5. Lower Inventory Limits of RBC for Ad-Hoc Deliveries

If RBC's inventory is greater than or equal to the lower inventory limits, transfers are made to DCs, else not. Lower inventory limits of RBC are calculated separately for each blood group, by using the formula given below:

$$LIL_j = TL_j * RBC\_LLC \quad (13)$$

where $j=1,\dots,8$, LIL_j is the lower inventory limit of RBC for the j^{th} blood group, TL_j is the target inventory level of RBC for the j^{th} blood group, and RBC_LLC is the RBC lower limit coefficient for the transfers to the DCs and gets values between 0 and 1.

4.3.1.6. Units Needed to be Transferred

The number of units needed to be transferred to replenish the inventory of TCs and DCs, and the amount of excess units to be transferred from DC to RBC or from RBC to another region are calculated at the time of deliveries.

4.3.1.6.1. Units Needed to be Transferred to TCs

Units needed to be transferred to replenish the inventory of TCs are calculated separately for each blood group, for each TC and for each delivery, by the formulas given below:

for routine deliveries;

$$UT_{bj} = \begin{cases} TL_{bj} - IP_{bj}, & \text{if } TL_{bj} > 0 \text{ and } IP_{bj} \leq RDL_{bj} \\ 0, & \text{else} \end{cases} \quad (14)$$

for ad-hoc deliveries;

$$UT_{bj} = \begin{cases} TL_{bj} - IP_{bj}, & \text{if } TL_{bj} > 0 \text{ and } IP_{bj} \leq AHL_{bj} \\ 0, & \text{else} \end{cases} \quad (15)$$

where $b=1,2,\dots,49$, $j=1,\dots,8$, UT_{bj} is the units needed to be transferred to the b^{th} TC for the j^{th} blood group at the time of the delivery, TL_{bj} is the target inventory level of the b^{th} TC for the j^{th} blood group, IP_{bj} is the inventory position of the j^{th} blood group of the b^{th} TC at the time of delivery, RDL_{bj} is the reorder point of the b^{th} TC for routine deliveries for the j^{th} blood group, and AHL_{bj} is the reorder point of the b^{th} TC for the j^{th} blood group for ad-hoc deliveries.

4.3.1.6.2. Units Needed to be Transferred to DCs

Units needed to be transferred to replenish the inventory of DCs are calculated separately for each blood group, for each DC and for each delivery, by using the formula given below:

$$UT_{aj} = \begin{cases} TL_{aj} - IP_{aj} & \text{if } IP_{aj} \leq AHL_{aj} \\ 0, & \text{else} \end{cases} \quad (16)$$

where $a=1,2, \dots, j=1, \dots, 8$, UT_{aj} is the units needed to be transferred to the DC_a for the j^{th} blood group at the time of delivery, TL_{aj} is the target inventory level of the DC_a for the j^{th} blood group, IP_{aj} is the inventory position of the j^{th} blood group of the DC_a at the time of delivery, and AHL_{aj} is the reorder point of the DC_a for the j^{th} blood group for ad-hoc deliveries.

4.3.1.6.3. Units Needed to be Transferred to RBC

Units needed to be transferred to RBC from a DC are calculated separately for each blood group, for each DC, by the formula given below:

$$UTR_{aj} = \begin{cases} TL_{aj} * IAPP\_Sd & \text{if } NI_{aj} > UIL_{aj} \\ 0, & \text{else} \end{cases} \quad (17)$$

where $a=1,2, j=1, \dots, 8$, UTR_{aj} is the number of units needed to be transferred to RBC from DC_a of the j^{th} blood group at the time of delivery, UIL_{aj} is the upper inventory limit of the DC_a for the j^{th} blood group, NI_{aj} is net inventory level of the DC_a for the j^{th} blood group at the time of delivery, TL_{aj} is the target inventory level of the DC_a for the j^{th} blood group, and $IAPP\_Sd$ is the excess amount coefficient of DCs .

4.3.1.6.4. Units Needed to be Transferred to Other Regions

Units needed to be transferred to other regions are calculated separately for each blood group, by the formula given below:

$$UTR_j = \begin{cases} TL_j * IAPP\_RSd & \text{if } NI_j > UIL_j \\ 0, & \text{else} \end{cases} \quad (18)$$

where $j = 1, \dots, 8$, UTR_j is the number of units needed to be transferred to other regions of j^{th} blood group at the time of delivery, UIL_j is the upper inventory limit of RBC for the j^{th} blood group, NI_j is net inventory level of RBC for the j^{th} blood group at the time of delivery, TL_j is the target inventory level of RBC for the j^{th} blood group, and $IAPP\_RSd$ is the excess amount coefficient of RBC.

4.3.1.7. Transferable Inventory Levels

While calculating transferable inventory levels, some restrictions are checked at the time of delivery; such as age restrictions and lower limit restrictions.

4.3.1.7.1. Transferable Inventory Levels of RBC for Ad-hoc Deliveries

Transferable inventory levels of RBC are calculated separately for each blood group, for each delivery by using the formula given below:

$$TIL_j = \begin{cases} YU_j, & \text{If } YU_j < (NI_j - LIL_j) \\ NI_j - LIL_j & \text{else} \end{cases} \quad (19)$$

where $j = 1, \dots, 8$, TIL_j is the transferable inventory level of RBC for the j^{th} blood group at the time of delivery, LIL_j is the lower inventory limit of RBC for the j^{th} blood group, NI_j is net inventory level of RBC for the j^{th} blood group at the time of delivery, YU_j is the number of units of the j^{th} blood group in RBC inventory which are younger than BDP_MASD at the time of delivery, and BDP_MASD is the maximum age of the units to be transferred to DCs, which is an absolute value.

4.3.1.7.2 Transferable Inventory Levels of DCs for Transfers to RBC

Transferable inventory levels of DCs are calculated separately for each blood group, for each TC, for each delivery, by using the formula given below:

$$TIL_{aj} = \begin{cases} YU_{aj}, & \text{If } YU_{aj} < UTR_{aj} \\ UTR_{aj} & \text{else} \end{cases} \quad (20)$$

where $a=1,2$, $j =1,\dots,8$, UTR_{aj} is the number of units needed to be transferred to RBC from DC_a of the j^{th} blood group at the time of delivery, TIL_{aj} is the transferable inventory level of the DC_a for the j^{th} blood group at the time of delivery, YU_{aj} is the number of units of the j^{th} blood group in DC_a inventory which are younger than BDP_MASR at the time of delivery, and BDP_MASR is the maximum age of the units to be transferred to RBC, which is an absolute value.

4.3.1.7.3. Transferable Inventory Levels of RBC for Transfers to Other Regions

Transferable inventory levels of RBC are calculated separately for each blood group, for each delivery, by using the formula given below:

$$TILO_j = \begin{cases} YU_j, & \text{If } YU_j < UTR_j \\ UTR_j & \text{else} \end{cases} \quad (21)$$

where $j =1,\dots,8$, $TILO_j$ is the transferable inventory level of RBC of the j^{th} blood group for transfers to other regions at the time of delivery, UTR_j is the number of units needed to be transferred to other regions of the j^{th} blood group at the time of delivery, YU_j is the number of units of the j^{th} blood group in RBC inventory which are younger than BDP_MASI at the time of delivery, and BDP_MASI is the maximum age of the units that can be transferred to other regions.

4.3.1.8. Supply Indices

Supply indices are used to calculate supply index ratios which define the rules of allocating aged units to TCs and DCs in order to share the risk of outdated between centers.

4.3.1.8.1. Supply Indices of TCs

Supply indices of TCs are calculated separately for each blood group, for each TC and for each delivery, by using the formula given below:

$$SI_{bj} = UT_{bj} / \sum_{b \in F_b} UT_{bj} \quad (22)$$

where $b=1,2,\dots,49$, $j=1,\dots,8$, SI_{bj} is the supply index of the b^{th} TC for the j^{th} blood group at the time of delivery, UT_{bj} is the units needed to be transferred to the b^{th} TC for the j^{th} blood group at the time of delivery, and F_b is the set of TCs which are supplied by the same DC or RBC with the b^{th} TC.

4.3.1.8.2. Supply Indices of DCs

Supply indices of DCs are calculated separately for each blood group, for each DC and for each delivery, by using the formula given below:

$$SI_{aj} = UT_{aj} / \sum_{a=1}^2 UT_{aj} \quad (23)$$

where $a=1,2$, $j=1,\dots,8$, SI_{aj} is the supply index of the DC_a for the j^{th} blood group at the time of delivery, UT_{aj} is the units needed to be transferred to the DC_a at the time of delivery for the j^{th} blood group

4.3.1.9. Supply Index Ratios

4.3.1.9.1. Supply Index Ratios of TCs

Supply index ratios of TCs are calculated separately for each blood group, for each TC and for each delivery, by applying the following steps.

4.3.1.9.1.1. TCs Supplied by a DC

a. Find $MSI_{aj} = \min_{b \in S_a} \{SI_{bj}\}$ (24)

where $a=1,2$, $j=1,\dots,8$, MSI_{aj} is the minimum supply index ratio of TCs supplied by the DC_a for the j^{th} blood group at the time of delivery, SI_{bj} is the supply index of the b^{th} TC for the j^{th} blood group at the time of delivery, and S_a is the set of TCs supplied by the DC_a .

b. Calculate $SIR_{bj} = \lfloor SI_{bj} / MSI_{aj} \rfloor$ (25)

where $a=1,2$, $b \in S_a$, $j=1,\dots,8$, SI_{bj} is the supply index of the b^{th} TC for the j^{th} blood group at the time of delivery, SIR_{bj} is the supply index ratio of the b^{th} TC for the j^{th} blood group at the time of delivery, and S_a is the set of TCs supplied by DC_a .

4.3.1.9.1.2. TCs Supplied by RBC

a. Find $MSI_j = \min_{b \in R} \{SI_{bj}\}$ (26)

where $j=1,\dots,8$, MSI_j is the minimum supply index ratio of TCs supplied by RBC for the j^{th} blood group at the time of delivery, SI_{bj} is the supply index of the b^{th} TC for the j^{th} blood group at the time of delivery, and R is the set of TCs supplied by RBC.

$$b. \text{ Calculate } SIR_{bj} = \lfloor SI_{bj} / MSI_j \rfloor \quad (27)$$

where $b \in R$, $j = 1, \dots, 8$, SI_{bj} is the supply index of the b^{th} TC for the j^{th} blood group at the time of delivery, SIR_{bj} is the supply index ratio of the b^{th} TC for the j^{th} blood group at the time of delivery, and R is the set of TCs supplied by RBC .

4.3.1.9.2. Supply Index Ratios of DCs

Supply index ratios of DCs are calculated separately for each blood group, for each DC and for each delivery, by applying the following steps:

$$a. \text{ Find } MSID_j = \min_{a=1,2} \{SI_{aj}\} \quad (28)$$

where $j = 1, \dots, 8$, $MSID_j$ is the minimum supply index ratio of DCs for the j^{th} blood group at the time of delivery, and SI_{aj} is the supply index of the DC_a for the j^{th} blood group at the time of delivery.

$$b. \text{ Calculate } SIR_{aj} = \lfloor SI_{aj} / MSID_j \rfloor \quad (29)$$

where $a=1,2$, $j = 1, \dots, 8$, SI_{aj} is the supply index of the DC_a for the j^{th} blood group at the time of delivery, SIR_{aj} is the supply index ratio of the DC_a for the j^{th} blood group at the time of delivery, and $MSID_j$ is the minimum supply index ratio of DCs for the j^{th} blood group at the time of delivery.

4.3.1.10. Supply Ratios

These ratios indicate whether available or transferable units of the supplier centers are enough to fulfill the blood needs of centers. Supply ratios which are less than 1, indicate that blood needs of centers can not be satisfied completely.

4.3.1.10.1. General Supply Ratios

General supply ratios are calculated separately for each blood group, for each TC and RBC, by using the following formulas:

4.3.1.10.1.1. General Supply Ratio of RBC

$$GSR_j = NI_j / \sum_{b \in R_b} UT_{bj} \quad (30)$$

where $j=1, \dots, 8$, GSR_j is the general supply ratio of RBC for the j^{th} blood group at the time of delivery, NI_j is net inventory level of RBC for the j^{th} blood group at the time of delivery, UT_{bj} is the units needed to be transferred to the b^{th} TC for the j^{th} blood group at the time of delivery, and R is the set of TCs supplied by RBC.

4.3.1.10.1.2. General Supply Ratio of DCs

$$GSR_{aj} = NI_{aj} / \sum_{b \in S_a} UT_{bj} \quad (31)$$

where $j=1, \dots, 8$, GSR_{aj} is the general supply ratio of the DC_a for the j^{th} blood group at the time of delivery, NI_{aj} is net inventory level of the DC_a for the j^{th} blood group at the time of delivery, UT_{bj} is the units needed to be transferred to the b^{th} TC for the j^{th} blood group at the time of delivery and S_a is the set of TCs supplied by DC_a .

4.3.1.10.2. DC Supply Ratios of RBC

DC supply ratios of RBC are calculated separately for each blood group for each delivery, by using the following formula:

$$GSRD_j = TILO_j / \sum_{a=1}^2 UT_{aj} \quad (32)$$

where $j=1,\dots,8$, $GSRD_j$ is the DC supply ratio of RBC for the j^{th} blood group at the time of delivery, TIL_j is the transferable inventory level of RBC for the j^{th} blood group at the time of delivery, and UT_{aj} is the units needed to be transferred to DC_a for the j^{th} blood group at the time of delivery.

4.3.1.11. Run-out Allocation

If blood needs of all centers can not be satisfied completely at the time of delivery, amount of units needed to be transferred to centers is reduced using supply ratios in order to share the risks among centers.

4.3.1.11.1. Run-out Allocation (Transfers to TCs)

Reduced numbers of units needed to be transferred to replenish the inventory of TCs are calculated separately for each blood group, for each TC and for each delivery, by using the formulas given below:

4.3.1.11.1.1. TCs Supplied by RBC

$$RUT_{bj} = \begin{cases} UT_{bj} & \text{if } GSR_j \geq 1 \\ \lfloor UT_{bj} * GSR_j \rfloor & \text{else} \end{cases} \quad (33)$$

where $j=1,\dots,8$, $b \in R$, RUT_{bj} is the reduced number of units needed to be transferred to the b^{th} TC for the j^{th} blood group at the time of delivery, GSR_j is the general supply ratio of RBC for the j^{th} blood group at the time of delivery, UT_{bj} is the units needed to be transferred to the b^{th} TC for the j^{th} blood group at the time of delivery, and R is the set of TCs supplied by RBC.

4.3.1.11.1.2. TCs Supplied by DCs

$$RUT_{bj} = \begin{cases} UT_{bj} & \text{if } GSR_{aj} \geq 1 \\ \lfloor UT_{bj} * GSR_{aj} \rfloor & \text{else} \end{cases} \quad (34)$$

where $j = 1, \dots, 8$, $b \in S_a$, RUT_{bj} is the reduced number of units needed to be transferred to the b^{th} TC for the j^{th} blood group at the time of delivery, GSR_{aj} is the general supply ratio of the DC_a for the j^{th} blood group at the time of delivery, UT_{bj} is the units needed to be transferred to the b^{th} TC for the j^{th} blood group at the time of delivery, and S_a is the set of TCs supplied by DC_a .

4.3.1.11.2. Run-out Allocation (Transfers to DCs)

Reduced numbers of units needed to be transferred to replenish the inventory of DCs are calculated separately for each blood group, for each DC and for each delivery, by using the formula given below:

$$RUT_{aj} = \begin{cases} UT_{aj} & \text{if } GSRD_j \geq 1 \\ \lfloor UT_{aj} * GSRD_j \rfloor & \text{else} \end{cases} \quad (35)$$

where $j = 1, \dots, 8$, RUT_{aj} is the reduced number of units needed to be transferred to the DC_a for the j^{th} blood group at the time of delivery, $GSRD_j$ is the DC supply ratio of RBC for the j^{th} blood group at the time of delivery, and UT_{aj} is the units needed to be transferred to the DC_a for the j^{th} blood group at the time of delivery.

4.3.1.12. Inventory Availability Indices of TCs

Inventory availability indices of TCs are calculated separately for each blood group, for each TC, by using the formula given below:

$$IVI_{bj} = NI_{bj} / TL_{bj} \quad (36)$$

where $b=1,2,\dots,49$, $j=1,\dots,8$, IVI_{bj} is the availability index of the b^{th} TC for the j^{th} blood group at the time of delivery, TL_{bj} is the target inventory of the b^{th} TC for the j^{th} blood group at the time of delivery, and NI_{bj} is net inventory level of the b^{th} TC for the j^{th} blood group at the time of delivery.

4.3.2. Descriptions of the Processes of the Simulation Model

The main processes of the model can be categorized into five sub-models; (i) Center Creation and Determining Run Characteristics sub-model, (ii) RBC sub-model, (iii) DC sub-model, (iv) TC sub-model, (v) Calculate Statistics sub-model. Context and Level 1 data flow diagrams illustrating the main processes of the simulation model are given in Figure 4.6. and Figure 4.7., respectively.

4.3.2.1. Center Creation and Determining Run Characteristics Sub Model

Centers are created and the hierarchy between centers is formed using the following parameters: (i) RBC_NameR , (ii) DC_NameD_a , (iii) DC_NameR , (iv) TC_NameT_b , and (v) $TC\_NameRDT_b$. Simulation is carried out in compatibility with the following simulation run parameters to mimic the supply chain: (i) The number of replications of each policy (SRP_RQ), (ii) Number of days needed to reach steady-state (warm-up period) (SRP_SS), (iii) Run length of each run (SRP_RL). Each run is executed for ($SRP\_RL + SRP\_SS$) days, but the statistics obtained until system reaches the steady-state is not taken into consideration. While calculating statistics, only the SRP_RL days after reaching the steady state is considered for each run. Model is executed SRP_RQ times for the same model configuration parameters.

4.3.2.2. RBC Sub Model

Level 2 - Data Flow Diagram of RBC sub-model is given in Figure 4.8.

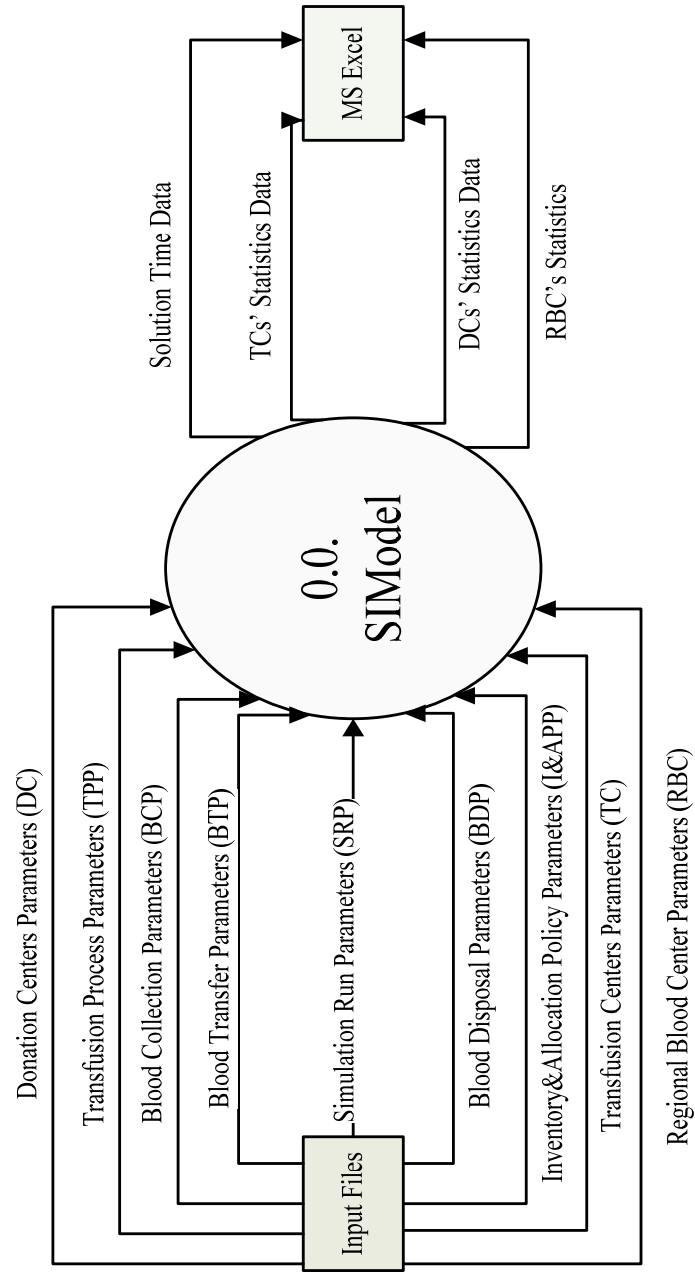


Figure 4.6. Context Diagram of the Simulation Model

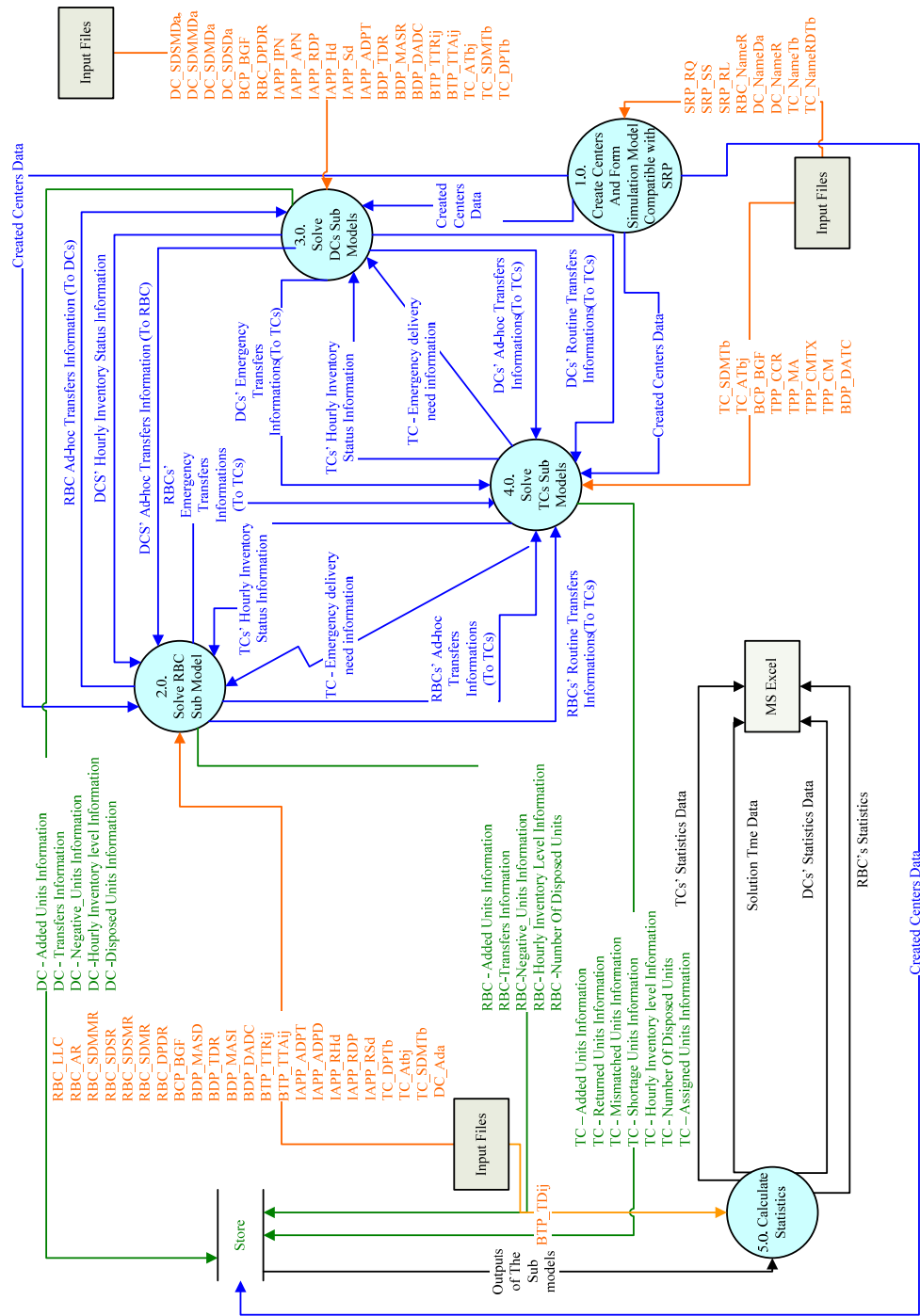


Figure 4.7. Level 1 Data Flow Diagram

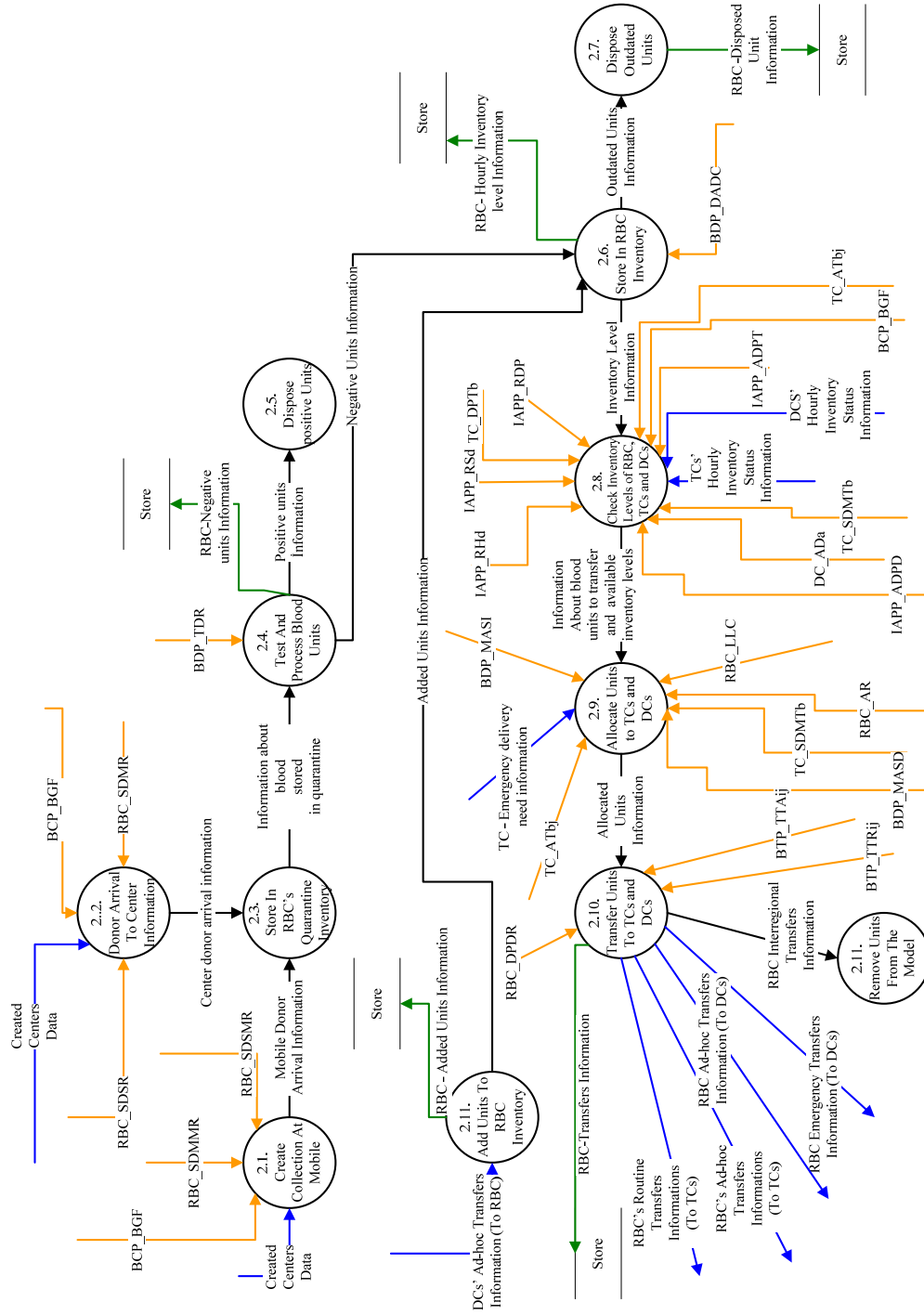


Figure 4.8. Level 2 - Data Flow Diagram of RBC Sub-model

4.3.2.2.1. Create Collections

Whole blood collections of RBC are created from two different resources: (i) Mobile Collections, (ii) Center Collections.

4.3.2.2.1.1. Create Collection at Mobile Units

Donations at mobile units follow a normal distribution and are created by using the following parameters RBC_SDMMR (Statistical distribution-mean for mobile collections of RBC) and RBC_SDSMR (Statistical distribution-standard deviation for mobile collections of RBC). Donated units are classified to blood groups using the probability distribution of BCP_BGF (Blood group frequency).

4.3.2.2.1.2. Create Collections at Center

Donations at center also follow a normal distribution and are created by using the following parameters RBC_SDMR (Statistical distribution-mean for center collections of RBC) and RBC_SDSR (Statistical distribution-standard deviation for center collections of RBC). Donated units are classified to blood groups using the probability distribution of BCP_BGF (Blood group frequency).

4.3.2.2.2. Store in Quarantine Inventory

Donated units either at the centers or the mobile units are stored in quarantine inventory until 12:00 a.m. on the next day when the tests of units are completed.

4.3.2.2.3. Test and Process of Blood Units

Whole Blood is separated into components (red blood cells, plasma and platelet concentrates). Components except the red blood cells are discarded from the model as we only consider the red blood cell component. Blood samples are tested against the infectious diseases which can be transmitted through blood transfusion. Each

component has a probability, equal to the value specified as BDP_TDR (Test disposal rate of blood units), of being disposed because of positive test results. Units which are negative (contain no viral markers of infectious diseases) are stored in the RBC inventory. The number of negative units are classified by blood groups and recorded.

4.3.2.2.4. Disposal of Positive Units

Units that are found to be positive are removed from the model because of being disposed.

4.3.2.2.5. Store in RBC Inventory

Every hour inventory level of each blood group is checked, and recorded. Each day at 08:00 a.m. the age of stored units in the RBC inventory is checked and the units at the age of BDP_DADC (Disposal age of units at DCs and RBC) are disposed because of outdating.

4.3.2.2.6. Dispose Outdated Units

Model counts the outdated units by the blood groups. Then outdated units are removed from the model.

4.3.2.2.7. Check Inventory levels of RBC, DCs and TCs

4.3.2.2.7.1. Inventory Check for Routine Deliveries

Inventory check for routine delivery is done at 13:00 o'clock periodically. Period is p days, which is specified separately for each TC in TC_DPT_b (Periodic review period for routine deliveries to TC). Inventory check for routine delivery is done only for TCs which have a review time corresponding to the current day. The units

needed to be transferred to each TC are calculated using the values at the time of delivery by the formula (14).

4.3.2.2.7.2. Inventory Check for Ad-Hoc Delivery

4.3.2.2.7.2.1. TCs

Inventory check for ad-hoc delivery is done every hour. The units needed to be transferred to each TC are calculated using the values at the time of delivery by the formula (15).

4.3.2.2.7.2.2. DCs

Inventory check for ad-hoc delivery is done at 13:30 o'clock each day. The units needed to be transferred to each DC are calculated using the values at the time of delivery by the formula (16).

4.3.2.2.7.3. Inventory Check for Inter-Regional Delivery

Inventory check for interregional delivery is done at 14:30 each day. Units needed to be transferred to other regions are calculated using the values at time of delivery by the formula (18).

4.3.2.2.8. Allocate Units to TCs and DCs

4.3.2.2.8.1. Calculation of the Amounts to be Sent

Priority is given to emergency deliveries. Allocation for ad-hoc, routine or interregional deliveries is done after the allocation of the units for emergency deliveries. Two alternative policies, for ad-hoc and routine deliveries, are used to calculate the amounts to be sent. The policy to use is determined by the value of the parameter IAPP_APN (Allocation method number).

4.3.2.2.8.1.1. Ad-Hoc or Routine Deliveries to TCs

4.3.2.2.8.1.1.1. Allocation Method 0

The amounts to be sent to TCs (US_{bj}) are equal to the reduced numbers of units needed to be transferred to TCs, which are calculated using the values at the time of delivery by the formula (33).

4.3.2.2.8.1.1.1. Allocation Method 1

Let:

$j=1,2,\dots,8$, $b \in R$, R be the set of TCs supplied by RBC, US_{bj} be the number of units to send to the b^{th} TC for the j^{th} blood group, IP_{bj} be the inventory position of the b^{th} TC for the j^{th} blood group at the time of delivery, and TL_{bj} be the target inventory level of the b^{th} TC for the j^{th} blood group .

The amounts to be sent to TCs are calculated in the following way:

0. Begin
1. $US_{bj}=0$
2. $j=0$
3. Set $j=j+1$
4. Calculate IP_{bj}/TL_{bj}
5. Find the TC_b which has the smallest IP_{bj}/TL_{bj} value
6. Add 1 to IP_{bj} value of the TC_b which has the smallest IP_{bj}/TL_{bj} value ($IP_{bj} = IP_{bj} + 1$) (b = the number of the TC_b which has the smallest IP_{bj}/TL_{bj} value)
7. Subtract 1 from net inventory of j^{th} blood group in RBC
8. Add 1 to US_{bj} value of the TC_b which has the smallest IP_{bj}/TL_{bj} value ($US_{bj} = US_{bj} + 1$) (b = the number of the TC_b which has the smallest IP_{bj}/TL_{bj} value)
9. Repeat 4-8 until net inventory of j^{th} blood group in RBC is finished or all (IP_{bj}/TL_{bj}) values for the j^{th} blood group are equal to one.

10. If $j < 8$ go to step 3, else end.

In allocation method 0, priority is given to the blood needs of centers at the time of delivery. However, in allocation method 1, allocation is done based on the blood needs of TCs in the long term (using target inventory levels). We try to share the risks of mismatching and outdating among centers by making IP_{bj}/TL_{bj} values of TCs closer to each other.

4.3.2.2.8.1.2. Ad-hoc Deliveries to DCs

4.3.2.2.8.1.2.1. Allocation Method 0

The amounts to be sent to DCs (US_{aj}) are equal to reduced numbers of units needed to be transferred to DCs, which are calculated using the values at the time of delivery by the formula (35).

4.3.2.2.8.1.2.2. Allocation Method 1

Let:

$j=1,2,\dots,8$, $a=1,2$, US_{aj} be the number of units to send to the DC_a for the j^{th} blood group, IP_{bj} be the inventory position of the DC_a for the j^{th} blood group at the time of delivery, and TL_{aj} be the target inventory level of the DC_a for the j^{th} blood group.

The amounts to be sent to DCs are calculated in the following way:

0. Begin
1. $US_{aj}=0$
2. $j=0$
3. Set $j=j+1$
4. Calculate IP_{aj}/TL_{aj}
5. Find the DC which has the smallest IP_{aj}/TL_{aj} value
6. Add 1 to IP_{aj} value of the DC_a which has the smallest IP_{aj}/TL_{aj} value ($IP_{aj} = NI_{aj} + 1$) (b = the number of the DC_a which has the smallest IP_{aj}/TL_{aj} value)

7. Subtract 1 from net inventory of j^{th} blood group in RBC
8. Add 1 to US_{aj} value of the DC_a which has the smallest IP_{aj}/TL_{aj} value ($US_{aj} = US_{aj} + 1$) ($b =$ the number of the DC_a which has the smallest IP_{aj}/TL_{aj} value)
9. Repeat 4-8 until net inventory of j^{th} blood group in RBC is finished or all (IP_{aj}/TL_{aj}) values for the j^{th} blood group are equal to one
10. If $j < 8$ go to step 3, else end.

4.3.2.2.8.1.3. Interregional Deliveries to Other Regions

The amounts to be sent to other regions are equal to the transferable inventory levels of RBC for transfer to other regions ($TILO_j$), which are calculated using the values at the time of delivery by the formula (21).

4.3.2.2.8.1.4. Emergency Deliveries to TCs

No ad-hoc or routine delivery is done to the TC_b for the j^{th} blood group if TL_{bj} value is equal to zero. In this case, when a requisition is placed by the physicians in TC_b for the blood group j , an emergency delivery is needed for the TC_b , if IP_{bj} is less than zero after the requisition is replaced. The number of units to send to the TC_b for the j^{th} blood (USE_{bj}) group with emergency delivery is calculated using the values at the time after the requisition is placed.

$$USE_{bj} = \begin{cases} |IP_{bj}| & \text{if } IP_{bj} \leq NI_j, TL_{bj} = 0 \text{ and } IP_{bj} < 0, \\ |NI_j| & \text{if } IP_{bj} > NI_j, TL_{bj} = 0 \text{ and } IP_{bj} < 0, \\ 0 & \text{else} \end{cases} \quad (37)$$

where $j=1,2,\dots,8$, $b \in R$, R is the set of TCs supplied by RBC, IP_{bj} is the inventory position of the TC_b for the j^{th} blood, TL_{bj} is the target inventory level of the TC_b for the j^{th} blood, and NI_j is the net inventory level of RBC for the j^{th} blood at the time after requisition is placed.

4.3.2.2.8.2. Issuing Methods Used To Allocate Units

An issuing method is used to allocate the aged units. The policy to use for ad-hoc and routine deliveries is determined by the value of the parameter $IAPP\_IPN$ (Issuing method number). If this parameter is set to 0, this means Issuing Method 0 is used, otherwise Issuing Method 1 is used.

4.3.2.2.8.2.1. Ad-Hoc or Routine Deliveries to TCs

4.3.2.2.8.2.1.1. Issuing Method 0

Let:

where $j=1,2,\dots,8$, $b \in R$, R be the set of TCs supplied by RBC , US_{bj} be the number of units to send to the b^{th} TC for the j^{th} blood group, NAU_{bj} be the number of allocated units to the b^{th} TC for the j^{th} blood group, and SIR_{bj} be the supply index ratio of the b^{th} TC for the j^{th} blood group at the time of delivery.

Allocation of the aged units is done in the following way:

0. Begin
1. $j=0$
2. Set $j=j+1$
3. $NAU_{bj}=0$
4. Calculate (SIR_{bj}) using the values at the time of the delivery and the formula (27)
5. Order TCs by the descending (SIR_{bj}) values. Let i be the ordering index number such that the smallest i value corresponds to the TC which has the highest SIR_{bj} value, $i=1,2,\dots, |R|$
6. $i=1$
7. if $NAU_{bj} < US_{bj}$ for the i^{th} indexed TC_b for j^{th} blood group, then allocate oldest j^{th} blood grouped units at the amount of $[min= \{ SIR_{bj}, US_{bj} - NAU_{bj} \}]$

and $NAU_{bj} = NAU_{bj} + [\min = \{ SIR_{bj}, US_{bj} - NAU_{bj} \}]$, else do not allocate any units

8. $i=i+1$
9. Repeat 7-8 until $i=|R|$
10. Repeat 6-9 until $NAU_{bj} = US_{bj}$.
11. If $j < 8$ go to step 2, else end.

4.3.2.2.8.2.1.2. Issuing Method 1

Let:

where $j=1,2,\dots,8$, $b \in R$, R be the set of TCs supplied by RBC, US_{bj} be the number of units to send to the b^{th} TC for the j^{th} blood group at the time of delivery, and TL_{bj} be the target inventory level of the b^{th} TC for the j^{th} blood group.

Allocation of the aged units is done in the following way:

0. Begin
1. $j=0$
2. Set $j=j+1$
3. Calculate (TL_{bj}) using the formula (5)
4. Order TCs by descending TL_{bj} values. Let i be the ordering index number such that the smallest i value corresponds to the TC which has the highest TL_{bj} value, $i=1,2,\dots, |R|$
5. $i=1$
6. Allocate oldest $|US_{bj}| j^{th}$ blood grouped units to i^{th} indexed TC_b
7. $i=i+1$
8. Repeat 6-8 until $i=|R|$
9. If $j < 8$ go to step 2, else end.

4.3.2.2.8.2.2. Ad-Hoc Deliveries to DCs

4.3.2.2.8.2.2.1. Issuing Method 0

Let:

where $j=1,2,\dots,8$, $a=1,2$, US_{aj} be the number of units to send to the DC_a for the j^{th} blood group, NAU_{aj} be the number of allocated units to the DC_a for the j^{th} blood group, and SIR_{aj} be the supply index ratio of the DC_a for the j^{th} blood group at the time of delivery

Allocation of the aged units is done in the following way:

0. Begin
1. $j=0$
2. Set $j=j+1$
3. $NAU_{aj}=0$
4. Calculate SIR_{aj} using the values at the time of the delivery and the formula (29)
5. Order DCs by descending SIR_{aj} values. Let i be the ordering index number such that the smallest i value corresponds to the DC which has the highest SIR_{aj} value, $i=1,2$
6. $i=1$
7. if $NAU_{aj} < US_{aj}$ for the i^{th} indexed DC_a for the j^{th} blood group then allocate oldest $[min= \{ SIR_{aj}, US_{aj} - NAU_{aj} \}] j^{th}$ blood grouped units and $NAU_{aj} = NAU_{aj} + [min= \{ SIR_{aj}, US_{aj} - NAU_{aj} \}]$, else do not allocate any units
8. $i=i+1$
9. Repeat 7-8 until $i=3$
10. Repeat 6-8 until $NAU_{aj} = US_{aj}$.
11. If $j < 8$ go to step 2, else end.

4.3.2.8.2.2.2. Issuing Method 1

Let:

$j=1,2,\dots,8$, $i=1,2$, US_{aj} be the number of units to send to the DC_a for the j^{th} blood group at the time of delivery, and TL_{aj} be the target inventory level of the DC_a for the j^{th} blood group

Allocation of the aged units is done in the following way:

0. Begin
1. $j=0$
2. Set $j=j+1$
3. Calculate TL_{aj} using the formula (6).
4. Order TCs by descending TL_{aj} values. Let i be the ordering index number such that the smallest i value corresponds to the DC which has the highest TL_{aj} value, $i=1,2$
5. $i=1$
6. Allocate oldest $|US_{aj}|$ j^{th} blood grouped units to i^{th} indexed DC_a
7. $i=i+1$
8. Repeat 7-8 until $i=3$
9. If $j < 8$ go to step 2, else end.

4.3.2.8.2.3. Interregional Deliveries to Other Regions

Oldest units which are younger than BDP_MASI (the maximum age of the units to be transferred to other regions) are sent to other regions.

4.3.2.8.2.4. Emergency Deliveries to TCs

Units are sent by using FIFO policy (oldest units first).

4.3.2.3. DC Sub Model

Level 2 - Data Flow Diagram of DC sub-model is given in Figure 4.9.

4.3.2.3.1. Create Collections

Whole blood collections of DCs are created from two different resources: (i) Mobile Collections, (ii) Center Collections.

4.3.2.3.1.1. Create Collection at Mobile Units

Donations at mobile units follow a normal distribution and are created by using the parameters DC_SDMMD_a (Statistical distribution-mean for mobile collections of DC) and DC_SDSMD_a (Statistical distribution-standard deviation for mobile collections of DC). Donated units are classified to blood groups using the probability distribution of BCP_BGF (Blood group frequency).

4.3.2.3.1.2. Create Collections at the Center

Donations at the center are created in a similar manner with the ones at mobile units.

4.3.2.3.2. Store in Quarantine Inventory

Donated units either at center or mobile are stored in quarantine inventory until the day after the next day (2 days later), 12:00 a.m.

4.3.2.3.3. Test and Process of Blood Units

Processes are the same with RBC except that DC does not test blood units against infectious diseases. Blood samples are sent from DC to RBC. Test results are sent back to DC from RBC. Therefore units become ready-to-use two days after they are donated.

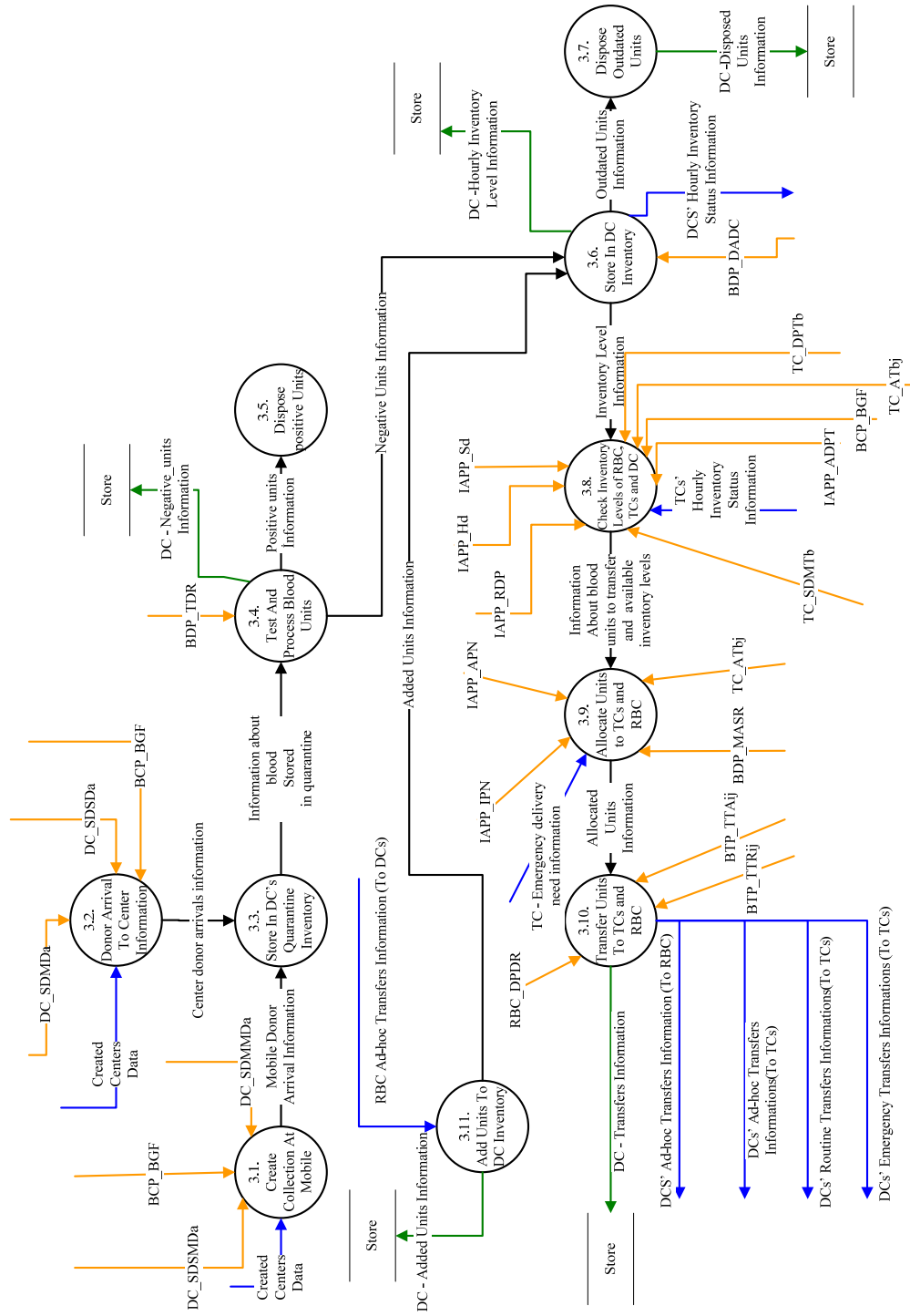


Figure 4.9. Level 2 - Data Flow Diagram of DC Sub-model

4.3.2.3.4. Dispose Positive Units

Units that are found to be positive are removed from the model because of disposing.

4.3.2.3.5. Store in DC Inventory

Every hour inventory level of each blood group is checked, and updated. Each day at 08:00 a.m. the age of the stored units in the DC inventory are checked and the units at the age of BDP_DADC (disposal age of units at DCs and RBC) are disposed because of outdating.

4.3.2.3.6. Disposal of Outdated Units

The model counts the outdated units classified by blood groups. Then outdated units are removed from the model.

4.3.2.3.7. Check Inventory levels of DC and TCs

4.3.2.3.7.1. Inventory Check for Routine Deliveries

Inventory check for routine delivery is done at 13:00 o'clock periodically. Period will be p days, which will be specified separately for each TC in TC_DPT_b (periodic review period for routine deliveries to TC). Inventory check for routine delivery is done only for TCs which have a review time corresponding to the current day. The units needed to be transferred to each TC are calculated using the values at the time of delivery by the formula (14).

4.3.2.3.7.2. Inventory Check for Ad-Hoc Delivery to TCs

Inventory check for ad-hoc delivery is done every hour. The units needed to be transferred to each TC are calculated using the values at the time of delivery by the formula (15).

4.3.2.3.7.3. Inventory Check for Ad-Hoc Delivery to RBC

Inventory check for ad-hoc delivery to RBC is done at 13:30 o'clock each day. Units needed to be transferred to RBC are calculated using the values at the time of delivery by the formula (17).

4.3.2.3.8. Allocate Units to TCs and RBC

4.3.2.3.8.1. Calculation of the Amounts to be Sent to Centers

Priority is given to emergency deliveries. If there is a need for emergency delivery not fulfilled at the time of allocation, units are first sent to TCs where an emergency delivery is needed. Two alternative policies, for ad-hoc and routine deliveries to TCs, are considered to calculate the amounts to be sent to centers. The policy to use is determined by the value of the parameter IAPP_APN (allocation method number).

4.3.2.3.8.1.1. Ad-Hoc or Routine Transfers to TCs

4.3.2.3.8.1.1.1. Allocation Method 0

The amounts to be sent to TCs (US_{bj}) are equal to the reduced numbers of units needed to be transferred to TCs, which are calculated using the values at the time of delivery by the formula (34).

4.3.2.3.8.1.1.1. Allocation Method 1

Let:

$a=1,2$ $j=1,2,\dots,8$, $b \in S_a$, S_a be the set of TCs supplied by DC_a , US_{bj} be the number of units to send to the b^{th} TC for the j^{th} blood group, IP_{bj} be the inventory position of the b^{th} TC for the j^{th} blood group at the time of delivery, and TL_{bj} be the target inventory level of the b^{th} TC for the j^{th} blood group.

The amounts to be sent to TCs are calculated in the following way:

0. Begin
1. $a=1$
2. $US_{bj}=0$
3. $j=0$
4. Set $j=j+1$
5. Calculate IP_{bj}/TL_{bj}
6. Find the TC_b which has the smallest IP_{bj}/TL_{bj} value
7. Add 1 to IP_{bj} value of the TC_b which has the smallest IP_{bj}/TL_{bj} value ($IP_{bj} = NI_{bj} + 1$) (b = the number of the TC_b which has the smallest IP_{bj}/TL_{bj} value)
8. Subtract 1 from net inventory of j^{th} blood group in DC_a
9. Add 1 to US_{bj} value of the TC_b which has the smallest IP_{bj}/TL_{bj} value ($US_{bj} = US_{bj} + 1$) (b = the number of the TC_b which has the smallest IP_{bj}/TL_{bj} value)
10. Repeat 4-8 until net inventory of j^{th} blood group in DC_a is finished or all (IP_{bj}/TL_{bj}) values for the j^{th} blood group are equal to one.
11. If $j < 8$ go to step 4, else go to step 11
12. $a=a+1$
13. If $a < 2$ go to step 2, else end

4.3.2.3.8.1.2. Ad-Hoc Transfers to RBC

The amounts to be sent to to RBC are equal to the transferable inventory levels of DCs for transfer to RBC (TIL_{aj}), which are calculated using the values at the time of delivery by the formula (20).

4.3.2.3.8.1.3. Emergency Deliveries to TCs

No ad-hoc or routine delivery is done to the TC_b for the j^{th} blood group if TL_{bj} value is equal to zero. In this case, when a requisition is placed by the physicians in TC_b for blood group j , an emergency delivery is needed for the TC_b , if NI_{bj} is less than zero after the requisition is placed. The number of units to send TC_b for the j^{th} blood (USE_{bj}) group with emergency delivery is calculated using the values at the time after the requisition is placed.

$$USE_{bj} = \begin{cases} |IP_{bj}| & \text{if } IP_{bj} \leq NI_{aj}, TL_{bj} = 0 \text{ and } IP_{bj} < 0, \\ |NI_{aj}| & \text{if } IP_{bj} > NI_{aj}, TL_{bj} = 0 \text{ and } IP_{bj} < 0, \\ 0 & \text{else} \end{cases} \quad (38)$$

where $j=1,2,\dots,8$, $a=1,2$, $b \in S_a$, S_a is the set of TCs supplied by DC_a , IP_{bj} is the inventory position of the TC_b for the j^{th} blood, TL_{bj} is the target inventory level of the TC_b for the j^{th} blood, and NI_{aj} is the net inventory level of the DC_a for the j^{th} blood at the time after requisition is placed.

4.3.2.3.8.2. Issuing Methods Used to Allocate Units

After the amounts to be sent to centers are calculated, an issuing method is used to allocate the aged units. The policy to use for ad-hoc and routine deliveries to TCs is determined by the value of the parameter $IAPP\_IPN$ (issuing method number). Algorithms to allocate units according to the issuing methods are similar with the ones used at the RBC.

4.3.2.4. TC Sub Model

Level 2 - Data Flow Diagram of TC sub-model is given in Figure 4.10.

4.3.2.4.1. Create Physician Request

Physicians requests arrivals follow a Poisson distribution and they are created by using TC_SDMT_b (average of daily requests of physicians at the TC). Request size follows a probability distribution probabilities of which were illustrated in Table 4.11. above. Requests are classified to blood groups using the probabilities specified in BCP_BGF (Blood group frequency). The numbers of units requested are counted by blood group.

4.3.2.4.2. Assign Units

Units are assigned to the requests in the following way when a request for a blood group is placed. Flowchart of the assign process is given in Figure 4.11.

1. Availability of the unassigned blood grouped units is checked in TC_b 's inventory
 - 1.1. If there is enough of the unassigned same blood grouped units at the TC_b 's inventory, the same blood grouped units are assigned by the FIFO issuing method (the number of units assigned is equal to the requested units).
 - 1.2. Else, the same blood grouped units (if any) are assigned, and the model waits for TPP_MA (mismatch activation period) hours for the availability of the unassigned same blood grouped units for the remaining part of the request. If the blood group of the patient has a TL_{bj} (target inventory level of b^{th} TC for the j^{th} blood group) value equal to zero, an emergency delivery is prepared by RBC or DC at the time of the request.
 - 1.2.1. If the same blood grouped units become available in TPP_MA hours, the required number of units to fulfill the request is assigned by using FIFO issuing method.

1.2.2. Else, If there is still a remaining unfulfilled request after TPP_MA hours from the occurrence of the request;

1.2.2.1. The other available and unassigned compatible blood grouped (mismatch compatible blood groups are illustrated in Table 4.18.) units are checked to fulfill the remaining part of the request.

1.2.2.1.1. Compatible blood groups are ordered (descending) by inventory availability indices calculated using the values at the time of the mismatch event by the formula (36).

1.2.2.1.2. Assigning units is started with the compatible blood group which has the highest inventory availability index. If available unassigned units of the compatible blood group which has the highest inventory availability index are not sufficient to fulfill the remaining part of the request, assignment is continued with the next one in descending order. FIFO issuing method is used in assignment. The numbers of mismatched and transfused blood units are counted.

1.2.2.1.3. If all available compatible blood grouped units are not sufficient to fulfill all requested units, then the number of shortage units (remaining requested units which could not be fulfilled by the same blood grouped units or other compatible blood grouped units) are counted by the requested blood group.

1.2.2.1.3.1. Requests of shortage units are fulfilled when new blood units become available.

2. Each unit assigned for the requests is cross-matched and sent back to the unassigned inventory with the probability of $(1-TPP\_CCR)$. Returned units are counted. If an assigned unit is sent back to the unassigned inventory, a new unit is assigned by applying the procedure described in Step 1. An assigned unit becomes ready for transfusion with the probability of TPP_CCR (Cross-match compability ratio).

3. Matched and ready-to-use units are transfused to the patients with the probability of TPP_CMTX . If a ready-to-use assigned unit is not transfused, then it is sent back to the unassigned inventory after staying in the assigned inventory for TPP_CM hours.

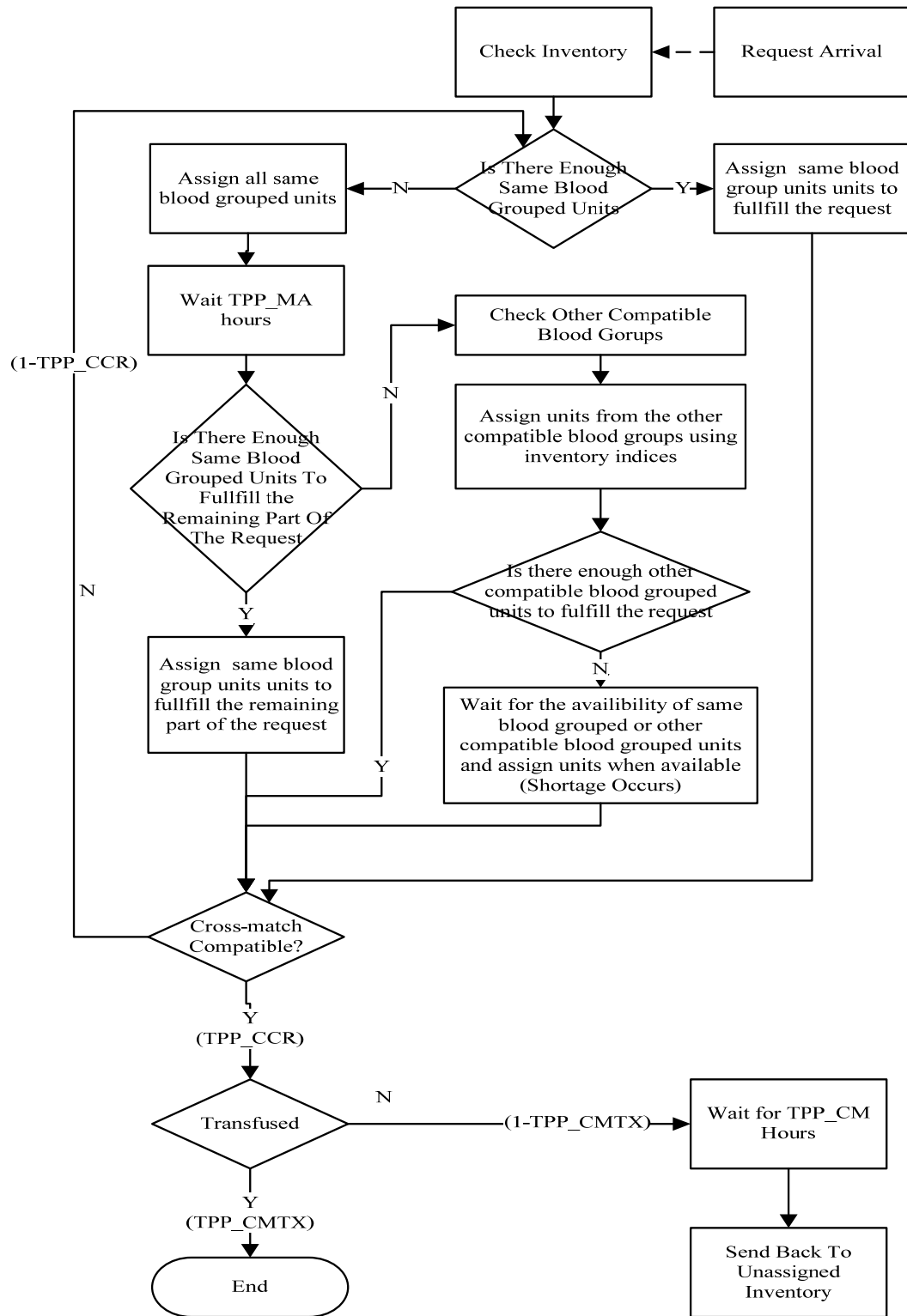


Figure 4.11. Flowchart of the Assign Process

Table 4.18. Mismatch Compatible Blood Groups

Donor	Patient							
	0 pos	0 neg	A pos	A neg	B pos	B neg	AB pos	AB neg
0 pos		✓	✓	✓	✓	✓	✓	✓
0 neg	✓		✓	✓	✓	✓	✓	✓
A pos				✓			✓	✓
A neg			✓				✓	✓
B pos						✓	✓	✓
B neg					✓		✓	✓
AB pos								✓
AB neg							✓	

4.3.2.4.3. Store in TC Inventory

Every hour inventory level of each blood group is checked and recorded. Each day at 08:00 a.m., the age of the stored units in the unassigned and assigned inventories are checked and the units at the age of *BDP_DATC* (disposal age of units at TCs) are disposed because of outdating.

4.3.2.4.4. Disposal of Outdated Units

Outdated units are counted by blood groups. Outdated units are removed from the model.

4.3.2.4.5. Add Units To TC Inventory

Units transferred from DC or RBC are added to the TC_b's inventory. Added units are counted classified by blood groups.

4.3.2.5. Sequence of Events Related with the Inventory Control Processes

Sequence of events which occur during the day is as follows:

- Age of units stored at TCs', DCs' and RBC's inventory is checked and outdated units are disposed.
- Tests of units are completed (donated units become ready for use).
- Inventory checks for routine deliveries to TCs are done by DC and RBC, and units are transferred.
- Inventory checks for ad-hoc deliveries to DCs are done by RBC, and inventory checks for ad-hoc deliveries to RBC are done by DCs. Units are transferred to centers, if necessary.
- Inventory checks for interregional deliveries are done by RBC, and units are transferred.
- Inventory checks for ad-hoc deliveries to TCs are done every hour by RBC and DCs.
- Emergency deliveries are done by RBC and DCs when a requisition is placed at TCs.

4.3.2.6. Calculate Statistics Sub Model

TCs', DCs', RBC's and the overall run's statistics are calculated by the model. The Model gives four output files including these statistics: (i) "TC.out", (ii) "DC.out", (iii) "RBC.out", and (iv) "SIM.out".

4.3.2.6.1. Calculation and Output of TCs' Statistics

The following statistics are calculated for each TC and for each run (replication) and the values are reported in "TC.out" file. File format of "TC.out" and the sample values are given in Appendix B.

- Total inventory levels by blood groups (sum of inventory levels counted every hour during the run)

- Number of inventory cycle counting
- Ending inventory level by blood groups, when the run (iteration) ends
- Total Number of added units by blood group
- Total Number of returned units by blood group
- Total Number of disposed units by blood group
- Total number of assigned units by blood group
- Total number of mismatched (and transfused) units by blood group
- Total number of requested units by blood group
- Total number of shortage units by blood group

4.3.2.6.2. Calculation and Output of DCs' Statistics

The following statistics are calculated for each DC and for each run (iteration) and the values are reported in “DC.out” file. File format of “DC.out” and the sample values are given in Appendix B.

- Total inventory levels by blood groups (sum of inventory levels counted every hour during the run)
- Number of inventory cycle counting
- Ending inventory level by blood groups, when the run (iteration) ends
- Total number of units, test results of which are negative by blood group
- Total number of added units by blood group
- Total number of disposed units by blood group
- Total number of units transferred with routine deliveries by blood group
- Total number of units transferred with ad-hoc deliveries to TCs, by blood group
- Total number of units transferred with emergency deliveries to TCs, by blood group
- Total number of units transferred with ad-hoc deliveries to RBC, by blood group
- Total number and kilometers of routine deliveries
- Total number and kilometers of ad-hoc deliveries to TCs

- Total number and kilometers of ad-hoc deliveries to RBC
- Total number and kilometers of emergency deliveries to TCs

4.3.2.6.3. Calculation and Output of RBC's Statistics

The following statistics of RBC are calculated for each run (iteration) and the values are reported in “RBC.out” file. File format of “RBC.out” and the sample values are given in Appendix B.

- Total inventory levels by blood groups (sum of inventory levels counted every hour during the run)
- Number of inventory cycle counting
- Ending inventory level by blood groups, when the run (iteration) ends.
- Total number of units test results of which are negative by blood group
- Total number of added units by blood group
- Total number of disposed units by blood group
- Total number of units transferred with routine deliveries to TCs, by blood group
- Total number of units transferred with emergency deliveries to TCs, by blood group
- Total number of units transferred with ad-hoc deliveries to TCs, by blood group
- Total number of units transferred with ad-hoc deliveries to DCs, by blood group
- Total number of units transferred with inter-regional deliveries to other regions, by blood group
- Total number and kilometers of routine deliveries
- Total number and kilometers of ad-hoc deliveries to TCs
- Total number and kilometers of ad-hoc deliveries to RBC
- Total number and kilometers of emergency deliveries to TCs
- Total number and kilometers of inter-regional deliveries to other regions

4.3.2.6.4. Calculation and Output of Simulation Statistics

The simulation run time and the ending inventory levels including units being transferred are reported in “SIM.out” file. File format of “SIM.out” and the sample values are given in Appendix B.

4.4. Calculation of the Performance Measures and Confidence Intervals

Key performance targets for determining the cost-effectiveness and quality of the chain are selected as the following:

- Mean Inventory Level by blood group (the smaller the better – the chain can operate with less donations).
- Outdate rates by blood group in the chain (the smaller the better—saves money, human sacrifice and donors’ efforts).
- Shortage rates by blood group in the chain (the smaller the better—saves lives).
- Mismatch rate by blood group in the chain (the smaller the better—saves lives and money).
- Numbers and percentages of routine/ad-hoc/emergency deliveries (the smaller the better for the total number of deliveries, but routine deliveries are more cost-effective and well-organized from the centers, hence the problem is more with ad-hoc and emergency deliveries).
- Average computer run time of the simulation model.

Although our aim is to analyze the performance of the entire supply chain (West-Mediterranean region including DCs and RBC), we also analyze TCs’, DCs’ and RBC’s individual performances, cities performances (DCs and RBC included and excluded cases), regional performances (excluding RBC and DCs). Samples of MS Excel outputs including performance measures, confidence intervals, summary tables and graphics are given in Appendix C.

4.4.1. Mean Inventory Levels by Blood Group

Calculation of the mean inventory levels is explained in the following sections.

4.4.1.1. Regional Performance Including DCs and RBC

$$MILRI_j = \left(\sum_{t=1}^{TDH} \sum_{b=1}^{49} NI_{tbj} + \sum_{a=1}^2 NI_{ta} + NI_{tj} \right) / TDH \quad (39)$$

where $j=1,2,\dots,8$, $MILRI_j$ is the mean inventory level of the region (including DCs and RBC) for the j^{th} blood group, NI_{tbj} is the net inventory level of the b^{th} TC for the j^{th} blood group at the t^{th} hour of simulation, NI_{ta} is the net inventory level of the DC_a for the j^{th} blood group at the t^{th} hour of simulation, NI_{tj} is the net inventory level of RBC for the j^{th} blood group at the t^{th} hour of simulation run, and TDH is the simulated real time excluding warm-up period.

4.4.1.2. Regional Performance Excluding DCs and RBC

$$MILRE_j = \left(\sum_{t=1}^{TDH} \sum_{b=1}^{49} NI_{tbj} \right) / TDH \quad (40)$$

where $j=1,2,\dots,8$, $MILRE_j$ is the mean inventory level of the region (excluding DCs and RBC) for the j^{th} blood group, NI_{tbj} is the net inventory level of the b^{th} TC for the j^{th} blood group at the t^{th} hour of simulation, and TDH is the total duration of simulation run in hours.

4.4.1.3. Cities Performance Including DCs and RBC

$$MILCI_{cj} = \left(\sum_{t=1}^{TDH} \sum_{b \in S_c} NI_{tbj} + NI_{tcj} \right) / TDH \quad (41)$$

where $j=1,2,\dots,8$, $c=1,2,3$, S_c is the set of TCs in the city c , $MILCI_j$ is the mean inventory level of the city c (including DCs and RBC) for the j^{th} blood group, NI_{tbj} is

the net inventory level of the b^{th} TC for the j^{th} blood group at the t^{th} hour of simulation, NI_{tcj} is the net inventory level of DC or RBC in the city c for the j^{th} blood group at the t^{th} hour of simulation, and TDH is the total duration of simulation run in hours.

4.4.1.4. Cities Performance Excluding DCs and RBC

$$MILCE_{cj} = \left(\sum_{t=1}^{TDH} \sum_{b \in S_c} NI_{tbj} \right) / TDH \quad (42)$$

where $j=1,2,\dots,8$, $c=1,2,3$, S_c is the set of TCs in the city c , $MILCE_j$ is the mean inventory level of the city c (excluding DCs and RBC) for the j^{th} blood group, NI_{tbj} is the net inventory level of the b^{th} TC for the j^{th} blood group at the t^{th} hour of simulation, and TDH is the total duration of simulation run in hours.

4.4.1.5. RBC's Single Performance

$$MILR_j = \left(\sum_{t=1}^{TDH} NI_{tj} \right) / TDH \quad (43)$$

where $j=1,2,\dots,8$, $MILR_j$ is the mean inventory level of the RBC for the j^{th} blood group, NI_{tj} is the net inventory level of RBC for the j^{th} blood group at the t^{th} hour of simulation run, and TDH is the total duration of simulation run in hours.

4.4.1.6. DCs' Single Performances

$$MILD_{aj} = \left(\sum_{t=1}^{TDH} NI_{taj} \right) / TDH \quad (44)$$

where $j=1,2,\dots,8$, $a=1,2$, $MILD_{aj}$ is the mean inventory level of the DC_a for the j^{th} blood group, NI_{taj} is the net inventory level of DC_a for the j^{th} blood group at the t^{th} hour of simulation, and TDH is the total duration of simulation run in hours.

4.4.1.7. TCs' Single Performances

$$MILD_{bj} = \left(\sum_{t=1}^{TDH} NI_{tbj} \right) / TDH \quad (45)$$

where $j=1,2,\dots,8$, $b=1,2,\dots,49$, $MILD_{bj}$ is the mean inventory level of the b^{th} TC for the j^{th} blood group, NI_{tbj} is the net inventory level of the b^{th} TC for the j^{th} blood group at the t^{th} hour of simulation, and TDH is the total duration of simulation run in hours.

4.4.2. Outdate Rates by Blood Group

Calculation of the outdate rates is the following sections.

4.4.2.1. Regional Performance Including DCs and RBC

$$ORI_j = \left(\sum_{b=1}^{49} NUO_{bj} + \sum_{a=1}^2 NUO_{aj} + NUO_j \right) / NUODR_j * 100 \quad (46)$$

where $j=1,2,\dots,8$, ORI_j is the outdate rate of the region (including DCs and RBC) for the j^{th} blood group, NUO_{bj} is the number of units outdated in the b^{th} TC for the j^{th} blood group, NUO_{aj} is the number of units outdated in the DC_a for the j^{th} blood group, NUO_j is the number of units outdated in RBC for the j^{th} blood group, and $NUODR_j$ is the total number of units used or disposed in the region (West-Mediterranean Region).

4.4.2.2. Regional Performance Excluding DCs and RBC

$$ORE_j = \left(\sum_{b=1}^{49} NUO_{bj} \right) / NUODR_j * 100 \quad (47)$$

where $j=1,2,\dots,8$, ORE_j is the outdate rate of the region (excluding DCs and RBC) for the j^{th} blood group, NUO_{bj} is the number of units outdated in the b^{th} TC for the j^{th}

blood group, and $NUODR_j$ is the total number of units used or disposed in the region (West-Mediterranean Region).

4.4.2.3. Cities Performance Including DCs and RBC

$$ORCI_{cj} = ((\sum_{b \in S_c} NUO_{bj}) + NUO_{cj} / NUODC_j) * 100 \quad (48)$$

where $j=1,2,\dots,8$, $c=1,2,3$, S_c is the set of TCs in the city c , $ORCI_{cj}$ is outdate rate of the city c (including DCs and RBC) for the j^{th} blood group, NUO_{bj} is the number of units outdated in the b^{th} TC for the j^{th} blood group, NUO_{cj} is the number of units outdated in DC or RBC in the city c for the j^{th} blood group, and $NUODC_j$ is the total number of units used or disposed in the city c .

4.4.2.4. Cities Performance Excluding DCs and RBC

$$ORCE_{cj} = (\sum_{b \in S_c} NUO_{bj} / NUODC_j) * 100 \quad (49)$$

where $j=1,2,\dots,8$, $c=1,2,3$, S_c is the set of TCs in the city c , $ORCE_{cj}$ is outdate rate of the city c (excluding DCs and RBC) for the j^{th} blood group, NUO_{bj} is the number of units outdated in the b^{th} TC for the j^{th} blood group, and $NUODC_j$ is the total number of units used or disposed in the city c .

4.4.2.5. RBC's Single Performance

$$OR_j = NUO_j / NUOD_j \quad (50)$$

where $j=1,2,\dots,8$, OR_j is outdate rate of RBC for the j^{th} blood group, NUO_j is the number of units outdated in RBC for the j^{th} blood group, and $NUOD_j$ is the total number of units used or disposed in responsibility area of RBC.

4.4.2.6. DCs' Single Performances

$$OR_{aj} = (NUO_{aj}) / NUOD_{aj} \quad (51)$$

where $j=1,2,\dots,8$, $a=1,2$, OR_{aj} is the outdate rate of DC_a for the j^{th} blood group, NUO_{aj} is the number of units outdated in DC_a for the j^{th} blood group, and $NUOD_{aj}$ is the total number of units used or disposed in the responsibility area of DC_a .

4.4.2.7. TCs' Single Performances

$$OR_{bj} = (NUO_{bj}) / NUOD_{bj} \quad (52)$$

where $j=1,2,\dots,8$, $b=1,2,\dots,49$, OR_{bj} is the outdate rate of the b^{th} TC for the j^{th} blood group, NUO_{bj} is the number of units outdated in the b^{th} TC for the j^{th} blood group, and $NUOD_{bj}$ is the total number of units used or disposed in the b^{th} TC.

4.4.3. Mismatch Rates by Blood Group

Mismatch only occurs in TCs, so we only calculate mismatch rates for TCs, cities and region. Excluding and including DCs and RBC cases are also the same for cities and region. Calculation of the mismatch rates is explained in the following sections.

4.4.3.1. Regional Performance

$$MRR_j = \left(\sum_{b=1}^{49} NUM_{bj} / \sum_{b=1}^{49} NUT_{bj} \right) * 100 \quad (53)$$

where $j=1,2,\dots,8$, MRR_j is the mismatch rate of the region for the j^{th} blood group, NUM_{bj} is the number of units mismatched in the b^{th} TC for the j^{th} blood group and NUT_{bj} is the number of units transfused in the b^{th} TC for the j^{th} blood group.

4.4.3.2. Cities Performance

$$MRR_{cj} = \left(\sum_{b \in S_c} NUM_{bj} / \sum_{b \in S_c} NUT_{bj} \right) * 100 \quad (54)$$

where $j=1,2,\dots,8$, $c=1,2,3$, S_c is the set of TCs in the city c , MRR_{cj} is the mismatch rate of the city c for the j^{th} blood group, NUM_{bj} is the number of units mismatched in the b^{th} TC for the j^{th} blood group, and NUT_{bj} is the number of units transfused in the b^{th} TC for the j^{th} blood group.

4.4.3.3. TCs' Single Performances

$$MRR_{bj} = (NUM_{bj} / NUT_{bj}) * 100 \quad (55)$$

where $j=1,2,\dots,8$, $b=1,2,\dots,49$, MRR_{bj} is the mismatch rate of the b^{th} TC for the j^{th} blood group, NUM_{bj} is the number of units mismatched in the b^{th} TC for the j^{th} blood group, and NUT_{bj} is the number of units transfused in the b^{th} TC for the j^{th} blood group.

4.4.4. Shortage Rates by Blood Group

Shortage also occurs only in TCs, so we only calculate shortage rates for TCs, cities and region. Excluding and including DCs and RBC cases are also the same for cities and region. Calculation of the shortage rates is explained in the following sections.

4.4.4.1. Regional Performance

$$SRR_j = \left(\sum_{b=1}^{49} NUS_{bj} / \sum_{b=1}^{49} NUR_{bj} \right) * 100 \quad (56)$$

where $j=1,2,\dots,8$, SRR_j is the shortage rate of the region for the j^{th} blood group, NUS_{bj} is the number of shortage units in the b^{th} TC for the j^{th} blood group and NUR_{bj}

is the number of units requested by the physicians in the b^{th} TC for the j^{th} blood group.

4.4.4.2. Cities Performance

$$SRR_{cj} = \left(\sum_{b \in S_c} NUS_{bj} / \sum_{b \in S_c} NUR_{bj} \right) * 100 \quad (57)$$

where $j=1,2,\dots,8$, $c=1,2,3$, S_c is the set of TCs in the city c , SRR_{cj} is the shortage rate of the city c for the j^{th} blood group, NUR_{bj} is the number of shortage units in the b^{th} TC for the j^{th} blood group, and NUR_{bj} is the number of units requested in the b^{th} TC for the j^{th} blood group.

4.4.4.3. TCs' Single Performances

$$SRR_{bj} = \left(NUS_{bj} / NUR_{bj} \right) * 100 \quad (58)$$

where $j=1,2,\dots,8$, $b=1,2,\dots,49$, SRR_{bj} is the shortage rate of the b^{th} TC for the j^{th} blood group, NUS_{bj} is the number of shortage units in the b^{th} TC for the j^{th} blood group, and NUR_{bj} is the number of units requested in the b^{th} TC for the j^{th} blood group.

4.4.5. Numbers, Kilometers and Percentages of routine/ad-hoc/ emergency deliveries

Numbers of deliveries are counted by the model by delivery type. Distance in kilometer of each delivery is calculated using the values specified in BTP_TD_{se} . All measures are calculated separately for each DC and RBC, and also for region totally.

CHAPTER 5

EXPERIMENTAL ANALYSIS

5.1. Verification and Validation Issues of the Simulation Model

Model verification and validation processes can be categorized in four groups; (i) data validity, (ii) conceptual model validity, (iii) model verification, and (iv) operational validity. Data validity is defined as ensuring that the data necessary for model building, model evaluation and testing, and conducting model experiments to solve the problem are adequate and correct. Conceptual model validity is defined as determining that the theories, and assumptions underlying the conceptual model are correct and the model representation of the problem entity is “reasonable” for the intended purpose of the model. Computerized model verification is defined as ensuring that the computer programming and implementation of the conceptual model is correct. Operational validity is defined as determining that the model’s output behavior has sufficient accuracy for the model’s intended purpose over the domain of the model’s intended applicability (Sargent 1998).

5.1.1. Data Validation

Even though data validity is usually not considered to be part of model validation, we discuss it, because it is usually difficult, time consuming, and costly to obtain sufficient, accurate and appropriate data. Sargent (1998) results that the best that can be done to ensure that data are correct, is to develop good procedures for collecting it, test the collected data using techniques such as screen for outlier. We used data obtained from an management information system and the Turkish Red Crescent

Blood Services Annual Report for building the conceptual model and performing experiments. The information system has device integrations (data link between blood donation devices and information management system) and when a donor begins to donate blood, it automatically sends the donation information to the system. The donation data are visually checked for outliers and internal consistency. Data obtained from information system is cross-checked with the records on papers reported to the headquarters of Turkish Red Crescent Society. We made some assumptions for the demand data of hospitals which is discussed in conceptual model validation part.

5.1.2. Conceptual Model Validation

Conceptual model validity is determining that (1) the theories and assumptions underlying the conceptual model are correct, and (2) the model representation of the problem entity and the model's structure, logic, and mathematical and causal relationships are "reasonable" for the intended purpose of the model. The theories and assumptions underlying the model should be tested using mathematical analysis and statistical methods. Examples of theories and assumptions are independent, stationary, and Poisson arrivals. Examples of applicable statistical methods are fitting distributions to data, estimating parameter values from the data, and plotting the data to determine if they are stationary. Next, each submodel and the overall model must be evaluated to determine if they are reasonable and correct for the intended purpose of the model. The primary validation techniques used for these evaluations are face validation and traces. Face validation has experts on the problem entity that evaluate the conceptual model to determine if it is correct and reasonable for its purpose. This usually requires examining the flowchart or graphical model, or the set of model equations (Sargent, 1998).

We fit normal distribution to donation data, using statistical analysis. We used distributions, that are repeatedly validated in the literature, for demand data of hospitals. We also used statistical techniques to estimate parameter values for the demand data of hospitals. We developed flowcharts and data flow diagrams to

validate the model representation of the problem and the model's logic. We made interviews with blood bank administrators to evaluate the conceptual model to determine if it is correct and reasonable for its purposes. Conceptual model is finalized with their contributions.

5.1.3. Model Verification

Computerized model verification ensures that the computer programming and implementation of the conceptual model are correct. After the SiModel has been developed, programming bugs are removed and it is tested for the correctness and accuracy by inspection and continuous unit testing.

5.1.4. Operational Validity

Operational validity is concerned with determining that the model's output behavior has the accuracy required for the model's intended purpose over the domain of its intended applicability. All of the validation techniques given above are applicable for operational validity. The technique(s) and how to use them (objectively or subjectively) must be decided by the model development team and other interested parties. The major attribute affecting operational validity is whether the system is observable, where "observable" means that it is possible to collect data on the operational behavior of the system (Sargent, 1998).

Animation: The model's operational behavior is displayed graphically as the model moves through time. For example, the movements of parts through a factory during a simulation are shown graphically.

Comparison to Other Models: Various results (e.g., outputs) of the simulation model being validated are compared to results of other (valid) models. For example, (1) simple cases of a simulation model may be compared to known results of analytical models, and (2) the simulation model may be compared to other simulation models that have already been validated.

Degenerate Tests: The degeneracy of the model's behavior is tested by appropriate selection of values of the input and internal parameters. For example, does the average number in the queue of a single server continue to increase with respect to time, when the arrival rate is larger than the service rate?

Event Validity: The "events" of occurrences of the simulation model are compared to those of the real system to determine if they are similar. An example of events is deaths in a fire department simulation.

Extreme Condition Tests: The model structure and output should be plausible for any extreme and unlikely combination of levels of factors in the system; e.g., if in-process inventories are zero, production output should be zero.

Face Validity: "Face validity" is asking people knowledgeable about the system whether the model and/or its behavior are reasonable.

Fixed Values: Fixed values (e.g., constants) are used for various model input and internal variables and parameters. This should allow the checking of model results against easily calculated values.

Historical Data Validation: If historical data exist (or if data are collected on a system for building or testing the model), part of the data is used to build the model and the remaining data are used to determine (test) whether the model behaves as the system does.

Historical Methods: The three historical methods of validation are rationalism, empiricism, and positive economics. Rationalism assumes that everyone knows whether the underlying assumptions of a model are true. Logic deductions are used from these assumptions to develop the correct (valid) model. Empiricism requires every assumption and outcome to be empirically validated. Positive economics

requires only that the model be able to predict the future and is not concerned with a model's assumptions or structure (causal relationships or mechanism).

Internal Validity: Several replications (runs) of a stochastic model are made to determine the amount of (internal) stochastic variability in the model. A high amount of variability (lack of consistency) may cause the model's results to be questionable and, if typical of the problem entity, may question the appropriateness of the policy or system being investigated.

Multistage Validation: Naylor and Finger (1967) proposed combining the three historical methods of rationalism, empiricism, and positive economics into a multistage process of validation. This validation method consists of (1) developing the model's assumptions on theory, observations, general knowledge, and function, (2) validating the model's assumptions where possible by empirically testing them, and (3) comparing (testing) the input-output relationships of the model to the real system.

Operational Graphics: Values of various performance measures, e.g., number in queue and percentage of servers busy, are shown graphically as the model moves through time; i.e., the dynamic behaviors of performance indicators are visually displayed as the simulation model moves through time.

Parameter Variability–Sensitivity Analysis: This technique consists of changing the values of the input and internal parameters of a model to determine the effect upon the model's behavior and its output. The same relationships should occur in the model as in the real system. Those parameters that are sensitive, i.e., cause important changes in the model's behavior or output, should be made sufficiently accurate prior to using the model (this may require iterations in model development).

Predictive Validation: The model is used to predict (forecast) the system behavior, and then comparisons are made between the system's behavior and the model's forecast to determine if they are the same. The system data may come from an operational system or from experiments performed on the system.

Traces: The behavior of different types of specific entities in the model are traced (followed) through the model to determine if the model's logic is correct and if the necessary accuracy is obtained.

Turing Tests: People who are knowledgeable about the operations of a system are asked if they can discriminate between system and model outputs (Sargent, 1998).

As the structure considered in this study is not fully implemented yet, it is impossible to collect data on the operational behavior of the system and there is not any historical data which reflects the system behavior. Therefore, most of the validation techniques (Multistage Validation, Turing Tests, Historical Data Validation, Event Validity, Predictive Validation, Traces, and Historical Methods) described above are inapplicable for the case. Also some of the techniques (Operational Graphics, Animation) can not be applied because of the run time restrictions and programming difficulties. Therefore, we only used face validity, fixed values, degenerate tests, extreme condition tests, comparison to other models (partially) and internal validity techniques for testing the operational validity in our case.

We made interviews with blood bank administrators to evaluate the model's outputs and system behavior whether they are reasonable or not. Extreme condition tests are also applied. For example, parameter values are specified so that there will be no whole blood donations in the system. Then it was checked whether any outdated units or any fulfilled requests exist in the system or not. Model's results are partially compared with previously validated simulation models' results. Effects of transfusion to cross-match ratio and cross-match release period are compared. Results are interpreted in sections 5.3.2. Policy Group 1 and 5.3.3. Policy Group 2. Confidence interval percentages (ratio of 95% confidence intervals to the mean of the performance measure) are calculated for each performance measures to check internal validity. Performance measure values (outdate rate, mismatch rate, shortage rate, mean inventory level, number of total deliveries) of the region including DCs and RBC are found to be within the confidence interval of 10% with probability

95%. The degeneracy of the model's behavior is also tested. An example of degenerate tests is using higher and lower transfusion to cross-match ratios and checking the ratio of returned unused units. Table 5.1. illustrates the results of an example degenerate test. We use different transfusion to cross-match ratios (CMTX) and calculate observed ratio of returned units to assigned units. Results are reported only for TC 1 for a one year run using the same configuration values with the baseline policy except CMTX. As depicted on Table 5.1., observed ratio of returned units to assigned units decreases, when CMTX increases.

The last technique used to test operational validity is to execute model with fixed values. We constructed a simplified version of the chain consisting of one RBC, one DC and two TCs (one supplied by RBC, named TCR, and one supplied by DC, named TCD). We reduce the stochastic processes in the model to easily calculate the expected results of the performance measures. Therefore, we made the following assumptions for the test problems:

- Frequency of blood group 0+ is equal to 1 and others are 0.
- Transfusion to cross-match ratio is equal to 1.
- Size of each request is equal to one.
- Transfers between DC and RBC are not allowed.
- Cross-match compatibility ratio is assumed to be 1.
- Standard deviations of whole blood donations both at mobile and at center are assumed to be 0.01 for DC and RBC.
- Routine delivery coefficient for TCs is equal to one.
- Ad-hoc delivery coefficient for TCs is equal to 0.01

Ten simple test problems are created using different mean daily request values for TCs, and different mean daily donation values for DC and RBC. As only one blood group is considered, no mismatch occurs in the system. Therefore, we calculated the expected values for outdate and shortage rates, and checked whether these values are within the confidence intervals obtained from the simulation experiments. Table 5.2. illustrates the results of simulation experiments of test problems. The upper and lower bounds of 95% confidence intervals are calculated. Orange highlighted values

correspond to the values that lie within the upper and lower limits of confidence intervals. Expected values for all performance measures lie within the confidence intervals, as depicted on Table 5.2. These results indicate that model is validated by the fixed values technique using test problems.

Table 5.1. An Example of Degenerate Test Results

CMTX	Values	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
0.2	# of returned units	1824	257	2368	300	808	133	408	64	6162
	# of assigned units	2271	313	2931	384	991	167	508	77	7642
	Observed Ratio of Returned Units to Assigned Units	0.80	0.82	0.81	0.78	0.82	0.80	0.80	0.83	0.81
0.3	# of returned units	1578	172	2032	275	730	134	382	73	5376
	# of assigned units	2273	249	2905	399	1043	189	543	104	7705
	Observed Ratio of Returned Units to Assigned Units	0.69	0.69	0.70	0.69	0.70	0.71	0.70	0.70	0.70
0.4	# of returned units	1388	146	1782	205	661	86	344	36	4648
	# of assigned units	2322	268	3003	359	1129	154	556	65	7856
	Observed Ratio of Returned Units to Assigned Units	0.60	0.54	0.59	0.57	0.59	0.56	0.62	0.55	0.59
0.5	# of returned units	1077	157	1560	206	515	70	290	42	3917
	# of assigned units	2218	295	3028	398	1038	146	580	82	7785
	Observed Ratio of Returned Units to Assigned Units	0.49	0.53	0.52	0.52	0.50	0.48	0.50	0.51	0.50
0.6	# of returned units	926	144	1198	153	467	58	212	31	3189
	# of assigned units	2293	355	3064	398	1078	150	537	80	7955
	Observed Ratio of Returned Units to Assigned Units	0.40	0.41	0.39	0.38	0.43	0.39	0.39	0.39	0.40
0.7	# of returned units	644	92	868	122	333	43	158	37	2297
	# of assigned units	2230	312	2916	432	1089	140	530	122	7771
	Observed Ratio of Returned Units to Assigned Units	0.29	0.29	0.30	0.28	0.31	0.31	0.30	0.30	0.30
0.8	# of returned units	451	55	572	89	208	31	122	12	1540
	# of assigned units	2207	303	3000	438	1098	165	588	57	7856
	Observed Ratio of Returned Units to Assigned Units	0.20	0.18	0.19	0.20	0.19	0.19	0.21	0.21	0.20

Table 5.2. Results of test problems

Test Problem Number		1	2	3	4	5	6	7	8	9	10
Mean Daily Donations of RBC		22	15	13	105	42	51	21	14	107	54
Mean Daily Donations of TCR		12	20	10	87	68	25	10	18	98	67
Mean Daily Donations of DC		10	19	12	59	25	15	36	35	105	24
Mean Daily Donations of TCD		18	6	5	23	19	25	42	37	69	13
Outdate Rate of RBC	Expected Result	45.46	0.00	23.08	17.14	0.00	50.98	52.38	0.00	8.41	0.00
	Mean	45.52	0.00	22.71	17.00	0.00	50.80	52.34	0.00	8.09	0.00
	Confidence Interval	0.28	0.00	0.55	0.30	0.00	0.20	0.28	0.00	0.37	0.00
	Upper Limit	45.80	0.00	23.26	17.30	0.00	51.00	52.62	0.00	8.46	0.00
	Lower Limit	45.24	0.00	22.16	16.71	0.00	50.61	52.06	0.00	7.72	0.00
	Confidence Interval Percentage	0.63	0.00	2.42	1.74	0.00	0.38	0.54	0.00	4.55	0.00
Shortage Rate of TCR	Expected Result	0.00	25.00	0.00	0.00	38.24	0.00	0.00	22.22	0.00	19.40
	Mean	0.00	25.10	0.00	0.00	38.26	0.00	0.00	22.32	0.00	19.52
	Confidence Interval	0.00	0.24	0.00	0.00	0.09	0.00	0.00	0.40	0.00	0.13
	Upper Limit	0.00	25.34	0.00	0.00	38.36	0.00	0.00	22.72	0.00	19.65
	Lower Limit	0.00	24.86	0.00	0.00	38.17	0.00	0.00	21.91	0.00	19.39
	Confidence Interval Percentage	0.00	0.96	0.00	0.00	0.24	0.00	0.00	1.81	0.00	0.68
Outdate Rate of DC	Expected Result	0.00	68.42	58.33	61.02	24.00	0.00	0.00	0.00	34.29	45.83
	Mean	0.00	68.37	58.15	61.05	23.99	0.00	0.00	0.00	34.12	45.63
	Confidence Interval	0.00	0.14	0.42	0.08	0.37	0.00	0.00	0.00	0.18	0.24
	Upper Limit	0.00	68.51	58.57	61.13	24.37	0.00	0.00	0.00	34.30	45.87
	Lower Limit	0.00	68.23	57.73	60.97	23.62	0.00	0.00	0.00	33.94	45.39
	Confidence Interval Percentage	0.00	0.20	0.72	0.13	1.56	0.00	0.00	0.00	0.54	0.30
Shortage Rate of TCD	Expected Result	44.44	0.00	0.00	0.00	0.00	40.00	14.29	5.41	0.00	0.00
	Mean	44.36	0.00	0.00	0.00	0.00	40.14	14.24	5.36	0.00	0.00
	Confidence Interval	0.17	0.00	0.00	0.00	0.00	0.15	0.12	0.22	0.00	0.00
	Upper Limit	44.53	0.00	0.00	0.00	0.00	40.28	14.36	5.58	0.00	0.00
	Lower Limit	44.20	0.00	0.00	0.00	0.00	39.99	14.12	5.13	0.00	0.00
	Confidence Interval Percentage	0.38	0.00	0.00	0.00	0.00	0.29	0.85	4.14	0.00	0.00
Outdate Rate of Region	Expected Result	31.25	38.24	40.00	32.93	8.96	39.39	19.30	0.00	21.23	14.10
	Mean	31.30	38.21	39.73	32.85	8.95	39.26	19.28	0.00	20.98	14.04
	Confidence Interval	0.20	0.08	0.38	0.20	0.14	0.15	0.10	0.00	0.27	0.07
	Upper Limit	31.49	38.29	40.11	33.05	9.09	39.41	19.39	0.00	21.25	14.11
	Lower Limit	31.10	38.13	39.36	32.65	8.81	39.11	19.18	0.00	20.72	13.97
	Confidence Interval Percentage	0.63	0.20	0.95	0.62	1.56	0.38	0.54	0.00	1.27	0.30
Shortage Rate of Region	Expected Result	26.67	19.23	0.00	0.00	29.89	20.00	11.54	10.91	0.00	16.25
	Mean	26.63	19.31	0.00	0.00	29.92	20.06	11.50	10.91	0.00	16.34
	Confidence Interval	0.15	0.19	0.00	0.00	0.08	0.10	0.10	0.24	0.00	0.12
	Upper Limit	26.77	19.50	0.00	0.00	30.00	20.16	11.60	11.16	0.00	16.46
	Lower Limit	26.48	19.12	0.00	0.00	29.84	19.96	11.40	10.67	0.00	16.23
	Confidence Interval Percentage	0.55	1.01	0.00	0.00	0.27	0.49	0.90	2.22	0.00	0.72

5.2. Design of Experiments

We need the following definitions first.

- *Policy*: It refers to a set of different system configuration parameters' values which define the behaviour of the system. When only one of the system configuration parameter is changed, we consider this set of parameters as another management policy.

- *Policy Group*: It refers to a class of management policies. The policies, constructed using different values for the same system configuration parameters, are classified as policy groups.

As there is no fully implemented real life application of the analyzed structure, we constructed a baseline policy by utilizing the generally used values in previous works (i.e. 0.50 for transfusion to cross match ratio, 72 hours for cross-match release period, 0.30 for ad-hoc delivery coefficient of TCs). There are some parameters in the model which haven't been analyzed in previous studies. Therefore, we selected values which are found acceptable by blood bank administrators for these parameters (i.e. maximum age of units to send to DCs, ad-hoc delivery coefficient for deliveries from RBC to DCs, etc.) to construct the baseline policy. 285 alternative policies, categorized in 9 policy groups, are analyzed and the results are compared. Policy groups are ordered. The analyses are started with the policy groups which included the parameters (crossmatch release period and transfusion to crossmatch period), effects of which are predicted not to be strictly dependent on the other parameters.

Main performance measures (outdate, mismatch and shortage rate of the region including DCs and RBC) are used to compare the results of the alternative policies. The best policy of a policy group, in terms of main performance measures, is determined and the corresponding parameter values are used in the following experiments of other policy groups. The priority of each main performance measure is considered to be the same. Therefore, the sum of outdate, mismatch and shortage rates of the region including DCs and RBC, is used as the selection criterion. The policy which has the minimum value is selected. Although a selection criterion is used to determine parameter's values to be used in the following experiments, we also determined the best of the alternative policies, corresponding to different objectives, for performance measures separately (i.e. the policy which minimizes the outdate rate of the region excluding DCs and RBC, the one which maximizes the routine delivery percentage, the one which minimizes the mismatch rate of the region including DCs and RBC, the one which minimizes the outdate rate mean of

single performances of TCs, the one which minimizes the mean inventory level of region including DCs and RBC, etc.). Orange highlighted values in the tables in Appendix E corresponds to the best policies of the policy groups for each performance measure. However, these policies, i.e. best alternatives only for a single performance measure, are not considered as a starting point to obtain the improved policies. The effects of the parameters on the supply chain main performance measures, within the boundaries specified by the model configuration values, are also investigated in addition to the efforts to find the improved policies.

Each policy is executed 10 times (replications) and mean values are used to evaluate the policies. Run length of each run and the time to reach steady state for each policy are 1825 and 60 days, respectively. Simulation run time is approximately 7 minutes for each policy. Important improvements have been achieved in terms of run time compared with the reported durations in Katsaliaki and Brailford (2006).

5.3. Results of the Experiments

5.3.1. Baseline Policy (Policy 0)

Values of the parameters of baseline policy and the input file format including these values are given in Appendix A. Outputs of the simulation model for the baseline policy are given in Appendix B, and values of performance measures, confidence intervals, summary tables and graphics for the baseline policy are given in Appendix C. Outdate, mismatch and shortage rates of the region including DCs and RBC are found to be 34.41%, 3.09%, and 0.57% respectively.

Different values for the parameters shown in Table 5.3. are used to construct the alternative policies. The values of the parameters used for each policy are given in Appendix D. Other model configuration parameters are the same for all policies, and define the general characteristics of the chain such as hierarchical structure of the supply chain, distances between centers, and statistical distributions of whole blood donations.

5.3.2. Policy Group 1

The effects of cross-match release period on performance measures are analyzed. Values used for cross-match release period vary between 72 to 24 hours. Results of the simulations of the policy group 1 and comparisons with the baseline policy are given in Appendix E, from Table E.1. to Table E.7.

Table 5.3. Parameters Used to Construct Alternative Policies

File	Parameters	Definition
BDP	DADC	Disposal Age of Units at DCs and RBC (in days)
BDP	MASD	The maximum age of the units to be transferred to DCs (in days)
BDP	MASR	The maximum age of the units to be transferred to RBC (in days)
BDP	MASI	The maximum age of the units to be transferred to other regions (in days)
DC	Ada -Burdur	Target inventory level coefficient of Burdur DC for red blood cells
DC	Ada - Isparta	Target inventory level coefficient of Isparta DC for red blood cells
IAPP	ADPT	Ad-hoc delivery coefficient for TCs
IAPP	ADPD	Ad-hoc delivery coefficient for DCs
IAPP	Hd	Upper Inventory Limit Coefficient of DCs
IAPP	Sd	Excessive Amount Coefficient for DCs
IAPP	RHd	Upper Inventory Limit Coefficient of RBC
IAPP	RSd	Excessive Amount Coefficient for RBC
IAPP	APN	Blood Allocation Method Parameter
IAPP	IPN	Blood Issuing Method Parameter
IAPP	RDP	Routine Delivery Coefficient for TCs
RBC	LLC	RBC lower limit coefficient for the transfers to the DCs
RBC	AR	Target inventory level coefficient of RBC for red blood cells
TC	DPTb	Periodic review period for routine deliveries to TC (in days)
TC	Atb	Target Inventory Level Coefficient of the TC's for red blood cells (considered to be the same as for each blood group for each TC from Policy Group 0 to Policy Group 6)
TPP	CM	Cross-match release period in hours
TPP	CMTX	Transfusion to cross-match ratio

Figure 5.1. illustrates the effects of cross-match release period on the main performance measures and Figure 5.2. on TCs' single performances means of outdate, mismatch and shortage rates. Simulation experiments indicate that a decrease occurs in outdating for both cases when this period is decreased from 72 hours to 60, 48, 36 and 24 hours, as depicted in Figure 5.1 and Figure 5.2. Effects on TC's single performances means are more distinctive than they are on the regions performance. Shortage and mismatch rates also decrease with cross-match release period. These observations are compatible with the results reported in previous studies (Cohen and Pierskalla, 1979; Jagannathan and Sen, 1991), therefore, they, especially the ones for the TCs' single performances means, can be considered as a partial model validation in terms of comparison to other models.

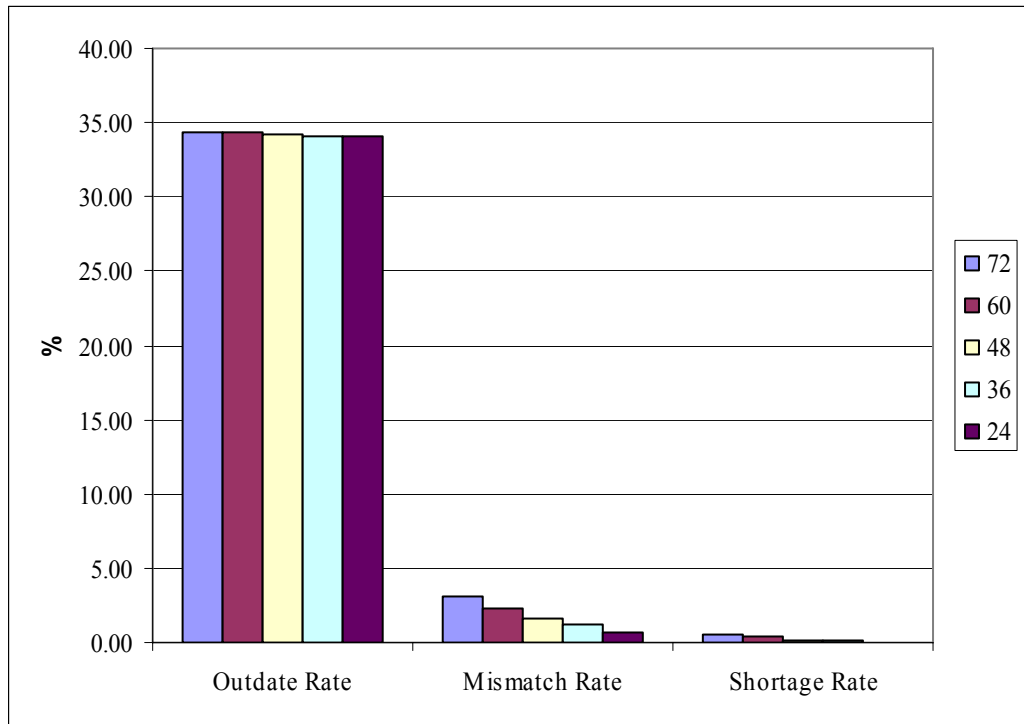


Figure 5.1. Effects of Cross-match Release Period on the Main Performance Measures

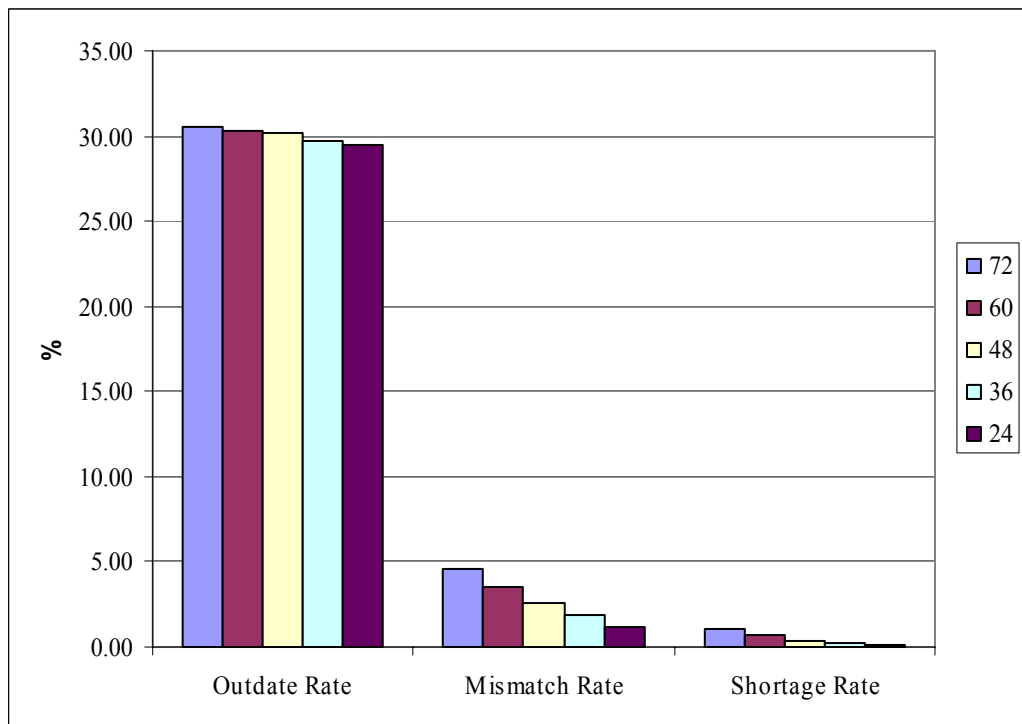


Figure 5.2. Effects of Cross-Match Release Period on TCs' Single Performances Means

Meaningful improvements can be achieved for each of the main performance measures by decreasing the cross-match release period from 72 hours to 60, 48, 36 and 24 hours. Therefore, the performance in terms of selection criterion also can be improved by using shorter periods. Figure 5.3. illustrates the effects of cross-match release period on the sum of the main performance measures.

Results of the simulation experiments also indicate that total number of deliveries in the region decreases and routine delivery percentage increases as cross-match release period decreases. However, mean inventory level of the region increases when cross-match release period is decreased.

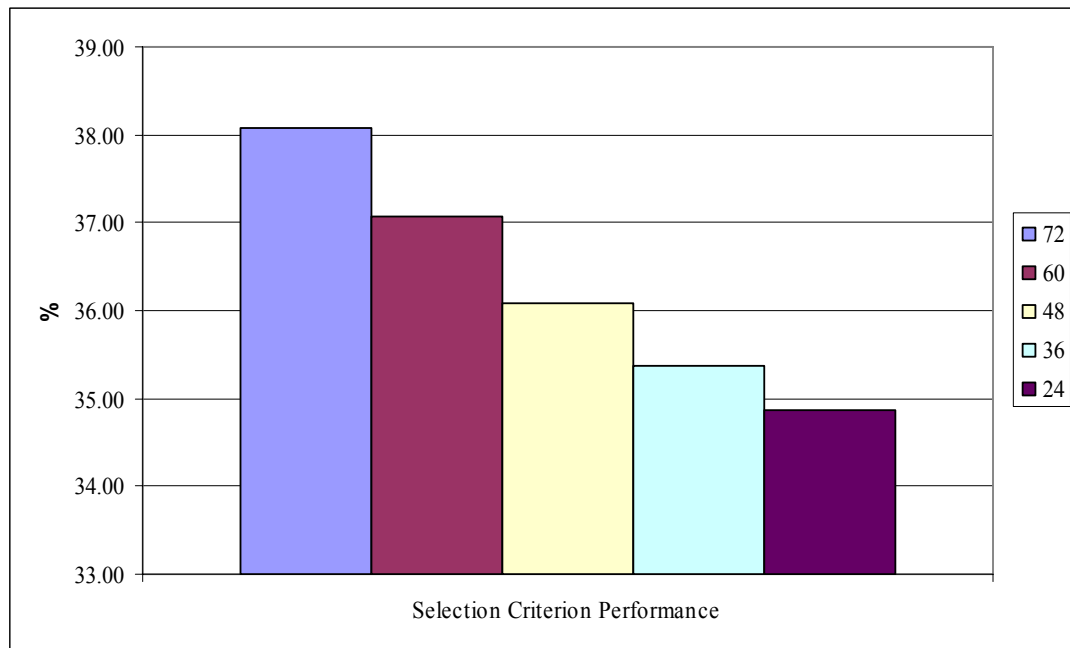


Figure 5.3. Effects of Cross-match Release Period on the Sum of Main Performance Measures

The policy (Policy1.4.), having a cross-match release period of 24 hours, has the smallest selection criterion value, 34.86 %. Therefore, cross-match release period of 24 hours is selected to be used in the following experiments.

5.3.3. Policy Group 2

The effects of transfusion to cross-match ratio on performance measures are analyzed. Values used for transfusion to cross-match ratio vary between 0.50 to 0.70. Results of the simulation experiments of the policy group 2 and comparisons with the policy 1.4. are given in Appendix E, from Table E.8 to Table E.14.

Figure 5.4. illustrates the effects of transfusion to cross-match ratio on outdate and mismatch rates of the region including DCs and RBC and Figure 5.5. on TCs' single performances means of outdate and mismatch rates. Results of the experiments

indicate that a dramatic decrease occurs in outdated for both cases when this ratio is increased from 0.50, to 0.55, 0.60, 0.65 and 0.70, as depicted in Figure 5.4 and Figure 5.5. Shortage and mismatch rates also decrease when transfusion to cross-match ratio increased from 0.50 to 0.55, 0.60 and 0.65. An increase occurs when cross-match release period is increased to 0.70. These observations are also compatible with the results reported in the previous studies (Cohen and Pierskalla, 1979; Jagannathan and Sen, 1991), therefore, especially the observations for the TCs' single performances means, can also be considered as a partial model validation.

Total number of deliveries in the region increases and routine delivery percentage decreases as transfusion to cross-match ratio increases. Although TCs carry more inventory, mean inventory level of the region decreases when transfusion to cross-match ratio is increased.

The policy (Policy 2.4.), having a transfusion to cross-match ratio of 0.70, has the smallest selection criterion value, 8.32 %. Therefore, transfusion to cross-match ratio of 0.70 is selected to be used in the following experiments. Figure 5.6. illustrates the effects of transfusion to cross-match ratio on the sum of main performance measures. Performance of the region improves when transfusion to cross-match ratio is increased from 0.50, to 0.55, 0.60, 0.65 and 0.70 as depicted on Figure 5.6.

5.3.4. Policy Group 3

The effects of the following parameters and effects of intercity and interregional transfers on performance measures are analyzed together:

- Target Inventory Level Coefficients of DCs and RBC (considered to be equal for DCs and RBC)
- Ad-Hoc Delivery Coefficient for DCs
- RBC Lower Limit Coefficient

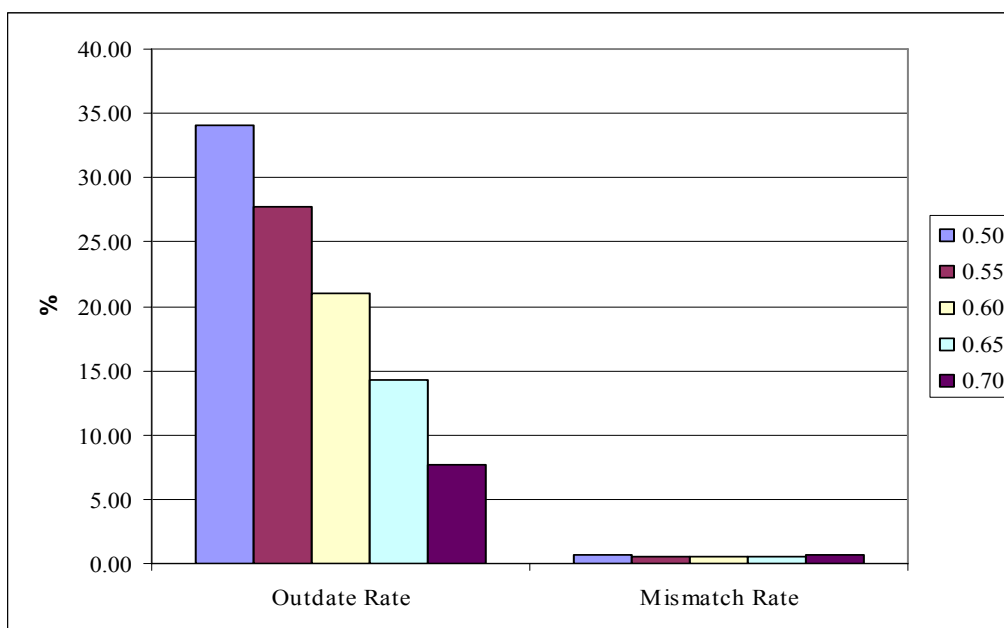


Figure 5.4. Effects of Transfusion to Cross-Match on Outdate and Mismatch Rates of the Region Including DCs and RBC

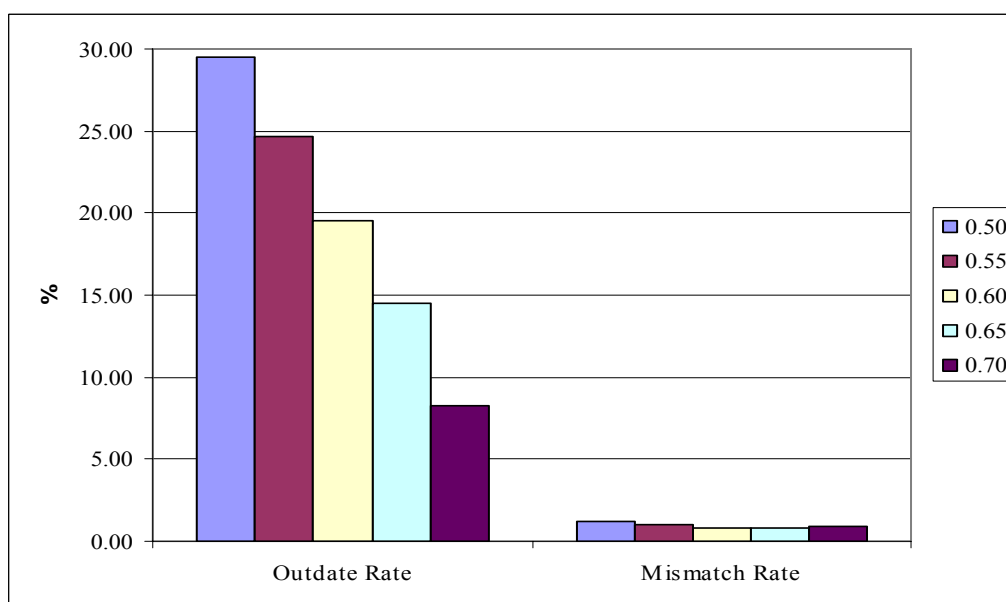


Figure 5.5. Effects of Transfusion to Cross-Match Ratio on TCs' Single Performances Means

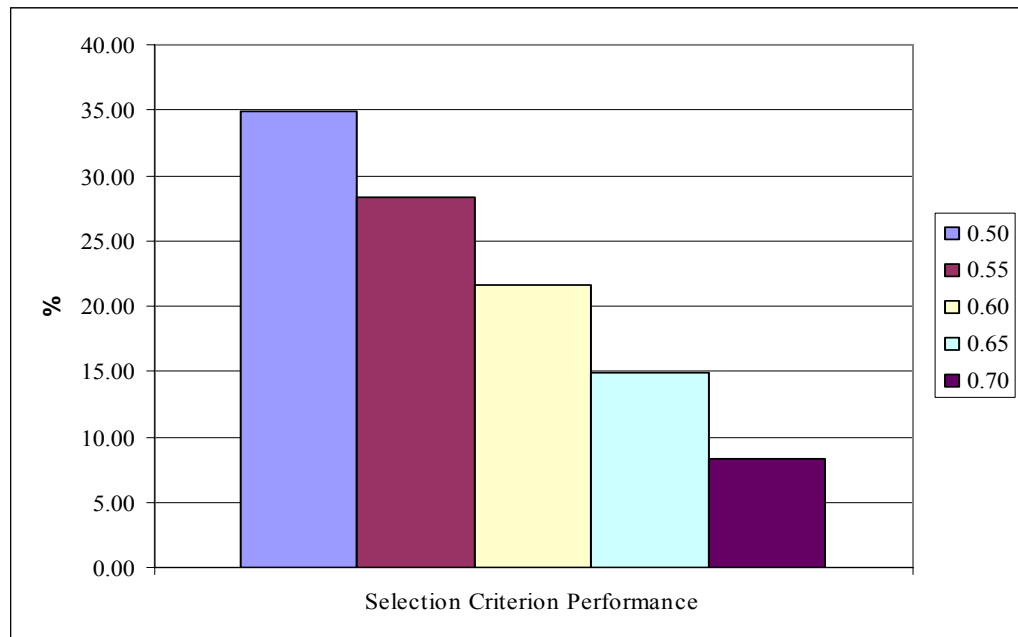


Figure 5.6. Effects of Transfusion to Cross-Match Ratio on the Sum of Main Performance Measures

Intercity or interregional transfers are not allowed in the baseline policy, and in policies belonging to the policy group 1 and 2. Policies of group 3 allow transfers between DCs and RBC, and also transfers from RBC to other regions. Parameters which define the conditions of transfers from DCs to RBC and RBC to other regions are considered to be the same for all policies belonging to the group 3. IAPP_Hd, IAPP_Sd, IAPP_RHd, and IAPP_Rd values are specified as 1.1, 0.1, 1.1 and 0.1, respectively. Target inventory level coefficient is considered to be equal for DCs and RBC. Values used for target inventory level coefficients of DCs and RBC, ad-hoc delivery coefficient for DCs, and RBC lower limit coefficient vary between 2 to 5, 0.1 to 0.5, 0.2 to 0.5 respectively. 80 different combinations of these parameters are used to construct alternative policies. Results of the simulation experiments of the policy group 3 and comparisons with the policy 2.4. are given in Appendix E, from Table E.15 to E.17.

Results of the experiments indicate that a dramatic decrease occurs in outdated when intercity and interregional transfers are allowed. Although outdated rate of the region including DCs and RBC is equal to 7.67 for policy 2.4., it varies between 0.64% to 0.97% for policies belonging to group 3. An increase is observed in mismatch rate of the region including DCs and RBC, but not as significant as of decrease in outdated.

Regression analyses using SPSS 14.0 are done to analyze the effect of the parameters on the main performance measures, selection criterion performance and the total number of deliveries. Model summaries, Anova statistics and coefficient tables of the analyses are given in Appendix E, from Table E.18 to Table E.32. Main indications obtained from the analyses are given below, noting that these indications are only valid within the analyzed boundaries of parameters:

- RBC lower limit coefficient and ad-hoc delivery coefficient for DCs do not have a significant contribution on the main performance measures, selection criterion performance, and total number of deliveries given that target inventory level coefficients of DCs and RBC are included.
- There is a negative correlation between outdated rate of the region including DCs and RBC, and target inventory level coefficients of DCs and RBC.
- There is a negative correlation between mismatch rate of the region including DCs and RBC, and target inventory level coefficients of DCs and RBC.
- There is a negative correlation between selection criterion performance and target inventory level coefficients of DCs and RBC.

Policy 3.32. has the smallest selection criterion value, which is equal to 1.35 %. We select values of 0.50 and 0.40 to be used in the following experiments for RBC lower limit coefficient, and ad-hoc delivery coefficient for DCs, respectively, although regression analyses indicate that they do not have an important effect on the main performance measure. These values are the ones used in policy 3.32.

Some additional policies are also analyzed to investigate the effect of target inventory level coefficients of DCs and RBC. The cases where target inventory level coefficients of DCs and RBC are equal to 6, 7, 8, 9, and 10 are investigated using the same values with the policy 3.32 for other parameters. Results of the simulation experiments indicate that outdate rate of the region including DCs and RBC increases and mismatch rate of the region including DCs and RBC decreases when target inventory level coefficients of DCs and RBC are increased from 6 to 7, 8, 9 and 10. Results of the simulation experiments of policies derived from policy 3.32 by increasing target inventory levels, are given in Appendix E, from Table E.33 to Table E.39.

5.3.5. Policy Group 4

The effects of the following parameters on performance measures are analyzed together:

- Target inventory level coefficients of DCs and RBC (considered to be equal for DCs and RBC).
- Disposal age of units at DCs and RBC (considered as a policy parameter, because to send younger units to TCs is better in terms of customer satisfaction).
- The maximum age of the units to be transferred to DCs, to RBC and to other regions (considered to be equal for DCs, RBC and other regions).

Higher values for target inventory level coefficients of DCs and RBC are used to construct alternative policies, as the system performs better with higher values. Values used for target inventory level coefficients of DCs and RBC vary between 4 to 8. Two main cases are considered for parameters defining age restrictions; age difference between disposal age of units at DCs and RBC, and the maximum age of units to be transferred is (1) 5 days, (2) 10 days. Values used for disposal age of units at DCs and RBC vary between 25 to 35 for both cases. Values used for the maximum age of units to be transferred vary between 30 to 20, and 25 to 15 for case 1 and case 2, respectively. 105 different combinations of these parameters are used

to construct alternative policies. Results of the simulation experiments of the policy group 4 and comparisons with the policy 3.32. are given in Appendix E., from Table E.40 to E.42.

Regression analyses are done to analyze the effect of the parameters on the main performance measures, selection criterion performance and total number of deliveries by using SPSS 14.0. Model summaries, AnovA statistics and coefficient tables of the regression models are given in Appendix E, from Table E.43 to Table E.57. Main indications obtained from the analyses are given below, noting that these indications are only valid within the analyzed boundaries of parameters:

- Disposal age of units at DCs and RBC, the maximum age of the units to be transferred to DCs, to RBC and to other regions, and the age difference between them do not have a distinctive contribution on the main performance measures, selection criterion performance, and total number of deliveries given that target inventory level coefficients of DCs and RBC are included.
- There is a positive correlation between outdate rate of the region including DCs and RBC, and target inventory level coefficients of DCs and RBC.
- There is a negative correlation between mismatch rate of the region including DCs and RBC, and target inventory level coefficients of DCs and RBC.
- There is a negative correlation between shortage rate of the region including DCs and RBC, and target inventory level coefficients of DCs and RBC.
- There is a negative correlation between selection criterion performance and target inventory level coefficients of DCs and RBC.
- There is a negative correlation between total number of deliveries and target inventory level coefficients of DCs and RBC.

Results of the simulation experiments of policy group 3 and 4 indicate that demand and supply are balanced at target inventory level coefficients which are higher than four. A trade-off occurs between outdate and mismatch rates for the values greater than four.

Policy 4.61. has the smallest selection criterion value, which is equal to 1.31 %. We select values of 27 and 17 days to be used in the following experiments for disposal age of units at DCs and RBC, and the maximum age of the units to be transferred to DCs, to RBC and to other regions, respectively, although regression analyses indicate that they do not have a meaningful effect on main performance measure. We also select the value of target inventory level coefficients of DCs and RBC as 6 to be used in the following experiments. These values are the ones used in policy 4.61.

5.3.6. Policy Group 5

The effects of review period of TCs for routine deliveries, target inventory level coefficients of TCs, different allocation and issuing methods, on performance measures are analyzed together. Two different allocation policies (APN-0 and APN-1) and two different issuing methods (IPN-0 and IPN-1) are considered. The same values are used for all TCs for routine delivery review periods and for target inventory level coefficients within a policy. Values used for routine delivery review period and target inventory level coefficient of TCs vary between 1 to 3, and 2 to 6, respectively. 60 different combinations of these parameters are used to construct alternative policies. Results of the simulation experiments of policy group 5 and comparisons with policy 4.61. are given in Appendix E, from Table E.58 to Table E.60. Policy 5.9. has the smallest selection criterion value, which is equal to 1.29 %. The values used in Policy 5.9. are not selected for use in the following experiments, because there is an opportunity to reach better results by using different routine delivery periods for TCs and different target inventory level coefficients for TCs and for blood groups. We tried to reach better performances by analyzing the effects of parameters in more detail.

Allocation and issuing methods can be defined for the whole supply chain in the simulation model. However, routine delivery review period can be defined for each TC and target inventory level can be defined specific to each TC and with respect to every blood group, separately. Therefore, we begin with the analyses of issuing and

allocation method combinations. There are four different combinations of these policies: (1) IPN-0 & APN-0, (2) IPN-0 & APN-1, (3) IPN-1 & APN-0, and (4) IPN-1 & APN-1. Figure 5.7., Figure 5.8. and Figure 5.9. illustrate selection criterion performance of combinations for different values of target inventory level coefficients of TCs where routine delivery review period is equal to 1, 2 and 3 days, respectively. Combination 3 performs better than the other three for all considered values in terms of selection criterion, as depicted in the figures. Therefore, we select combination 3 to be used in the following experiments. Then we continue analyses with routine delivery review periods of TCs. Table E.61. is formed by eliminating the policies where combination 3 is not used. Table E.61 shows the selection criterion performance values of TCs for the policies where issuing method 1 and allocation method 0 are used. Orange highlighted values show the minimum selection criterion value for each target inventory level coefficient (At_b) value, for each TC. Therefore, it also indicates the routine delivery review period resulting with the minimum selection criterion value for a specific target inventory level coefficient for a specific TC. Routine delivery review period value of each TC is determined by visual inspection. While determining the values to be used in the following experiments, priority is given to the routine delivery review period which has the minimum selection criterion values for higher target inventory level coefficient values of TC, because supply chain performs better with higher target inventory level coefficients of TCs in terms of selection criterion performance as depicted on Figures 5.7., 5.8., and 5.9. Selected routine delivery review period of each TC is also given in Table E.61.

After determining routine delivery review period of each TC, we continued analyses with target inventory level coefficients of TCs. Tables E.62 to E.69 show the selection criterion values of TCs for the blood groups 0+, 0-, A+, A-, B+, B-, AB+, AB-, respectively. While forming the tables, we only considered the policies where issuing method 1 and allocation method 0 are used. Orange highlighted values in Tables E.62 to E.69 correspond to the minimum selection criterion value for each routine delivery period value, for each TC. In other words, these values indicate target inventory level coefficient value resulting with the minimum selection

criterion value for a specific routine delivery review period and for a specific TC. We determine target inventory level coefficient values for each TC for each blood group separately. While determining the values for each TC, we select target inventory level coefficient value which is corresponding to the minimum selection criterion value for the previously determined routine delivery review period value of the TC. Table 5.4. shows the selected values of routine delivery review periods and target inventory level coefficients for each blood group and for each TC. These values are used in the following experiments.

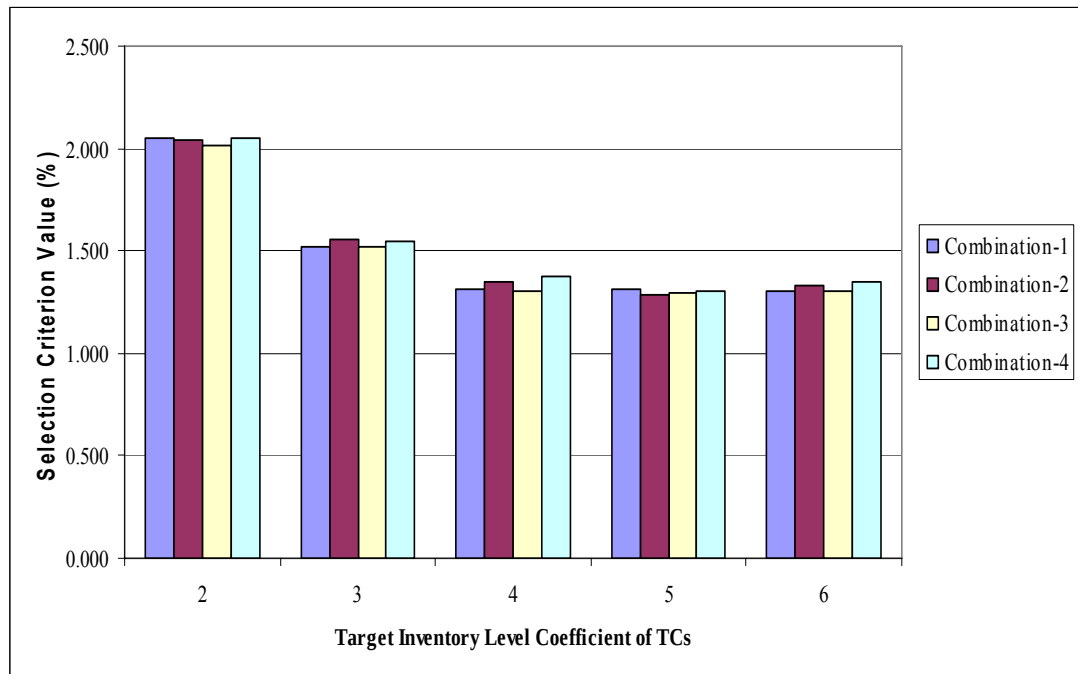


Figure 5.7. Selection Criterion Performance of Issuing and Allocation Methods Combinations Where Routine Delivery Review Period is One Day

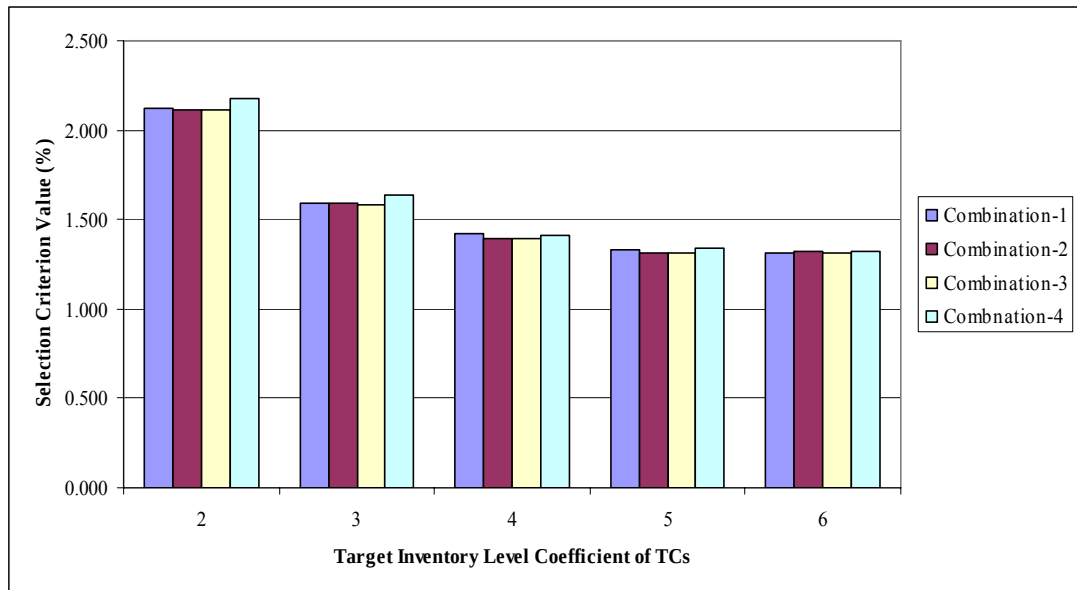


Figure 5.8. Selection Criterion Performance of Issuing and Allocation Methods
Combinations Where Routine Delivery Review Period is Two Days

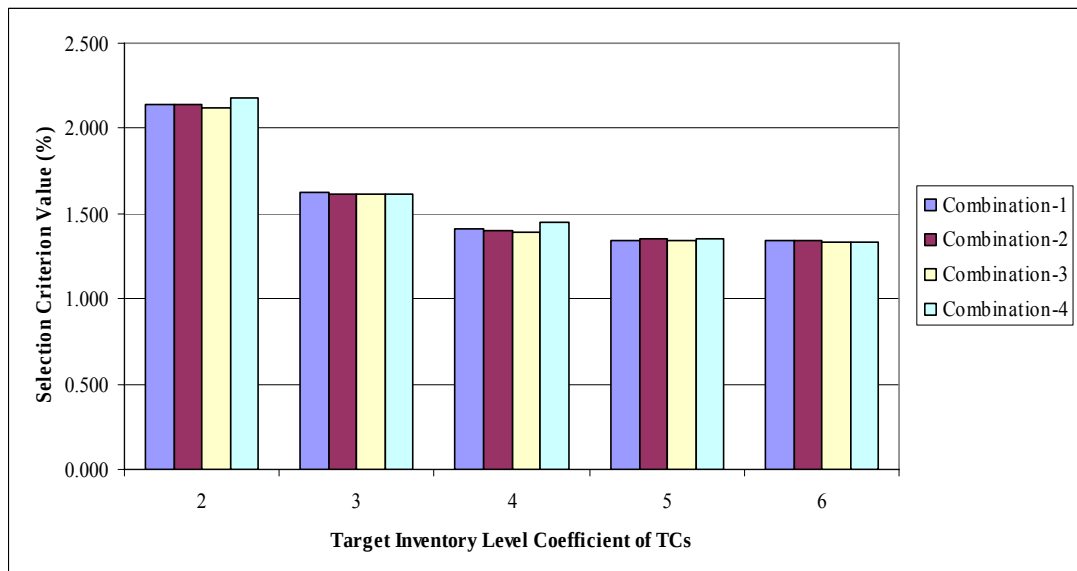


Figure 5.9. Selection Criterion Performance of Issuing and Allocation Methods
Combinations Where Routine Delivery Review Period is Three Days

5.3.7. Policy Group 6

Seven alternative policies are constructed by using different target inventory level coefficient values for TCs and blood groups. The values in Table 5.4. are used in policy 6.1. Results of the previous policy groups indicate that higher outdate and mismatch rates occur for blood groups with small blood group frequencies. Therefore, an alternative management policy for these blood groups is tested in the policies from 6.2. to 6.6. Target inventory level of blood groups with small frequencies is considered zero for all TCs. In each policy from 6.2. to 6.6. only one of these blood groups' target inventory level coefficient is equal to zero for all TCs, other values are equal to the ones given on Table 5.4. Blood groups target inventory level coefficient of which is considered to be equal to zero, are 0-, A-, B-, AB-, AB+ for policies 6.2. to 6.6., respectively. TCs do not carry inventory for the blood group target inventory level coefficient of which is equal to zero. When a request for this blood group occurs, an emergency delivery is done by RBC or DC to fulfill the request.

Results of the simulation experiments of the policy group 6 and comparisons with the policy 5.9. are given in Appendix E, Tables E.70 to E.77. Tables E.78, E.80, E.82, E.83, and E.84 show the selection criterion values of each TC for blood groups 0-, A-, B-, AB+, and AB-, respectively. The smallest selection criterion value for each TC and for each blood group is determined from the results of policies 6.1. to 6.6.

We decided whether to use zero or the values in Table 5.4. for target inventory level coefficients of each TC for blood groups 0-, A-, B-, AB-, AB+ separately, based on the smallest selection criterion values.. These values are used to construct Policy 6.7. Target inventory level coefficient values of TCs used in Policy 6.7. are given in Table 5.5.

Table 5.4. Selected Values of Routine Delivery Review Periods and Target Inventory Level Coefficients

TC	DPTb	ATb0pos	ATb0neg	ATbApos	ATbAneg	ATbBpos	ATbBneg	ATbABpos	ATbABneg
TC1	2	6	6	6	6	6	6	5	6
TC2	2	6	5	6	4	6	3	4	2
TC3	2	6	5	6	4	6	5	4	4
TC4	2	6	3	5	3	5	2	4	2
TC5	2	6	6	6	4	3	2	4	4
TC6	2	6	5	6	5	6	2	3	3
TC7	2	6	5	6	2	4	2	4	2
TC8	1	6	3	6	2	4	2	4	2
TC9	2	5	5	6	3	4	3	2	2
TC10	2	6	4	6	4	4	6	2	2
TC11	1	6	5	6	2	6	4	5	2
TC12	2	6	4	6	2	3	2	2	3
TC13	2	5	5	6	4	3	5	3	2
TC14	2	6	6	6	4	6	5	5	2
TC15	1	6	3	6	2	2	3	5	3
TC16	1	5	4	6	4	3	2	4	3
TC17	1	5	3	6	4	4	2	2	2
TC18	1	6	6	6	6	6	6	6	6
TC19	1	6	6	6	6	6	4	6	5
TC20	1	5	6	6	6	6	4	6	3
TC21	2	6	4	6	2	4	4	4	3
TC22	1	5	4	6	3	6	6	5	2
TC23	1	6	4	5	4	6	3	3	3
TC24	1	6	3	6	3	6	3	4	2
TC25	1	4	3	6	2	3	2	4	3
TC26	1	5	3	6	3	4	3	3	2
TC27	2	6	6	6	5	5	2	5	2
TC28	1	6	5	6	5	5	3	3	3
TC29	1	6	5	6	6	6	5	4	3
TC30	1	5	4	6	4	4	3	4	2
TC31	2	6	5	6	4	6	2	4	3
TC32	1	6	5	6	6	6	6	6	2
TC33	1	6	2	6	2	6	3	5	2
TC34	1	6	6	5	6	6	6	6	4
TC35	1	6	2	6	2	4	4	3	3
TC36	2	6	5	5	2	5	3	2	2
TC37	1	6	4	6	2	6	4	4	3
TC38	2	6	5	6	6	6	6	6	5
TC39	3	6	5	6	3	6	3	4	2
TC40	1	6	6	6	6	6	6	5	2
TC41	2	6	4	6	6	6	2	2	3
TC42	1	6	6	6	2	3	6	2	4
TC43	3	5	3	6	4	4	2	2	5
TC44	1	6	2	6	2	3	2	6	3
TC45	1	5	4	6	3	5	2	1	3
TC46	1	5	3	6	2	3	2	5	3
TC47	1	6	3	6	3	3	2	6	4
TC48	3	6	5	6	6	6	5	5	6
TC49	2	5	2	6	3	3	6	3	4

Table 5.5. Target Inventory Level Coefficient Values of TCs Used In Policy 6.7.

TC	ATb0pos	ATb0neg	ATbApos	ATbAneg	ATbBpos	ATbBneg	ATbABpos	ATbABneg
TC1	6	6	6	6	6	6	5	0
TC2	6	0	6	4	6	0	4	0
TC3	6	0	6	0	6	0	4	0
TC4	6	0	5	0	5	0	0	0
TC5	6	0	6	0	3	0	0	0
TC6	6	0	6	0	6	0	3	0
TC7	6	0	6	0	4	0	0	0
TC8	6	0	6	0	4	0	0	0
TC9	5	0	6	0	4	0	0	0
TC10	6	0	6	0	4	0	0	0
TC11	6	0	6	0	6	0	5	0
TC12	6	0	6	0	3	0	0	0
TC13	5	0	6	0	3	0	0	0
TC14	6	0	6	4	6	0	5	0
TC15	6	0	6	0	2	0	0	0
TC16	5	0	6	0	3	0	0	0
TC17	5	0	6	0	4	0	0	0
TC18	6	6	6	6	6	6	6	6
TC19	6	6	6	6	6	4	6	0
TC20	5	6	6	6	6	0	6	0
TC21	6	0	6	0	4	0	0	0
TC22	5	0	6	0	6	0	0	0
TC23	6	4	5	4	6	0	3	0
TC24	6	0	6	0	6	0	4	0
TC25	4	0	6	0	3	0	0	0
TC26	5	0	6	0	4	0	0	0
TC27	6	0	6	5	5	0	5	0
TC28	6	0	6	0	5	0	3	0
TC29	6	5	6	6	6	0	4	0
TC30	5	0	6	0	4	0	0	0
TC31	6	0	6	4	6	0	4	0
TC32	6	5	6	6	6	0	6	0
TC33	6	0	6	0	6	0	5	0
TC34	6	6	5	6	6	0	6	0
TC35	6	0	6	0	4	0	0	0
TC36	6	0	5	0	5	0	0	0
TC37	6	0	6	0	6	0	4	0
TC38	6	5	6	6	6	6	6	0
TC39	6	5	6	3	6	0	4	0
TC40	6	6	6	6	6	0	5	0
TC41	6	4	6	6	6	0	2	0
TC42	6	0	6	0	3	0	0	0
TC43	5	0	6	0	4	0	0	0
TC44	6	0	6	0	3	0	0	0
TC45	5	0	6	0	5	0	0	0
TC46	5	0	6	0	3	0	0	0
TC47	6	0	6	0	3	0	0	0
TC48	6	5	6	6	6	5	5	0
TC49	5	0	6	0	3	0	0	0

Results indicate that emergency delivery alternative performs better for small-sized hospitals and for blood groups with small frequencies. Meaningful improvements are achieved by using emergency delivery strategy in terms of outdate rates, mismatch rates and selection criterion. Figure 5.10 illustrates the change of selection criterion performances, outdate rates and mismatch rates of the region including DCs and RBC for Policies from 6.1. to 6.7 and Policy 5.9.

Policy 6.7. has the smallest selection criterion value, which is equal to 0.84 %. Therefore, values on Table 5.5. are selected to be used in the following experiments.

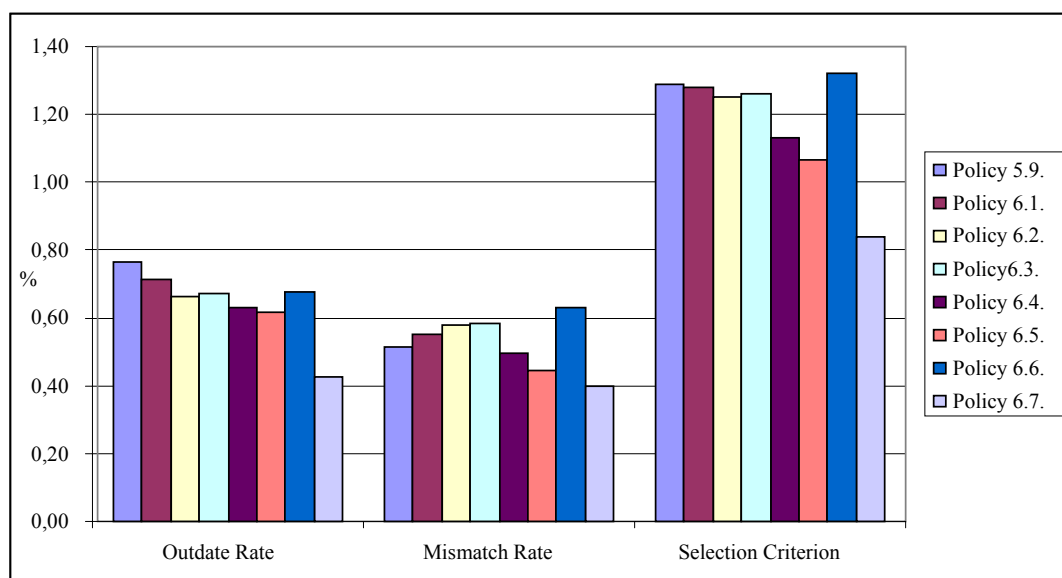


Figure 5.10. Change of Selection Criterion Values, Outdate Rates and Mismatch Rates of the Region Policies from 5.9 to 6.7

5.3.8. Policy Group 7

The effects of routine delivery coefficient and ad-hoc delivery coefficient of TCs on performance measures are analyzed. Values used for routine delivery coefficient and ad-hoc delivery coefficient of TCs are 1.0, 0.9, 0.8 and 0.3, 0.4, 0.5 respectively. All combinations of these values are used and 9 alternative policies are constructed. Results of the simulations of the policy group 7 and comparisons with Policy 6.7. are given in Appendix E, on Tables E.86 to E.92. Figure 5.11, Figure 5.12. and Figure 5.13 illustrate the effects of ad-hoc delivery coefficient of TCs on selection criterion performance, and outdate and mismatch rates of the region including DCs and RBC where routine delivery coefficient of TCs is equal to 1, 0.9, and 0.8 respectively. Ad-hoc delivery coefficient of TCs has no meaningful effect on outdate rate of the region including DCs and RBC for the analyzed ranges. However, higher ad-hoc delivery coefficient values correspond to lower mismatch rates of region including DCs and RBC. Effect of ad-hoc delivery coefficient of TCs on mismatch rates of the region is more consequential for the cases where routine delivery coefficient is equal to 0.8 and 1.

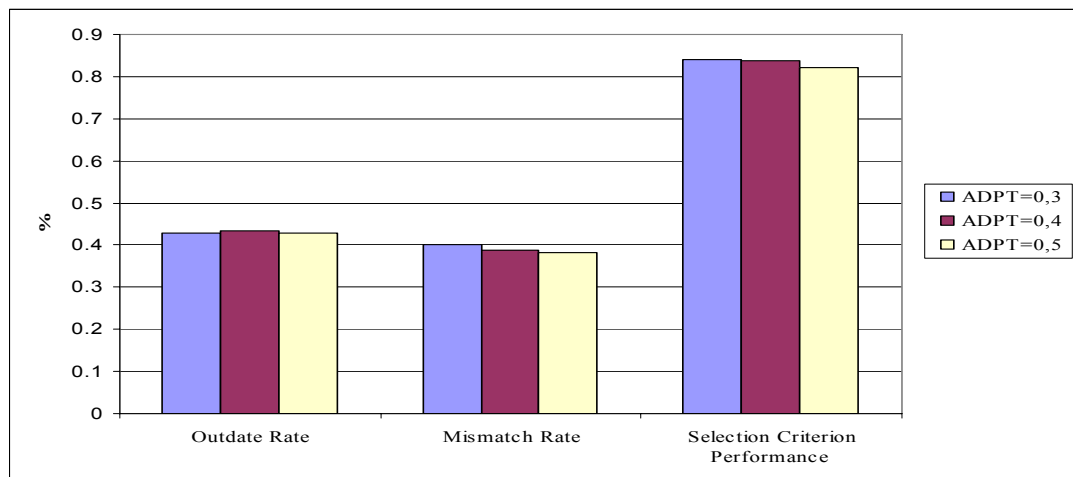


Figure 5.11. Effects of Ad-Hoc Delivery Coefficient of TCs on Region's Performance where Routine Delivery Coefficient of TCs is Equal to 1

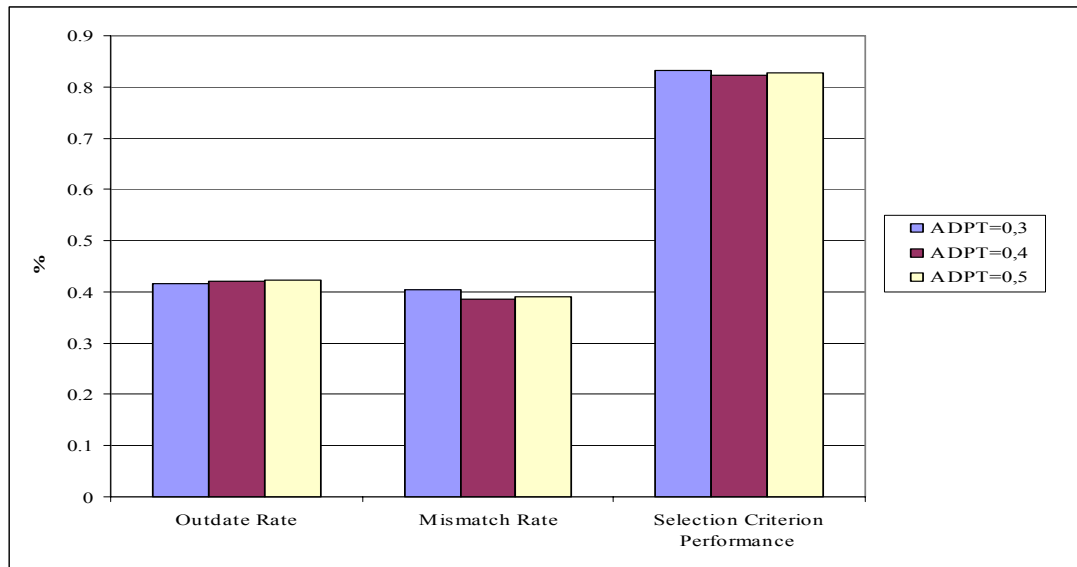


Figure 5.12. Effects of Ad-Hoc Delivery Coefficient of TCs on Region's Performance where Routine Delivery Coefficient of TCs is Equal to 0.9

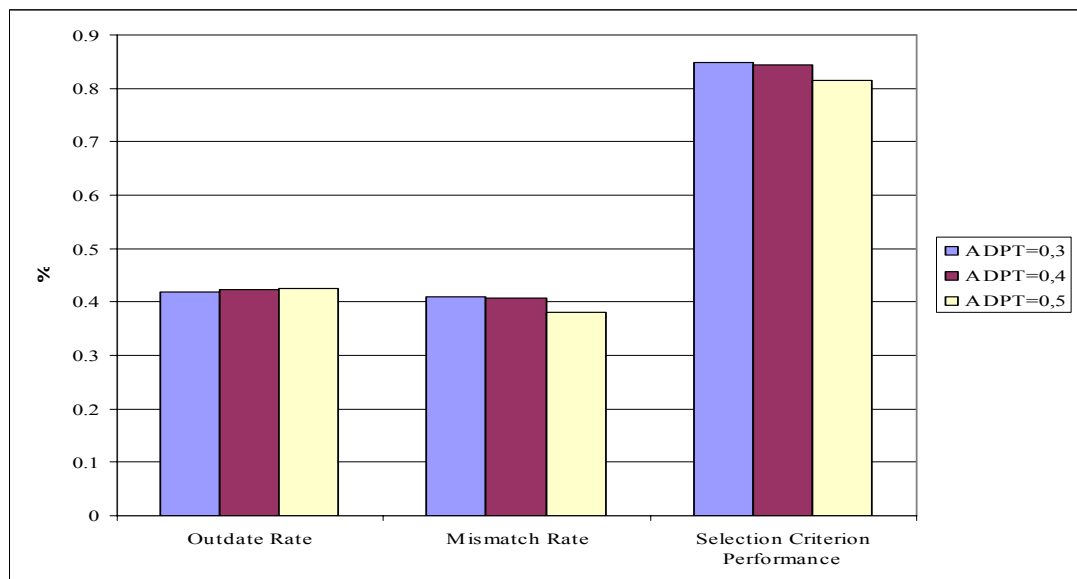


Figure 5.13. Effects of Ad-Hoc Delivery Coefficient of TCs on Region's Performance where Routine Delivery Coefficient of TCs is Equal to 0.8

Figure 5.14, Figure 5.15. and Figure 5.16 illustrate the effects of routine delivery coefficient on the selection criterion performance, outdate and mismatch rates of the region including DCs and RBC where ad hoc delivery percentage of TCs is equal to 0.5, 0.4, and 0.3 respectively.

Routine delivery coefficient has no meaningful effect on outdate and mismatch rates of the region including DCs and RBC for the analyzed ranges. However, smallest values for outdate rates appear when routine delivery coefficient is equal to 0.90.

The policy (Policy 7.8.), having routine delivery coefficient value of 0.80 and ad-hoc delivery coefficient value of 0.50, has the smallest selection criterion value, 0.81 %. Therefore, 0.80 and 0.50 are selected to be used in the following experiments for routine delivery coefficient and ad-hoc delivery coefficient, respectively.

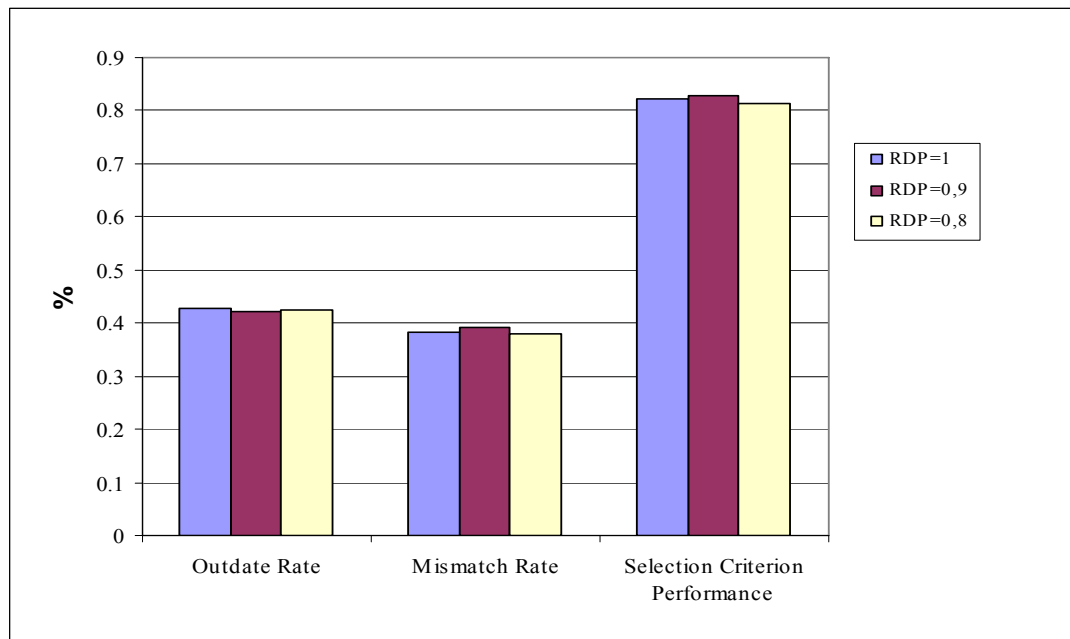


Figure 5.14. Effects of Routine Delivery Coefficient of TCs on Region's Performance where Ad-hoc Delivery Coefficient of TCs is Equal to 0.5

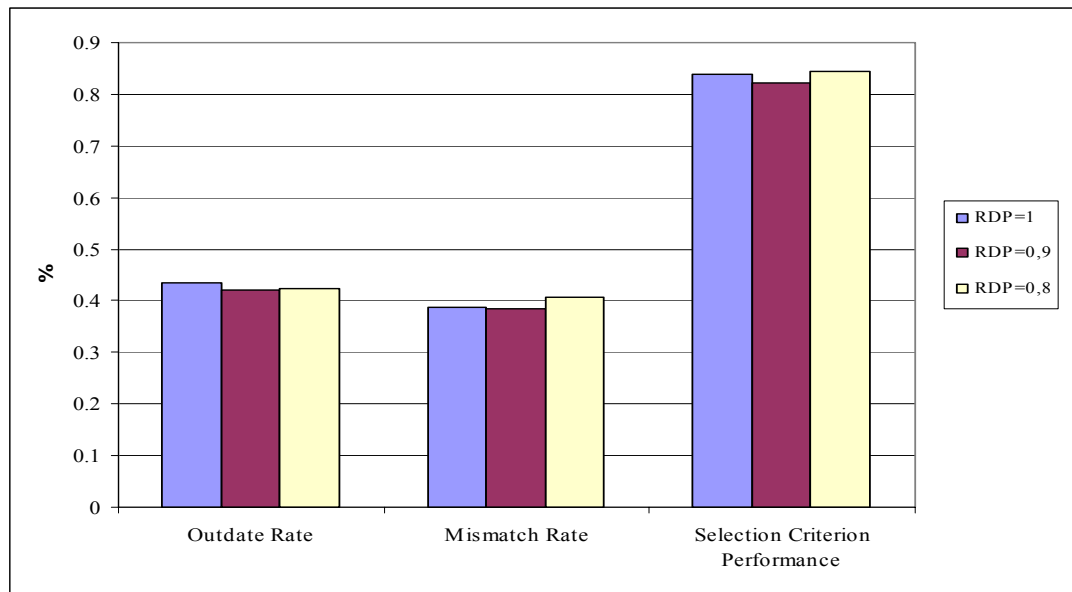


Figure 5.15. Effects of Routine Delivery Coefficient of TCs on Region's Performance where Ad-hoc Delivery Coefficient of TCs is Equal to 0.4

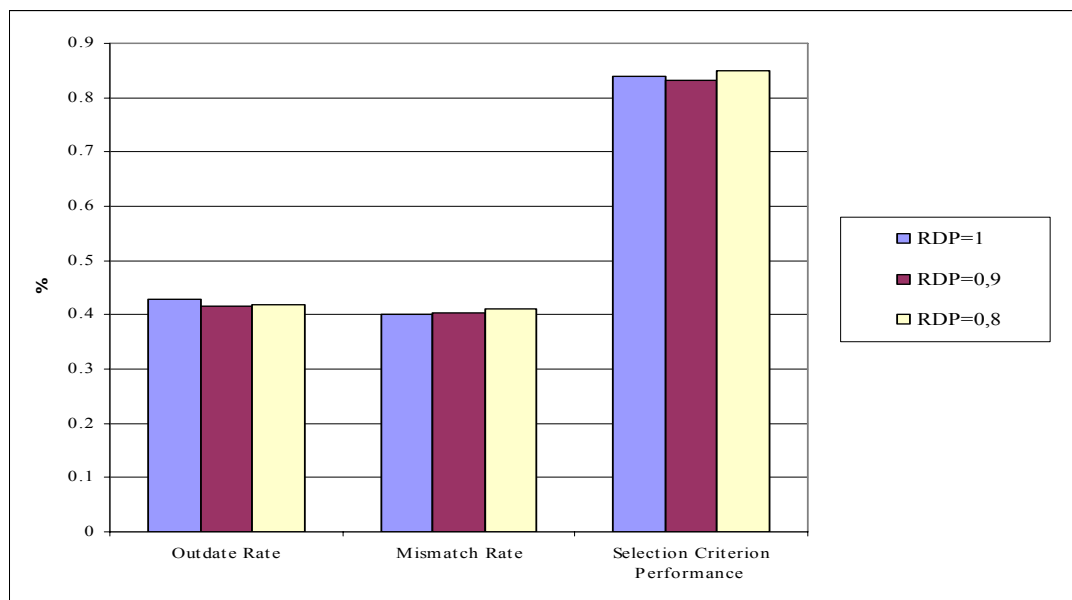


Figure 5.16. Effects of Routine Delivery Coefficient of TCs on Region's Performance where Ad-hoc Delivery Coefficient of TCs is Equal to 0.3

5.3.9. Policy Group 8

Results of the previous policy groups indicate that Burdur's performance in terms of outdate, mismatch and shortage rates is worse than the other two. One of the main reasons of this situation is predicted to be the imbalance between the demand and supply of the city, because Burdur's blood demand is higher than the blood collections in the city. Therefore, higher (the same target inventory level coefficient values are used for both of the DCs and RBC in the previous experiments) target inventory level coefficient values for Burdur DC are used to construct alternative policies. Other parameters used in policy group 8 are the same with the policy 7.8. Values used for target inventory level coefficient of Burdur vary from 7 to 12. Results of the simulations of the policy group 8 and comparisons with Policy 7.8. are given in Appendix E, on Tables E.93 to E.99.

Figure 5.17. illustrates the effect of the changes of Burdur DC's target inventory level coefficient on selection criterion value of the region and outdate, mismatch, and shortage rates of the city. Simulation experiments indicate that an important decrease occurs in mismatch rate of Burdur when target inventory level coefficient is increased from 6 to 10. Decrease in mismatch rate continues with the increasing values of target inventory level coefficient, but not as significant, thereafter. Simulation experiments also indicate that an important decrease occurs in outdate and shortage rates of Burdur when target inventory level coefficient is increased from 6 to 9. Supply and demand of Burdur city seems to be balanced at the target inventory coefficient value of 10, as the policy (Policy 8.4.), having target inventory level coefficient value of 10 has the smallest selection criterion value, 0.75 %. Target inventory level coefficient value of 10 is selected to be used in the following experiments.

5.3.10. Policy Group 9

The effects of upper inventory limit and excessive amount coefficients of DCs and RBC are analyzed. Upper inventory limit coefficients and excessive amount coefficients are considered to be the same for DCs and RBC in all policies belonging

to the group 9. Values of upper inventory limit and excessive amount coefficients used to construct alternative policies vary from 1.2 to 1.6 and 0.2 to 0.6, respectively. Six alternative policies are constructed using different values for these coefficients. Results of the simulations of the policy group 9 and comparisons with Policy 8.4. are given in Appendix E, on Tables E.100 to E.106.

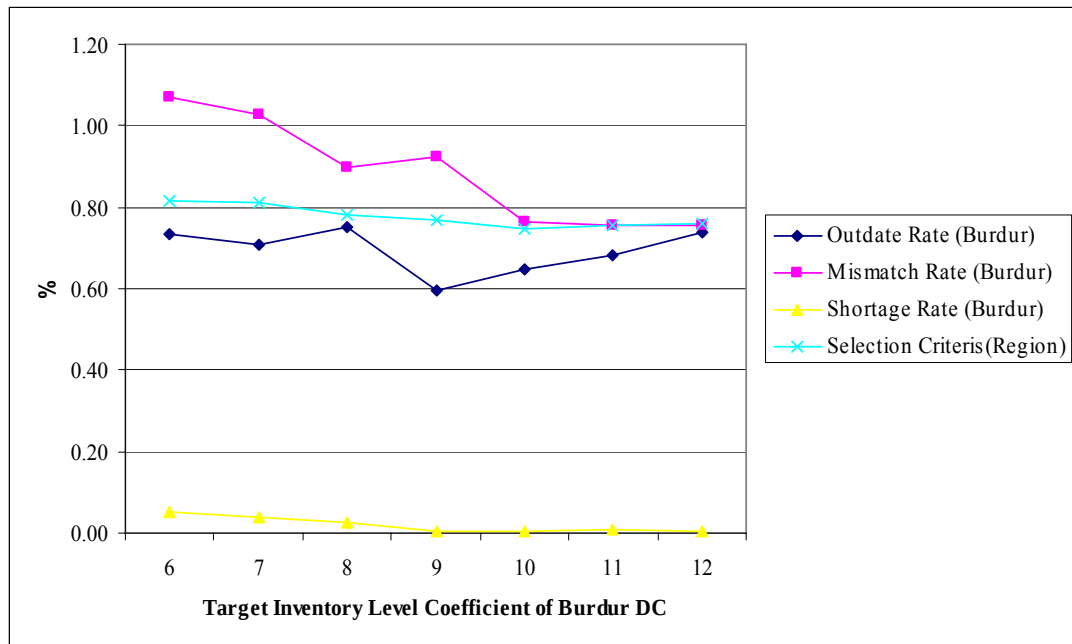


Figure 5.17. Effect of Burdur DC's target inventory level coefficient on selection criterion value of the region and outdate, mismatch, and shortage rates of the city

Figure 5.18 illustrates the effects of different upper inventory limit and excessive amount coefficients pairs on the main performance measures and selection criterion value. Simulation experiments indicate that a meaningful decrease in mismatch rate and an important increase in outdate rate occur when values of upper inventory limit and excessive amount coefficients pairs are increased from 1.2-0.2 to 1.6-0.6. The policy (Policy 9.2.), using upper inventory limit and excessive amount coefficients

pair of 1.3-0.3, has the smallest selection criterion value, 0.72 %. This value is the smallest selection criterion value of all policies analyzed before in this study. An important observation for policy group 9 is that outdate rates of the region including DCs and RBC, and excluding DCs and RBC become closer to each other. In other words outdate rates of DCs and RBC approximate to zero.

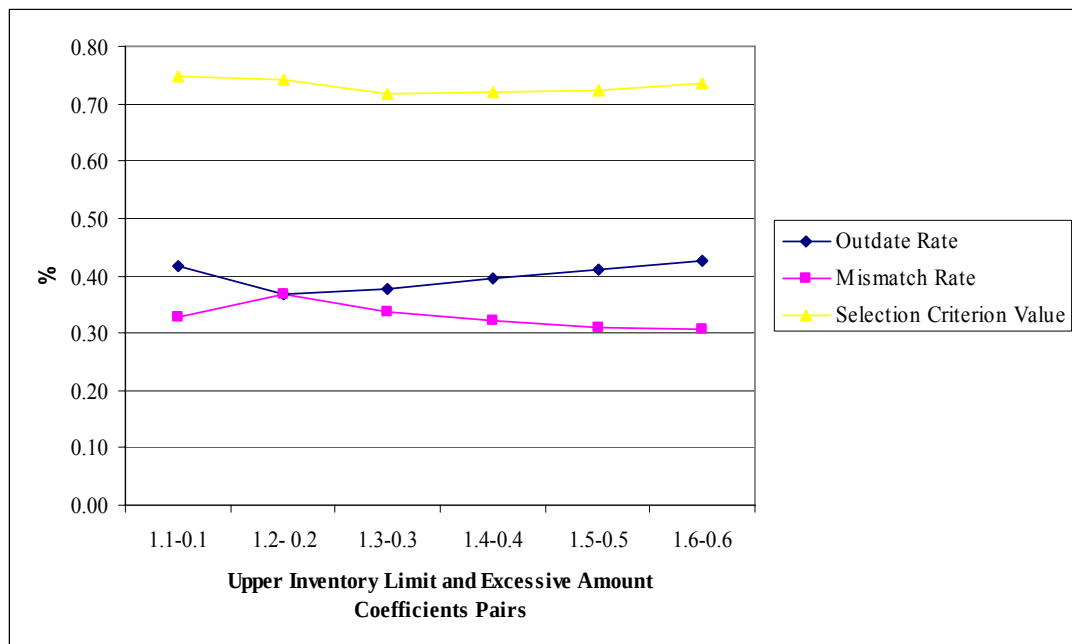


Figure 5.18. Effects of Different Upper Inventory Limit and Excessive Amount Coefficients Pairs on Main Performance Measures and Selection Criterion Value

The most significant improvement is achieved with the change of Hd, RHd, Sd and RSd parameters. This corresponds to the case where intercity and interregional transfers are allowed. These results indicate that allowing intercity and interregional transfers performs better than keeping inventory in centers.

5.4. Comparison of Best Policies of Groups with Baseline Scenario

Detailed comparison of performances of best policies and percentage changes in performance measures achieved with the best policies are given in Appendix E, on Tables E.107 to E.122. Table 5.6. gives a summary of percentage change in performance measures achieved with best policies of groups (values are compared with the baseline policy). Numbers in bold indicate that an improvement is achieved. Table 5.7. shows the values used to construct the best policies of policy groups.

Table 5.6. Summary of Percentage Change in Performance Measures Achieved With Best Policies of Groups

Performance Measures		Values	Percentage Change								
		0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
Region Including DCs and RBC	Outdate Rate	34.41	-0.9%	-77.7%	-98.0%	-97.9%	-97.8%	-98.8%	-98.8%	-98.8%	-98.9%
	Mismatch Rate	3.09	-76.7%	-79.9%	-78.9%	-81.2%	-83.4%	-87.1%	-87.7%	-89.4%	-89.1%
	Shortage Rate	0.57	-92.2%	-95.2%	-95.2%	-97.3%	-98.1%	-98.0%	-98.3%	-99.5%	-99.4%
	Selection Criterion Value	38.08	-8.5%	-78.2%	-96.4%	-96.6%	-96.6%	-97.8%	-97.9%	-98.0%	-98.1%
	Mean Inventory Level	14628	4.4%	-12.6%	-69.0%	-65.4%	-61.8%	-60.5%	-63.7%	-62.2%	-60.4%
	Total Number of Deliveries	140105	-1.0%	-3.6%	-8.3%	-8.5%	-15.1%	-24.5%	-11.5%	-11.9%	-12.6%
	Routine Delivery Percentage	54.00	2.2%	0.1%	0.1%	0.2%	12.9%	-0.5%	-42.7%	-42.3%	-42.0%
City Performances	Selection Criterion Value (Antalya)	3.62	-9.6%	-88.0%	-96.6%	-96.6%	-96.6%	-98.0%	-98.1%	-98.2%	-98.2%
	Selection Criterion Value (Burdur)	39.46	-9.8%	-74.5%	-93.1%	-94.2%	-94.3%	-95.4%	-95.4%	-96.5%	-96.5%
	Selection Criterion Value (Isparta)	43.58	-6.0%	-62.0%	-97.3%	-97.3%	-97.4%	-98.2%	-98.3%	-98.3%	-98.5%
Single TC Performances	Mean of Outdate Rates of TCs	30.51	-3.3%	-72.8%	-95.1%	-94.9%	-94.6%	-97.5%	-97.5%	-97.4%	-97.3%
	Mean of Mismatch Rates of TCs	4.56	-73.4%	-79.5%	-79.0%	-80.9%	-83.1%	-85.7%	-86.4%	-88.2%	-87.9%
	Mean of Shortage Rates of TCs	1.08	-90.7%	-94.6%	-94.9%	-97.0%	-97.8%	-97.4%	-97.7%	-99.2%	-99.2%
	Mean of Selection Criterion Values of TCs	36.15	-14.7%	-74.3%	-93.1%	-93.2%	-93.2%	-96.0%	-96.1%	-96.3%	-96.2%

Table 5.7. Values Used to Construct the Best Policies of Policy Groups

Policy Group	Policy Number	DADC	MASD	MASR	MAST	Ada-Burdur	Ada - Isparta	ADPT	ADPD	Hd	Sd	RHD	RSD	APN	IPN	RDP	LLC	AR	DPTb	Atb	CM	CMTX
0	0	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	1	4	1	4	72	0.5
1	4	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	1	4	1	4	24	0.5
2	4	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	1	4	1	4	24	0.7
3	32	35	25	25	25	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
4	61	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
5	9	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	1	5	24	0.7
6	7	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7
7	8	27	17	17	17	6	6	0.5	0.4	1.1	0.1	1.1	0.1	1	0	0.8	0.5	6	*	**	24	0.7
8	4	27	17	17	17	10	6	0.4	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7
9	2	27	17	17	17	9	6	0.4	0.4	1.3	0.3	1.3	0.3	1	0	1	0.5	6	*	**	24	0.7

* Values in Table 5.4. is used

** Values in Table 5.5. is used

Although sum of outdate, mismatch and shortage rates of region including DCs and RBC is used as a selection criterion to achieve improved policies, important improvements are achieved for all performance measures except routine delivery percentage. In addition to that, single performances of each TC in terms of outdate, shortage and mismatch rates are also improved, as depicted on Table E.117.

Outdate, mismatch, shortage rates and selection criterion value of the region including DCs and RBC are decreased from 34.41% to 0.38%, from 3.09% to 0.34%, from 0.57% to 0.003%, and from 38.08% to 0.72% respectively.

Figure 5.19. illustrates the change in main performance measure of the region including DCs and RBC achieved with the best policies of groups. Mean inventory level of the region and total number of deliveries are also decreased from 14627 to 5799 and from 140105 to 122493, respectively.

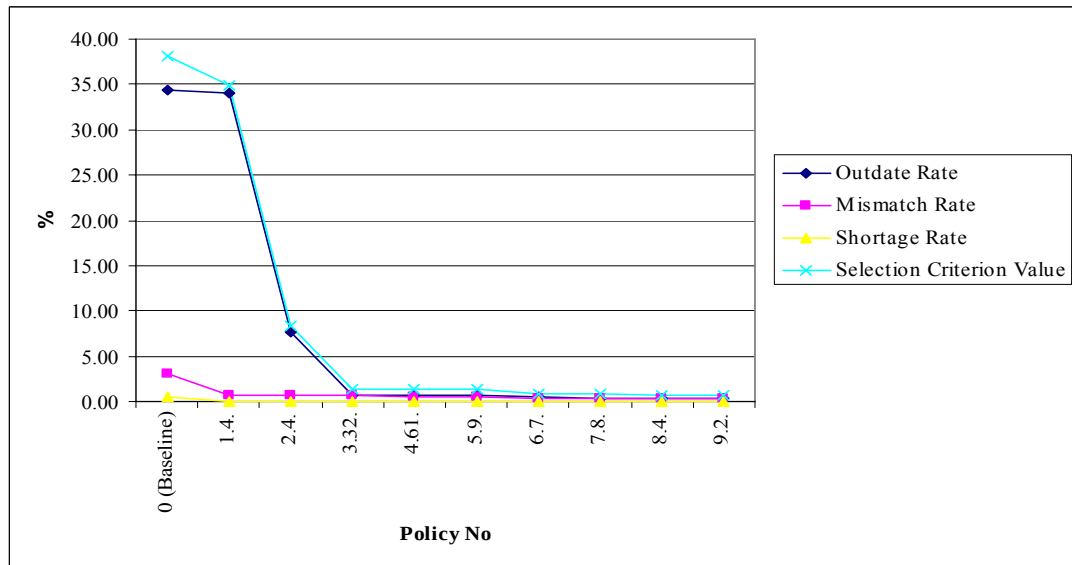


Figure 5.19. The Change in Main Performance Measure of Region Including DCs and RBC Achieved with thw Best Policies of Policy Groups

5.5. General Observations about the Blood Supply Chain

5.5.1. Comparison of Performances of Blood Groups

Figure 5.20. and Figure 5.21. illustrate the outdate and mismatch rates of blood groups for the region including DCs and RBC for Policy 9.2, respectively. AB-blood group has the highest rates for both outdate and mismatch. Although alternative strategies such as emergency delivery are adopted and consequential improvements are achieved for blood groups with small frequencies, blood groups with small frequencies still have higher mismatch and outdate rates than the ones with higher frequencies. Figure 5.22. illustrates the change in outdate rates with different blood group frequencies. Both outdate and mismatch rates increase when blood group frequency decreases, as depicted on Figure 5.22. Although numbers are different, the same behavior is observed for all policies where transfers between DCs and RBC, and from RBC to other regions are allowed. Therefore, generally we can state that special attention is required for blood groups with small frequencies and

proposed policies in this study perform better for blood groups with high frequencies such as A+, 0+ and B+ and AB+.

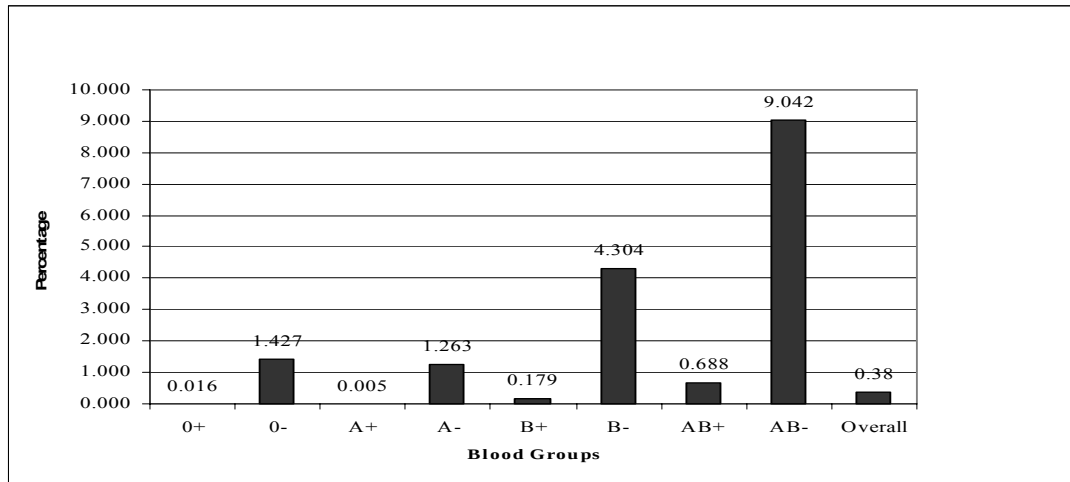


Figure 5.20. Outdate Rates of Blood Groups for Region Including DCs and RBC for Policy 9.2

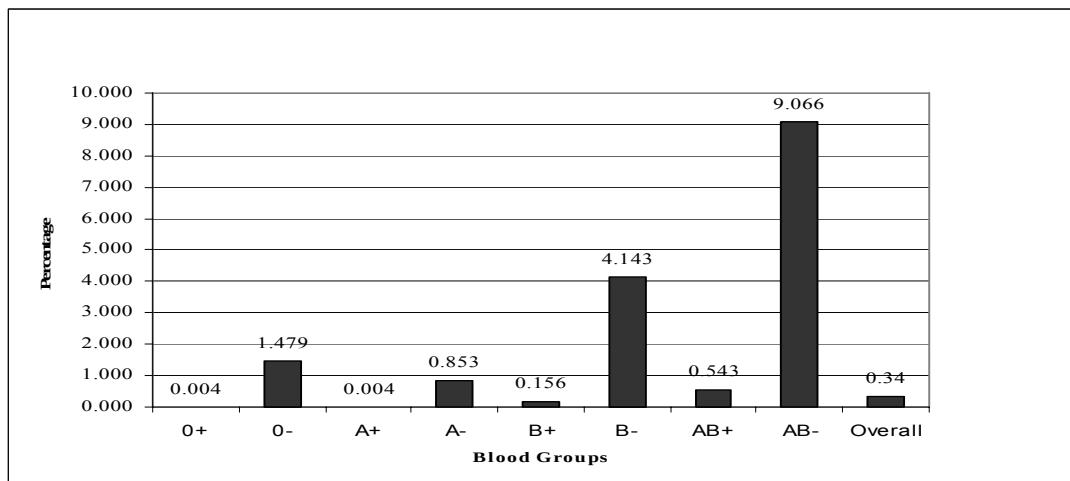


Figure 5.21. Mismatch Rates of Blood Groups for Region Including DCs and RBC for Policy 9.2

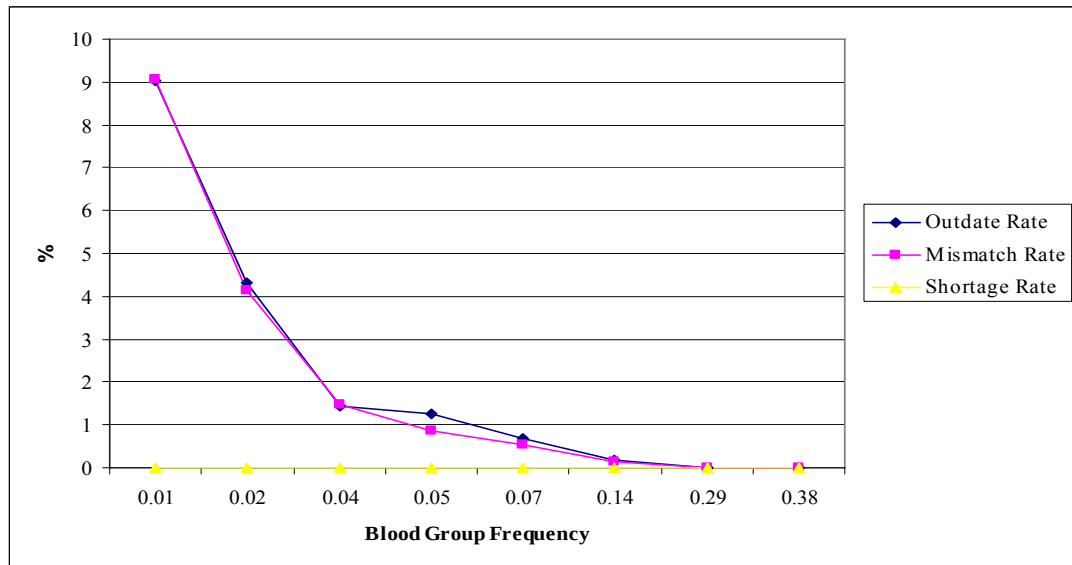


Figure 5.22. Outdate, Mismatch and Shortage Rates For Different Blood Group Frequencies for Region Including DCs and RBC for Policy 9.2

Figure 5.23 illustrates the shortage rates of blood groups for region including DCs and RBC for Policy 9.2, respectively. 0- and 0+ blood groups have the higher shortage rate values than other blood groups. The same behavior is observed for all policies where transfers between DCs and RBC, and from RBC to other regions are allowed, because these blood groups can only be mismatched with each other. Therefore, shortage risks of these blood groups are higher than the others.

5.5.2. Comparison of Performances of Different Sized Hospitals

Figure 5.24., Figure 5.25., and Figure 5.26 illustrate outdate, mismatch and shortage rates of different sized TCs for Policy 9.2, respectively. All of the performance measures decrease when the mean daily requests of hospitals increase. Although numbers are different, the same pattern is observed for all policies where transfers between DCs and RBC, and from RBC to other regions are allowed. Simulation experiments indicate that large sized hospitals perform better than medium and small sized hospitals, in terms of outdate, mismatch and shortage rates.

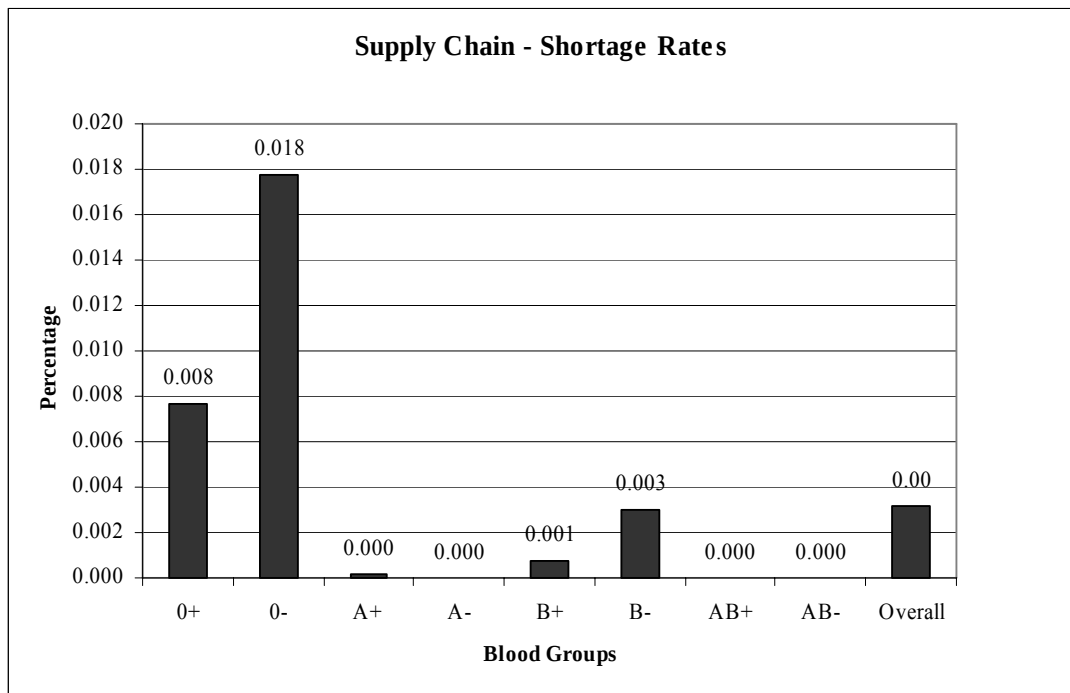


Figure 5.23. Shortage Rates of Blood Groups for the Region Including DCs and RBC for Policy 9.2

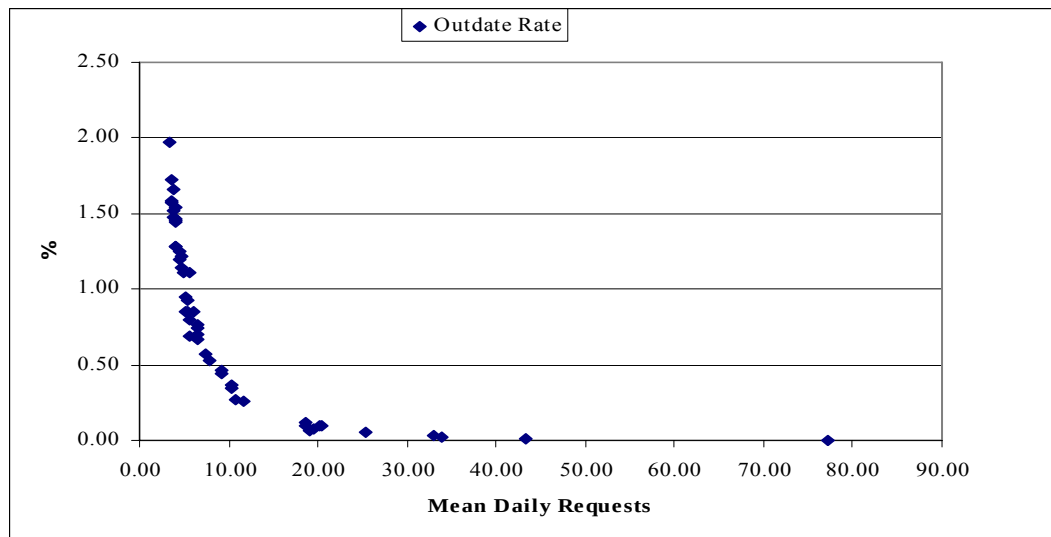


Figure 5.24. Comparison of Outdate Rates of Different Sized TCs for Policy 9.2.

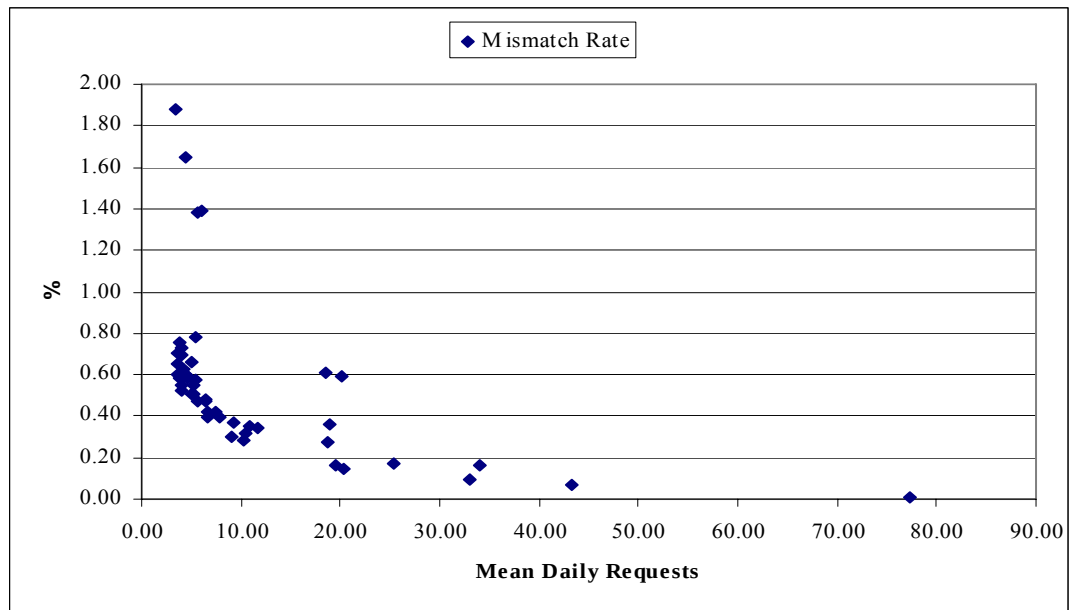


Figure 5.25. Comparison of Mismatch Rates of Different Sized TCs for Policy 9.2.

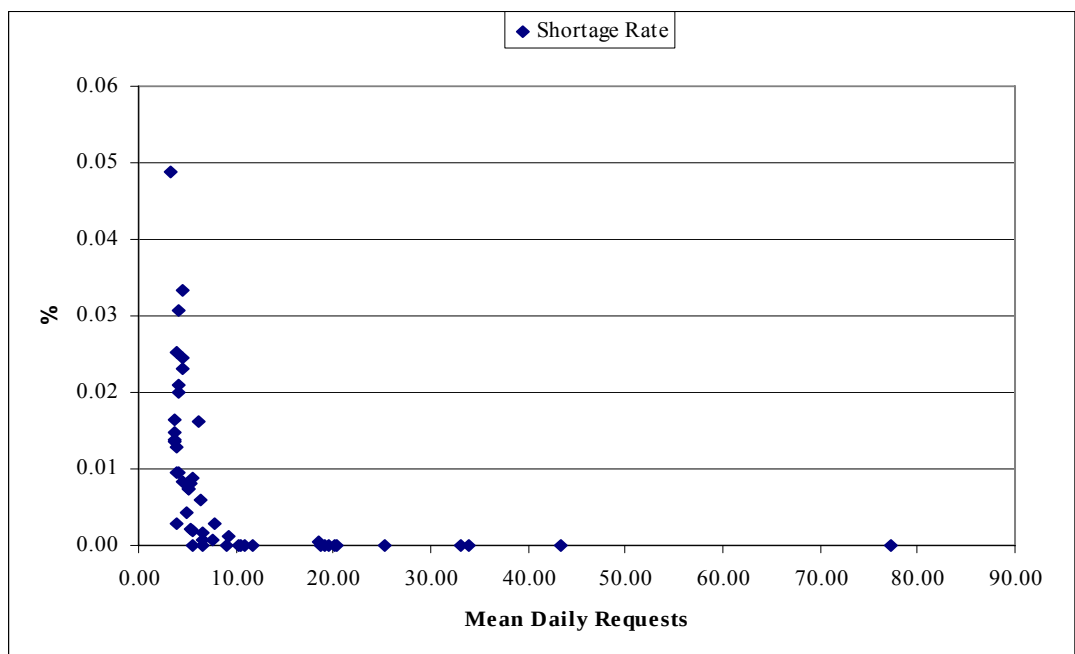


Figure 5.26. Comparison of Shortage Rates of Different Sized TCs for Policy 9.2.

5.6. Comparison of TC Performances with Previous Work

Although the considered environments are not the same, we compare the results of our experiments with the ones in Katsaliaki and Brailsford (2006) to have an idea about the success of the achieved performances. They considered a vertical section of a blood supply chain which consists of 1 RBC and 1 TC. They analyzed the performance of a medium sized hospital with about 21 orders of RBC units per day. There are 3 similar sized hospitals in the region considered in this study. Therefore, we compare the results of policy 9.2. with the results of the best scenario reported in Katsaliaki and Brailsford, 2006. Table 5.8. shows the comparison of the average numbers of outdated, mismatched and shortage units per day, and the ratios of these values to mean daily requests. Performance measures are not reported as percentages, such as outdate, mismatch and shortage rates, in Katsaliaki and Brailsford (2006), so a comparison including these rates is not possible. TCs considered in our study perform better than the one considered in Katsaliaki and Brailsford (2006) in terms of all comparison criteria given in Table 5.8.

Table 5.8. Performance Comparison of Similar Sized TCs with those in Katsaliaki and Brailford, 2006

TCs	Hospital in Katsaliaki and Brailsford (2006)	TC 20 (Antalya)	TC 34 (Burdur)	TC 41 (Isparta)
Mismatch Activation Period	2.5 h	2.5 h	2.5 h	2.5 h
Transfusion to Cross-match Ratio	0.70	0.70	0.70	0.70
Cross-match Release Period	24 h	24 h	24 h	24 h
Issuing Method Used in TC	FIFO	FIFO	FIFO	FIFO
Mean Daily Number Of Requests	21	20	20	19
Outdated Units (O)	36	24	25	15
Mismatched Units (M)	19	38	152	88
Shortages in Units (S)	78	0	0	0
Time Horizon (Day)	182	1825	1825	1825
Average Outdated Units Per Day	0.20	0.01	0.01	0.01
Average Mismatched Units Per Day	0.10	0.02	0.08	0.05
Average Shortage Units Per Day	0.43	0.00	0.00	0.00
Average Outdated Units Per Day / Mean Daily Requests *100 (O)	0.94	0.07	0.07	0.05
Average Mismatched Units Per Day / Mean Daily Requests *100 (M)	0.50	0.10	0.41	0.26
Average Mismatched Units Per Day / Mean Daily Requests *100 (S)	2.04	0.00	0.00	0.00
Total (O+M+S)	3.48	0.17	0.48	0.30

CHAPTER 6

CONCLUSION AND FURTHER RESEARCH ISSUES

In this study, we deal with a real-life blood supply chain management problem and propose an approach to obtain a better understanding of the system and to establish improved management policies to be adapted to the supply chain. A conceptual model of the blood supply chain which captures all the activities from donation to transfusion is developed. A computer simulation program is constructed to test the effects of several policies and system parameters in a risk-free environment. The simulation model is validated by using face validity, fixed values, degenerate tests, extreme condition tests, comparison to other models (partially) and internal validity techniques. We analyze the effect of the alternative management policies on the performance measures determined for the region and try to find improved management policies to be adapted to the blood supply chain.

Simulation experiments of several policies indicate that the West-Mediterranean supply chain's performance can be improved by adopting the following policy parameters:

- Using upper inventory limit coefficient of 1.3 for DCs and RBC
- Using excessive amount coefficient of 0.3 for DCs and RBC
- Using lower inventory limit coefficient of 0.5 for RBC
- Using target inventory level coefficient of 6 for RBC and Isparta DC, and 9 for Burdur DC
- The reduction of cross-match release period to 24 hours
- The increase of transfusion to cross-match ratio from 0.5 to 0.70
- Using ad-hoc delivery limit coefficient of 0.4 for DCs and TCs

- Using routine delivery coefficient of 1
- Setting a limit of 17 days of age for red blood cells for transfer to RBC, DCs and other regions
- Setting Disposal Age of Units at DCs and RBC to 27 days
- Using allocation method 0, which uses a supply index ratio while allocating units
- Using issuing method 1, in which oldest units are first sent to TC which have the highest target inventory level
- Using values in Table 5.4. and Table 5.5. for routine delivery periods of TCs and for target inventory level coefficients of TCs, respectively.

In adopting all these recommendations (policy parameters), compared to the baseline policy, the total system gains are:

- 98.9 % reduction in red blood cells outdate rate of region
- 89.1 % reduction in red blood cells mismatch rate of region
- 99.4 % reduction in red blood cells shortage rate of region
- 60.4 % reduction in mean inventory levels of region
- 24.5 % reduction in total number of deliveries (although 12.4 % reductions occurs in planned deliveries)
- 97.5 % reduction in mean of outdate rates of TCs
- 88.2 % reduction in mean of mismatch rates of TCs
- 99.2 % reduction in mean of shortage rates of TCs

We compare the results of our experiments with the hospitals performances located in other countries to have an idea about the success of the achieved performances. We compared the performances of 3 similar sized hospitals with the one in Katsaliaki and Brailsford (2006). Results of the best policies of the studies are used. Comparisons indicate that TCs considered in this study perform better than the one considered in Katsaliaki and Brailsford (2006) in terms of the ratios of the average numbers of outdated, mismatched and shortage units per day to mean daily requests.

In addition to the efforts to obtain improved policies, we investigated the effects of the parameters on the supply chain main performance measures, within the boundaries specified by the model configuration values. We also obtained some useful observations about the performances of different sized hospitals and different blood groups. Simulation experiments indicate that large sized hospitals perform better in terms of outdate, mismatch and shortage rates than medium and small sized hospitals. Another important observation is that proposed policies in this study perform better for blood groups with high frequencies such as A+, O+ and B+ and AB+. As a result of these observations, we can state that special attention is required for the management of small sized hospitals and for blood groups with small frequencies.

Within the scope of this study, we developed and used a tailored program (SiModel) for the simulation of the supply chain to solve the run time problem rather than using a general purpose simulation software package. We also made some simplifications in the modelling side to reduce the run time. Very good solutions are achieved in terms of run time. Mustafee et al. (2006) reported execution time of 35.8 hours for a single run for a blood supply chain that consists of 1 RBC and 4 TCs. Simulation run time of our experiments is approximately 7 minutes for the supply chain that consists of 1 RBC, 2 DCs and 49 TCs. This improvement is achieved by making simplifications in the modelling side, using a specialized software, and calculating performance measures and making detailed analysis out of the simulation model using MS Excel.

Contributions of this study can be summarized as follows:

- A unique blood supply chain network which is not addressed before in the literature is analyzed through simulation modelling. The simulation model of the blood supply chain with a three-echelon hierarchical structure is coded in a very efficient way, which takes 7 minutes per run on the average. Effects of different management policies and system parameters on the supply chain performance are observed. A better understanding of the whole supply chain is

obtained and alternative improved policies corresponding to different objectives (performance measures) are proposed.

- Important findings (observations) are achieved, which can be used by TRCS to plan for the near future and to develop a road map for regional/national management of the blood supply chain.
- A flexible decision support tool, which can be used to analyze other regions by TRCS, is provided.
- The proposed methodology and the modelling approach can as well be applied to various supply chains of products with the similar characteristics such as food industry, pharmaceuticals, and other perishable goods.

Further research issues:

The area seems to be fruitful for future research. A heuristic method can be developed to search for near optimal solutions. An integrated solution approach of simulation and heuristic solution methodology can be proposed. Several different cases of the modelling environment can also be analyzed:

- The case, including more than one RBC or the whole blood supply chain of Turkey including 12 regions, can be considered. Effects of interregional shipments between RBCs can be analyzed.
- The case in which all main blood components such as platelets, fresh frozen plasma can be considered.
- Effectiveness of different regionalization network configurations can be analyzed. For example, network design investigated in this study can be compared with the others discussed before in the literature.
- Different cross-matching policies such as FIFO-MILO and double cross-matching can also be included in the model and the effects can be analyzed.
- The case, in which transfers among centers belonging to the same hierarchical levels are allowed, can be analyzed.
- The effect of using central TCs as central stock points on the supply chain performance can be analyzed.

- A solution approach, which also considers vehicle routing and scheduling problems of the chain in addition to the inventory, allocation and transportation aspects, can be developed.
- The effects of different donation levels on the supply chain performance can be analyzed to help decision makers to plan for voluntary donor recruitment programs.
- The case, where blood requests are divided as emergency requests and non-emergency requests, can be analyzed. Different issuing methods which give priority to emergency deliveries can be included in the model.
- The case with blood rotations can be analyzed. Blood rotations refer to the case where aging blood components are taken back to RBC and redistributed in the region.
- The amount circulating between RBC and DC can be examined to search for the alternative policies to eliminate the unnecessary transfers.

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APPENDIX A

SIMULATION MODEL INPUT FILE FORMATS AND VALUES USED IN BASELINE POLICY

Table A.1. File format of the “BDP.txt” File and Values Used in Baseline Policy

TDR	DATC	DADC	MASD	MASR	MASI
0.029	42	35	30	30	30

Table A.2. File Format of the “DC.txt” File and Values Used in Baseline Policy

Expecting NameDa(str)	NameR(str)	SDMMDa	SDSMDa	SDMDa	SDSDa	ADa
IspartaDC	MediterraneanRBC	50.99	30.85	66.49	16.03	4
BurdurDC	MediterraneanRBC	37.89	22.42	7.27	3.94	4

Table A.3. File Format of the “IAPP.txt” File and Values Used in Baseline Policy

ADPT	ADPD	Hd	Sd	RHd	RSd	APN	IPN	RDP
0.3	0.5	20	0.1	200	0.1	0	0	1

Table A.4. File Format of the “RBC.txt” File and Values Used in Baseline Policy

NameR(str)	SDMMR	SDSMR	SDMR	SDSR	DPDR	LLC	AR
West-Mediterranean RBC	137.98	98.26	121.1444	64.86	0.2	1	4

Table A.5. File Format of the “SRP.txt” File and Values Used in Baseline Policy

SRP_RQ	SRP_SS	SRP_RL
10	60	1825

Table A.6. File Format of the “TPP.txt” File and Values Used in Baseline Policy

CM	CMTX	MA	CCR
72	0.50	2.50	0.98

Table A.7. File Format of the “BTP.txt” File and Values Used in Baseline Policy

start	end	TDij	TTRij	TTAij
TC1	WestMediterraneanRBC	13	0.51	0.21
TC2	WestMediterraneanRBC	18	0.3	0.3
TC3	WestMediterraneanRBC	22	0.66	0.36
TC4	WestMediterraneanRBC	15	0.76	0.25
TC5	WestMediterraneanRBC	18	0.3	0.3
TC6	WestMediterraneanRBC	33	0.56	0.55
TC7	WestMediterraneanRBC	34	1.28	0.56
TC8	WestMediterraneanRBC	28	0.46	0.46
TC9	WestMediterraneanRBC	85	0.7	0.7
TC10	WestMediterraneanRBC	24	1.03	0.4
TC11	WestMediterraneanRBC	22	1.03	0.36
TC12	WestMediterraneanRBC	40	0.66	0.66
TC13	WestMediterraneanRBC	38	0.63	0.63
TC14	WestMediterraneanRBC	23	1.01	0.38
TC15	WestMediterraneanRBC	135	1.12	1.12
TC16	WestMediterraneanRBC	38	0.63	0.63
TC17	WestMediterraneanRBC	120	1	1
TC18	WestMediterraneanRBC	135	1.12	1.12
TC19	WestMediterraneanRBC	35	0.58	0.58
TC20	WestMediterraneanRBC	135	1.12	1.12
TC21	WestMediterraneanRBC	88	0.73	0.73
TC22	WestMediterraneanRBC	45	0.75	0.75
TC23	WestMediterraneanRBC	111	0.92	0.92
TC24	WestMediterraneanRBC	180	1.5	1.5
TC25	WestMediterraneanRBC	147	1.22	1.22
TC26	WestMediterraneanRBC	168	1.4	1.4
TC27	WestMediterraneanRBC	60	1	1
TC28	WestMediterraneanRBC	90	0.75	0.75
TC29	WestMediterraneanRBC	78	0.65	0.65
TC30	WestMediterraneanRBC	40	0.66	0.66
TC31	WestMediterraneanRBC	40	0.66	0.66
TC32	BurdurDC	23	0.63	0.38
TC33	BurdurDC	15	0.25	0.25
TC34	BurdurDC	45	0.75	0.75
TC35	BurdurDC	107	0.89	0.89
TC36	BurdurDC	60	0.5	0.5
TC37	BurdurDC	25	0.66	0.41
TC38	IspartaDC	15	0.25	0.25
TC39	IspartaDC	12	0.86	0.2
TC40	IspartaDC	32	0.93	0.53
TC41	IspartaDC	24	0.4	0.4
TC42	IspartaDC	45	0.75	0.75
TC43	IspartaDC	76	0.63	0.63
TC44	IspartaDC	120	1	1
TC45	IspartaDC	65	1.08	1.08
TC46	IspartaDC	105	0.87	0.87
TC47	IspartaDC	105	0.87	0.87
TC48	IspartaDC	12	0.51	0.2
TC49	IspartaDC	19	0.31	0.31
BurdurDC	WestMediterraneanRBC	122	1.01	1.01
IspartaDC	WestMediterraneanRBC	128	1.06	1.06

Table A.7. (Continued)

WestMediterraneanRBC	BurdurDC	122	1.01	1.01
WestMediterraneanRBC	IspartaDC	128	1.38	1.38
WestMediterraneanRBC	TC1	13	0.51	0.21
WestMediterraneanRBC	TC2	18	0.3	0.3
WestMediterraneanRBC	TC3	22	0.66	0.36
WestMediterraneanRBC	TC4	15	0.76	0.25
WestMediterraneanRBC	TC5	18	0.3	0.3
WestMediterraneanRBC	TC6	33	0.56	0.55
WestMediterraneanRBC	TC7	34	1.28	0.56
WestMediterraneanRBC	TC8	28	0.46	0.46
WestMediterraneanRBC	TC9	85	0.7	0.7
WestMediterraneanRBC	TC10	24	1.03	0.4
WestMediterraneanRBC	TC11	22	1.03	0.36
WestMediterraneanRBC	TC12	40	0.66	0.66
WestMediterraneanRBC	TC13	38	0.63	0.63
WestMediterraneanRBC	TC14	23	1.01	0.38
WestMediterraneanRBC	TC15	135	1.12	1.12
WestMediterraneanRBC	TC16	38	0.63	0.63
WestMediterraneanRBC	TC17	120	1	1
WestMediterraneanRBC	TC18	135	1.12	1.12
WestMediterraneanRBC	TC19	35	0.58	0.58
WestMediterraneanRBC	TC20	135	1.12	1.12
WestMediterraneanRBC	TC21	88	0.73	0.73
WestMediterraneanRBC	TC22	45	0.75	0.75
WestMediterraneanRBC	TC23	111	0.92	0.92
WestMediterraneanRBC	TC24	180	1.5	1.5
WestMediterraneanRBC	TC25	147	1.225	1.225
WestMediterraneanRBC	TC26	168	1.4	1.4
WestMediterraneanRBC	TC27	60	1	1
WestMediterraneanRBC	TC28	90	0.75	0.75
WestMediterraneanRBC	TC29	78	0.65	0.65
WestMediterraneanRBC	TC30	40	0.66	0.66
WestMediterraneanRBC	TC31	40	0.66	0.66
BurdurDC	TC32	23	0.63	0.38
BurdurDC	TC33	15	0.25	0.25
BurdurDC	TC34	45	0.75	0.75
BurdurDC	TC35	107	0.89	0.89
BurdurDC	TC36	60	0.5	0.5
BurdurDC	TC37	25	0.66	0.41
IspartaDC	TC38	15	0.25	0.25
IspartaDC	TC39	12	0.86	0.2
IspartaDC	TC40	32	0.93	0.53
IspartaDC	TC41	24	0.4	0.4
IspartaDC	TC42	45	0.75	0.75
IspartaDC	TC43	76	0.63	0.63
IspartaDC	TC44	120	1	1
IspartaDC	TC45	65	1.08	1.08
IspartaDC	TC46	105	0.87	0.87
IspartaDC	TC47	105	0.87	0.87
IspartaDC	TC48	12	0.51	0.2
IspartaDC	TC49	19	0.31	0.31
WestMediterraneanRBC	BurdurDC	122	1.01	1.01
WestMediterraneanRBC	IspartaDC	128	1.06	1.06
BurdurDC	WestMediterraneanRBC	122	1.01	1.01
IspartaDC	WestMediterraneanRBC	128	1.38	1.38

Table A.8. File Format of the “TC.txt” File and Values Used in Baseline Policy

NameTb	Name RDTb	DPTb	SDMTb	Atb Opos	Atb Oneg	Atb Apos	Atb Aneg	Atb Bpos	Atb Bneg	Atb Abpos	Atb Abneg
TC1	West-MediterraneanRBC	1	19.15	4	4	4	4	4	4	4	4
TC2	West-MediterraneanRBC	1	4.53	4	4	4	4	4	4	4	4
TC3	West-MediterraneanRBC	1	2.91	4	4	4	4	4	4	4	4
TC4	West-MediterraneanRBC	1	2.2	4	4	4	4	4	4	4	4
TC5	West-MediterraneanRBC	1	2.04	4	4	4	4	4	4	4	4
TC6	West-MediterraneanRBC	1	3.32	4	4	4	4	4	4	4	4
TC7	West-MediterraneanRBC	1	2.48	4	4	4	4	4	4	4	4
TC8	West-MediterraneanRBC	1	2.34	4	4	4	4	4	4	4	4
TC9	West-MediterraneanRBC	1	1.82	4	4	4	4	4	4	4	4
TC10	West-MediterraneanRBC	1	2.27	4	4	4	4	4	4	4	4
TC11	West-MediterraneanRBC	1	2.89	4	4	4	4	4	4	4	4
TC12	West-MediterraneanRBC	1	1.71	4	4	4	4	4	4	4	4
TC13	West-MediterraneanRBC	1	1.79	4	4	4	4	4	4	4	4
TC14	West-MediterraneanRBC	1	4.02	4	4	4	4	4	4	4	4
TC15	West-MediterraneanRBC	1	2.37	4	4	4	4	4	4	4	4
TC16	West-MediterraneanRBC	1	1.98	4	4	4	4	4	4	4	4
TC17	West-MediterraneanRBC	1	1.83	4	4	4	4	4	4	4	4
TC18	West-MediterraneanRBC	1	34.19	4	4	4	4	4	4	4	4
TC19	West-MediterraneanRBC	1	14.60	4	4	4	4	4	4	4	4
TC20	West-MediterraneanRBC	1	9.03	4	4	4	4	4	4	4	4
TC21	West-MediterraneanRBC	1	1.75	4	4	4	4	4	4	4	4
TC22	West-MediterraneanRBC	1	2.84	4	4	4	4	4	4	4	4
TC23	West-MediterraneanRBC	1	4.62	4	4	4	4	4	4	4	4
TC24	West-MediterraneanRBC	1	2.89	4	4	4	4	4	4	4	4
TC25	West-MediterraneanRBC	1	2.04	4	4	4	4	4	4	4	4
TC26	West-MediterraneanRBC	4	1.63	4	4	4	4	4	4	4	4
TC27	West-MediterraneanRBC	1	4.06	4	4	4	4	4	4	4	4
TC28	West-MediterraneanRBC	1	3.49	4	4	4	4	4	4	4	4
TC29	West-MediterraneanRBC	1	8.66	4	4	4	4	4	4	4	4
TC30	West-MediterraneanRBC	1	1.70	4	4	4	4	4	4	4	4
TC31	West-MediterraneanRBC	1	5.19	4	4	4	4	4	4	4	4
TC32	BurdurDC	1	8.22	4	4	4	4	4	4	4	4
TC33	BurdurDC	1	2.49	4	4	4	4	4	4	4	4
TC34	BurdurDC	1	8.94	4	4	4	4	4	4	4	4
TC35	BurdurDC	1	1.98	4	4	4	4	4	4	4	4
TC36	BurdurDC	1	1.49	4	4	4	4	4	4	4	4
TC37	BurdurDC	1	2.71	4	4	4	4	4	4	4	4
TC38	IspartaDC	1	15.03	4	4	4	4	4	4	4	4
TC39	IspartaDC	1	4.79	4	4	4	4	4	4	4	4
TC40	IspartaDC	1	8.26	4	4	4	4	4	4	4	4
TC41	IspartaDC	1	8.41	4	4	4	4	4	4	4	4
TC42	IspartaDC	1	1.61	4	4	4	4	4	4	4	4
TC43	IspartaDC	1	1.75	4	4	4	4	4	4	4	4
TC44	IspartaDC	1	2.26	4	4	4	4	4	4	4	4
TC45	IspartaDC	1	1.81	4	4	4	4	4	4	4	4
TC46	IspartaDC	3	1.67	4	4	4	4	4	4	4	4
TC47	IspartaDC	5	2.45	4	4	4	4	4	4	4	4
TC48	IspartaDC	1	11.20	4	4	4	4	4	4	4	4
TC49	IspartaDC	1	1.62	4	4	4	4	4	4	4	4

APPENDIX B

SIMULATION MODEL OUTPUT FILE FORMATS AND SAMPLES FROM BASELINE POLICY

Table B.1. File format of the “TC.Out” File and a Sample from Output of Baseline Policy

[TC1]	0+	0-	A+	A-	B+	B-	AB+	AB-
inventory count	43800							
inventory	1203658	184468	1607892	233662	584315	99238	302630	79371
last-inv	28	5	41	9	14	3	1	2
added	13379	1734	17149	2320	6685	827	3276	406
returned	11557	1605	15057	1956	5466	766	2656	343
disposed	1773	159	1963	428	1115	35	638	25
transfused	11420	1536	15153	1970	5577	788	2760	403
mismatch	15	115	2	107	59	89	130	49
requested	22836	3115	30147	4011	11061	1573	5563	735
shortage	21	4	0	0	0	0	0	0

Same values are calculated and reported in “TC.Out” file for 49 hospitals and for 10 Iteration. Table above illustrates values of TC1 for iteration 1

Table B.2. File format of the “DC.Out” File and a Sample Output of Baseline Policy

[IspartaDC]	0+	0-	A+	A-	B+	B-	AB+	AB-
inventory count	43800							
inventory	47543739	5595058	62682882	7775366	22742609	2150725	11085529	667185
last-inv	1091	117	1387	195	492	38	248	1
negative	60121	8306	78911	10409	28995	4170	14519	2013
added	0	0	0	0	0	0	0	0
disposed	12475	65	18387	714	4782	4	1431	0
trRoutine	42657	2242	56077	3976	17288	385	6362	53
trAdhocTC	4579	5936	4075	5655	6696	3749	6605	1964
trAdhoc	0	0	0	0	0	0	0	0
emergency	0	0	0	0	0	0	0	0
routine count	18130	km	886185	adhocTC count		16262	km	939840
adhoc count	0	km	0	emergency count		0	km	0

Same values are calculated and reported in “TC.Out” file for both DCs and for 10 Iteration. Table above illustrates values of Isparta DC for iteration 1.

Table B.3. File format of the “RBC.Out” File and a Sample Output of Baseline Policy

[RBC]	0+	0-	A+	A-	B+	B-	AB+	AB-
inventory cnt=	43800							
inventory	103047953	9701555	135811926	15559679	48711453	2379152	23101558	599887
last-inv	2380	211	3094	326	1077	109	475	3
negative	134067	18587	175261	23090	64399	8993	32074	4605
added	0	0	0	0	0	0	0	0
disposed	14832	0	24500	45	3998	0	635	0
trRoutine	104566	5674	139094	8835	41382	1526	14729	351
trAdhocTC	12879	12750	9587	13953	18314	7378	16397	4263
trAdhoc	0	0	0	0	0	0	0	0
emergency	0	0	0	0	0	0	0	0
interregion	0	0	0	0	0	0	0	0
routine count	47991	km	3147508	adhocTC count	39309	km	2589401	
Adhoc count	0	km	0	emergency count	0	km	0	
interregion count	0	km	0					

Same values are calculated and reported in “RBC.Out” file for 10 Iterations. Table above illustrates values for iteration 1.

Table B.4. File format of the “SIM.Out” File and a Sample Output of Baseline Policy

Simulation duration=	414.23							
LAST INVENTORY current & includes items being transferred:								
RBC[WestMediterraneanRBC]:								
	0+	0-	A+	A-	B+	B-	AB+	AB-
current	2177	212	2856	337	999	87	574	23
current+tr	2177	212	2856	337	999	87	574	23
DC[IspartaDC]:								
current	1048	129	1448	183	474	44	259	19
current+tr	1048	129	1448	183	474	44	259	19
DC[BurdurDC]:								
current	483	50	569	65	211	17	101	3
current+tr	483	50	569	65	211	17	101	3
TC[TC1]:								
current	18	4	30	5	20	4	9	2
current+tr	50	7	58	9	24	4	12	2

Same values are calculated and reported in “SIM.Out” file for 49 hospitals. Table above illustrates values of TC1.

APPENDIX C

EXAMPLES OF THE OUTPUTS OF THE EXCEL FILE FOR BASELINE POLICY

Table C.1. TCs' Single Performance Measures and Confidence Intervals – Mean
Inventory Level by Blood Group

Hospital	Mean Inventory Level								
TC1	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	27.48	4.21	36.71	5.33	13.34	2.27	6.91	1.81	98.06
Iteration 2	27.39	4.24	36.65	5.43	13.26	2.21	7.06	1.84	98.07
Iteration 3	27.49	4.28	37.02	5.42	13.36	2.25	6.81	1.91	98.54
Iteration 4	27.49	4.13	36.51	5.57	13.05	2.24	6.75	1.85	97.59
Iteration 5	27.34	4.25	36.62	5.47	13.37	2.22	6.74	1.80	97.81
Iteration 6	26.82	4.22	36.89	5.57	13.12	2.15	6.85	1.81	97.43
Iteration 7	27.05	4.08	36.47	5.43	13.53	2.17	6.98	1.95	97.65
Iteration 8	27.39	4.17	36.05	5.56	13.24	2.21	7.01	1.77	97.41
Iteration 9	27.22	4.30	37.72	5.49	13.61	2.21	6.93	1.77	99.25
Iteration 10	27.36	4.24	36.90	5.43	13.17	2.18	6.81	1.96	98.04
Mean	27.30	4.21	36.75	5.47	13.31	2.21	6.88	1.85	97.99
Standard deviation	0.22	0.07	0.44	0.08	0.18	0.04	0.11	0.07	0.56
Confidence Interval	0.14	0.04	0.23	0.04	0.09	0.02	0.06	0.04	0.29
Upper Limit	27.44	4.25	36.98	5.51	13.40	2.23	6.94	1.88	98.28
Lower Limit	27.17	4.18	36.53	5.43	13.21	2.19	6.83	1.81	97.69

Same values are calculated and reported in excel for all hospitals in the chain. Table above illustrates the format of the output of excel file.

Table C.2. TCs' Single Performance Measures and Confidence Intervals – Outdate Rates by Blood Group

Hospital	Outdate Rate								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
TC1									
Iteration 1	13.25	9.17	11.45	18.45	16.68	4.23	19.47	6.16	13.40
Iteration 2	12.84	10.29	12.10	17.26	17.69	8.07	20.63	5.44	13.80
Iteration 3	13.74	12.01	12.49	22.24	19.12	6.34	21.11	6.89	14.76
Iteration 4	13.82	8.89	12.50	22.85	18.15	8.35	20.90	10.23	14.62
Iteration 5	12.97	8.35	12.17	21.28	18.88	7.32	19.74	4.22	14.08
Iteration 6	11.81	7.13	12.25	18.92	17.26	5.07	17.72	4.95	13.20
Iteration 7	13.51	10.47	12.62	20.66	19.58	9.32	20.87	9.45	14.73
Iteration 8	13.67	10.25	11.71	21.29	17.24	8.36	20.79	8.57	14.08
Iteration 9	14.33	9.83	12.67	20.70	18.52	6.41	20.63	9.09	14.75
Iteration 10	12.89	6.77	12.56	17.89	18.01	8.00	20.09	8.56	13.95
Mean	13.28	9.32	12.25	20.16	18.11	7.15	20.19	7.36	14.14
Standard deviation	0.70	1.60	0.41	1.90	0.92	1.61	1.02	2.09	0.57
Confidence Interval	0.00	0.83	0.00	0.99	0.00	0.84	0.53	1.09	0.30
Upper Limit	13.28	10.15	12.25	21.15	18.11	7.98	20.73	8.45	14.43
Lower Limit	13.28	8.48	12.25	19.17	18.11	6.31	19.66	6.27	13.84

Same values are calculated and reported in excel for all hospitals in the chain. Table above illustrates the format of the output of excel file.

Table C.3. TCs’ Single Performance Measures and Confidence Intervals –
Mismatch Rates by Blood Group

Hospital	Mismatch Rate								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
TC1									
Iteration 1	0.13	7.49	0.01	5.43	1.06	11.29	4.71	12.16	1.43
Iteration 2	0.10	7.97	0.00	4.55	1.03	8.82	3.66	7.86	1.24
Iteration 3	0.04	6.88	0.01	5.51	0.95	10.02	5.03	9.64	1.36
Iteration 4	0.13	6.09	0.00	5.38	1.29	8.13	4.67	9.54	1.29
Iteration 5	0.06	7.05	0.00	5.10	0.99	8.79	4.50	10.16	1.31
Iteration 6	0.09	6.89	0.01	4.91	1.60	7.55	4.12	13.45	1.35
Iteration 7	0.12	8.90	0.01	5.86	1.55	9.68	4.07	8.58	1.49
Iteration 8	0.09	7.37	0.01	5.53	1.12	8.26	4.11	9.56	1.27
Iteration 9	0.10	6.22	0.01	4.26	0.92	7.78	4.08	10.08	1.14
Iteration 10	0.14	7.05	0.00	4.27	1.00	9.54	4.72	12.18	1.30
Mean	0.10	7.19	0.01	5.08	1.15	8.99	4.37	10.32	1.32
Standard deviation	0.03	0.82	0.01	0.56	0.25	1.16	0.42	1.75	0.10
Confidence Interval	0.02	0.43	0.00	0.29	0.13	0.60	0.22	0.00	0.05
Upper Limit	0.12	7.62	0.01	5.37	1.28	9.59	4.59	10.32	1.37
Lower Limit	0.08	6.77	0.00	4.79	1.02	8.39	4.15	10.32	1.27

Same values are calculated and reported in excel for all hospitals in the chain. Table above illustrates the format of the output of excel file.

Table C.4. TCs’ Single Performance Measures and Confidence Intervals – Shortage Rates by Blood Group

Hospital	Shortage Rate								
TC1	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	0.09	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.09
Iteration 2	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Iteration 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iteration 4	0.07	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Iteration 5	0.08	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.08
Iteration 6	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.06
Iteration 7	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Iteration 8	0.06	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.06
Iteration 9	0.03	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Iteration 10	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Mean	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Standard deviation	0.03	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Confidence Interval	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Limit	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Lower Limit	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.05

Same values are calculated and reported in excel for all hospitals in the chain. Table above illustrates the format of the output of excel file.

Table C.5. TCs' Single Performance Measures and Confidence Intervals – Number of Added Units by Blood Group

Hospital	Added								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
TC1									
Iteration 1	13379	1734	17149	2320	6685	827	3276	406	45776
Iteration 2	13402	1788	17118	2369	6710	867	3267	441	45962
Iteration 3	13352	1724	16895	2374	6517	883	3430	450	45625
Iteration 4	13330	1767	17198	2346	6765	850	3325	391	45972
Iteration 5	13546	1772	17076	2354	6659	888	3455	450	46200
Iteration 6	13384	1696	16955	2373	6653	868	3329	424	45682
Iteration 7	13333	1806	17165	2410	6661	880	3354	434	46043
Iteration 8	13360	1746	17537	2273	6892	813	3382	455	46458
Iteration 9	13474	1688	16934	2299	6627	796	3326	418	45562
Iteration 10	13513	1669	17200	2325	6712	813	3390	432	46054
Mean	13407.3	1739.0	17122.7	2344.3	6688.1	848.5	3353.4	430.1	45933.4
Standard deviation	76.8	45.2	183.7	40.6	96.8	33.7	61.4	20.7	278.1
Confidence Interval	47.6	28.0	113.8	25.2	60.0	20.9	38.1	12.8	172.4
Upper Limit	13454.9	1767.0	17236.5	2369.5	6748.1	869.4	3391.5	442.9	46105.8
Lower Limit	13359.7	1711.0	17008.9	2319.1	6628.1	827.6	3315.3	417.3	45761.0

Same values are calculated and reported in excel for all hospitals in the chain. Table above illustrates the format of the output of excel file.

Table C.6. TCs' Single Performance Measures and Confidence Intervals – Number of Disposed Units by Blood Group

Hospital	Disposed								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
TC1									
Iteration 1	1773	159	1963	428	1115	35	638	25	6136
Iteration 2	1721	184	2072	409	1187	70	674	24	6341
Iteration 3	1834	207	2110	528	1246	56	724	31	6736
Iteration 4	1842	157	2150	536	1228	71	695	40	6719
Iteration 5	1757	148	2078	501	1257	65	682	19	6507
Iteration 6	1580	121	2077	449	1148	44	590	21	6030
Iteration 7	1801	189	2167	498	1304	82	700	41	6782
Iteration 8	1826	179	2054	484	1188	68	703	39	6541
Iteration 9	1931	166	2145	476	1227	51	686	38	6720
Iteration 10	1742	113	2161	416	1209	65	681	37	6424
Mean	1780.7	162.3	2097.7	472.5	1210.9	60.7	677.3	31.5	6493.6
Standard deviation	92.9	29.5	62.8	45.3	54.6	14.1	37.9	8.5	261.9
Confidence Interval	57.6	18.3	38.9	28.1	33.8	8.7	23.5	5.3	162.3
Upper Limit	1838.3	180.6	2136.6	500.6	1244.7	69.4	700.8	36.8	6655.9
Lower Limit	1723.1	144.0	2058.8	444.4	1177.1	52.0	653.8	26.2	6331.3

Same values are calculated and reported in excel for all hospitals in the chain. Table above illustrates the format of the output of excel file.

Table C.7. TCs' Single Performance Measures and Confidence Intervals – Number of Mismatched Units by Blood Group

Hospital	Mismatched								
TC1	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	15	115	2	107	59	89	130	49	566
Iteration 2	11	128	0	92	57	72	98	33	491
Iteration 3	4	101	1	106	50	84	143	38	527
Iteration 4	15	94	0	101	72	61	128	33	504
Iteration 5	7	113	0	98	54	72	130	44	518
Iteration 6	10	107	1	97	89	61	116	55	536
Iteration 7	14	142	1	117	84	78	112	35	583
Iteration 8	10	114	1	103	64	62	114	39	507
Iteration 9	11	92	2	80	50	57	112	39	443
Iteration 10	16	107	0	84	55	71	133	48	514
Mean	11.3	111.3	0.8	98.5	63.4	70.7	121.6	41.3	518.9
Standard deviation	3.83	15.13	0.79	11.03	13.87	10.65	13.34	7.44	38.89
Confidence Interval	2.37	9.38	0.49	6.83	8.60	6.60	8.26	4.61	24.10
Upper Limit	13.67	120.68	1.29	105.33	72.00	77.30	129.87	45.91	543.00
Lower Limit	8.93	101.92	0.31	91.67	54.80	64.10	113.34	36.69	494.80

Same values are calculated and reported in excel for all hospitals in the chain. Table above illustrates the format of the output of excel file.

Table C.8. TCs’ Single Performance Measures and Confidence Intervals – Number of Shortage Units by Blood Group

Hospital	Shortage								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
TC1									
Iteration 1	21	4	0	0	0	0	0	0	25
Iteration 2	12	0	0	0	0	0	0	0	12
Iteration 3	1	0	0	0	0	0	0	0	1
Iteration 4	17	4	0	0	0	0	0	0	21
Iteration 5	18	1	0	0	0	0	0	0	19
Iteration 6	14	1	0	0	0	0	0	0	15
Iteration 7	11	0	0	0	0	0	0	0	11
Iteration 8	13	3	0	0	0	0	0	0	16
Iteration 9	6	3	0	0	0	0	0	0	9
Iteration 10	11	0	0	0	0	0	0	0	11
Mean	12.4	1.6	0	0	0	0	0	0	14
Standard deviation	5.82	1.71	0.00	0.00	0.00	0.00	0.00	0.00	6.80
Confidence Interval	3.60	1.06	0.00	0.00	0.00	0.00	0.00	0.00	4.21
Upper Limit	16.00	2.66	0.00	0.00	0.00	0.00	0.00	0.00	18.21
Lower Limit	8.80	0.54	0.00	0.00	0.00	0.00	0.00	0.00	9.79

Same values are calculated and reported in excel for all hospitals in the chain. Table above illustrates the format of the output of excel file.

Table C.9. TCs' Single Performance Measures and Confidence Intervals – Number of Transfused Units by Blood Group

Hospital	Transfused								
TC1	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	11420	1536	15153	1970	5577	788	2760	403	39607
Iteration 2	11470	1607	15020	2020	5553	816	2679	420	39585
Iteration 3	11331	1467	14759	1925	5288	838	2841	394	38843
Iteration 4	11359	1544	15014	1879	5581	750	2740	346	39213
Iteration 5	11596	1602	14968	1923	5432	819	2887	433	39660
Iteration 6	11637	1553	14842	1976	5567	808	2816	409	39608
Iteration 7	11308	1596	14951	1996	5405	806	2753	408	39223
Iteration 8	11347	1546	15444	1864	5721	751	2771	408	39852
Iteration 9	11399	1479	14768	1880	5428	733	2743	387	38817
Iteration 10	11610	1517	15011	1969	5512	744	2816	394	39573
Mean	11447.7	1544.7	14993	1940.2	5506.4	785.3	2780.6	400.2	39398.1
Standard deviation	124.25	48.38	200.30	53.94	121.17	37.52	59.76	23.25	355.68
Confidence Interval	77.01	29.98	124.14	33.43	75.10	23.26	37.04	14.41	220.45
Upper Limit	11524.7	1574.6	15117.1	1973.6	5581.5	808.5	2817.6	414.6	39618.5
Lower Limit	11370.6	1514.7	14868.8	1906.7	5431.3	762.0	2743.5	385.7	39177.6

Same values are calculated and reported in excel for all hospitals in the chain. Table above illustrates the format of the output of excel file.

Table C.10. TCs' Single Performance Measures and Confidence Intervals – Number of Requested Units by Blood Group

Hospital	Requested								
TC1	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	22836	3115	30147	4011	11061	1573	5563	735	79041
Iteration 2	22901	3197	30100	4011	11087	1591	5331	834	79052
Iteration 3	22733	2931	29658	3927	10761	1652	5666	808	78136
Iteration 4	22822	3153	30169	3826	11264	1493	5619	699	79045
Iteration 5	23037	3197	30030	3874	10901	1651	5757	799	79246
Iteration 6	23422	3125	29794	3910	11198	1592	5647	768	79456
Iteration 7	22984	3187	30097	4008	10797	1652	5542	790	79057
Iteration 8	22839	3151	30817	3771	11262	1524	5474	820	79658
Iteration 9	22995	3001	29245	3829	10764	1464	5525	755	77578
Iteration 10	23075	3071	29933	3934	11102	1566	5705	850	79236
Mean	22964.4	3112.8	29999	3910.1	11019.7	1575.8	5582.9	785.8	78950.5
Standard deviation	193.87	88.32	404.40	85.05	199.77	66.59	123.95	46.76	624.58
Confidence Interval	120.16	54.74	250.65	52.71	123.82	41.27	76.82	28.98	387.11
Upper Limit	23084.5	3167.5	30249.6	3962.8	11143.5	1617.1	5659.7	814.8	79337.6
Lower Limit	22844.2	3058.1	29748.3	3857.4	10895.9	1534.5	5506.1	756.8	78563.4

Same values are calculated and reported in excel for all hospitals in the chain. Table above illustrates the format of the output of excel file.

Table C.11. DCs’ Single Performance Measures and Confidence Intervals – Mean Inventory Levels by Blood Group

DC	Inventory Level								
[IspartaDC]	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	1085.47	127.74	1431.12	177.52	519.24	49.10	253.09	15.23	3658.52
Iteration 2	1110.95	132.41	1453.14	181.49	531.72	49.89	264.44	15.87	3739.91
Iteration 3	1107.54	133.11	1456.90	179.79	532.49	54.70	258.41	17.21	3740.14
Iteration 4	1097.15	125.70	1445.83	174.03	522.99	51.55	258.07	16.09	3691.42
Iteration 5	1108.88	136.38	1444.95	175.87	522.46	56.21	259.04	18.41	3722.20
Iteration 6	1105.76	137.69	1458.87	178.63	534.17	53.45	262.33	18.45	3749.35
Iteration 7	1103.65	132.42	1448.14	176.83	527.22	55.91	262.25	15.96	3722.39
Iteration 8	1111.92	127.90	1468.37	184.73	528.22	53.42	261.76	17.66	3753.97
Iteration 9	1100.82	130.69	1455.26	182.96	525.79	50.12	258.35	19.03	3723.02
Iteration 10	1098.23	131.73	1432.25	181.28	526.85	57.68	249.98	13.39	3691.39
Mean	1103.04	131.58	1449.48	179.31	527.11	53.20	258.77	16.73	3719.23
Standard deviation	7.99	3.77	11.63	3.35	4.76	2.96	4.42	1.74	30.27
Confidence Interval	4.95	2.34	7.21	2.08	2.95	1.83	2.74	1.08	18.76
Upper Limit	1107.99	133.91	1456.69	181.39	530.06	55.04	261.51	17.81	3737.99
Lower Limit	1098.08	129.24	1442.28	177.24	524.17	51.37	256.03	15.65	3700.47

Same values are calculated and reported in excel for each DC. Table above illustrates the format of the output of excel file.

Table C.12. DCs’ Single Performance Measures and Confidence Intervals –
Dispose Rates by Blood Group

DC	Outdate Rate								
[IspartaDC]	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	20.75	0.78	23.30	6.86	16.49	0.10	9.86	0.00	18.25
Iteration 2	22.93	2.16	25.20	7.04	18.47	0.10	12.60	0.38	20.12
Iteration 3	22.61	1.60	25.40	6.83	17.53	0.57	12.48	0.14	19.95
Iteration 4	21.49	2.14	25.45	6.01	17.32	0.14	11.91	0.00	19.57
Iteration 5	22.50	2.45	24.06	5.57	16.64	0.57	10.98	0.00	19.15
Iteration 6	21.96	2.19	25.83	5.55	18.11	0.85	12.43	0.00	19.96
Iteration 7	21.74	1.48	24.83	5.73	17.15	0.50	11.90	0.00	19.33
Iteration 8	22.66	1.79	25.64	6.76	17.00	0.57	12.81	0.14	20.04
Iteration 9	22.07	1.69	24.88	6.99	17.18	0.29	10.50	0.10	19.42
Iteration 10	21.09	1.81	23.44	7.51	17.24	0.88	9.36	0.00	18.55
Mean	21.98	1.81	24.80	6.48	17.31	0.45	11.48	0.08	19.43
Standard deviation	0.72	0.47	0.91	0.70	0.61	0.29	1.23	0.12	0.64
Confidence Interval	0.45	0.29	0.56	0.44	0.38	0.18	0.76	0.08	0.40
Upper Limit	22.42	2.10	25.36	6.92	17.69	0.63	12.25	0.15	19.83
Lower Limit	21.53	1.52	24.24	6.05	16.94	0.28	10.72	0.00	19.04

Same values are calculated and reported in excel for each DC. Table above illustrates the format of the output of excel file.

**Table C.13. DCs' Single Performance Measures and Confidence Intervals –
Deliveries Data**

DC	Deliveries Data									
[IspartaDC]	Number of Routine Deliveries	Kilometers of Routine Deliveries	Number of Ad-Hoc Deliveries to TCs	Kilometers of Ad-Hoc Deliveries to TCs	Number of Ad-Hoc Deliveries to RBC	Kilometers of Ad-Hoc Deliveries to RBC	Number of Emergency Deliveries to TCs	Kilometers of Emergency Deliveries to TCs	total Number of Deliveries	total Kilometers of Deliveries
Iteration 1	18130	886185	16262	939840	0	0	0	0	34392	1826025
Iteration 2	18232	894117	16401	945944	0	0	0	0	34633	1840061
Iteration 3	18265	896573	16411	951428	0	0	0	0	34676	1848001
Iteration 4	18118	887949	16242	938408	0	0	0	0	34360	1826357
Iteration 5	18088	885284	16764	967539	0	0	0	0	34852	1852823
Iteration 6	18178	888806	16585	956571	0	0	0	0	34763	1845377
Iteration 7	18212	892781	16704	967825	0	0	0	0	34916	1860606
Iteration 8	18141	888345	16586	958407	0	0	0	0	34727	1846752
Iteration 9	18119	888176	16488	946366	0	0	0	0	34607	1834542
Iteration 10	18150	888461	16589	959679	0	0	0	0	34739	1848140
Mean	18163	889667	16503	953200	0	0	0	0	34666	1842868
Standard deviation	56.9	3615.5	174.7	10539.5	0.0	0.0	0.0	0.0	179.2	11169.2
Confidence Interval	35.3	2240.9	108.3	6532.4	0.0	0.0	0.0	0.0	111.1	6922.6
Upper Limit	18198	891908	16611	959733	0.0	0.0	0.0	0.0	34777	1849791
Lower Limit	18128	887426	16394	946668	0.0	0.0	0.0	0.0	34555	1835945

Same values are calculated and reported in excel for each DC. Table above illustrates the format of the output of excel file.

Table C.14. DCs’ Single Performance Measures and Confidence Intervals –
Number of Units Used or Disposed in Responsibility Area of DC by Blood Group

DC	Units Used or Disposed in the Responsibility Area of DC								
[IspartaDC]	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	60121	8306	78911	10409	28995	4170	14519	2013	207444
Iteration 2	61200	8506	79984	10557	29540	4209	14905	2116	211017
Iteration 3	61114	8543	80227	10479	29552	4229	14589	2124	210857
Iteration 4	60459	8282	79535	10267	29017	4220	14616	2061	208457
Iteration 5	61189	8517	79593	10302	29075	4239	14724	2156	209795
Iteration 6	61048	8558	80270	10496	29701	4247	14832	2161	211313
Iteration 7	60887	8401	79723	10406	29292	4217	14820	2106	209852
Iteration 8	61321	8199	80756	10703	29392	4229	14816	2129	211545
Iteration 9	60625	8418	80028	10631	29181	4166	14624	2104	209777
Iteration 10	60640	8346	78944	10564	29275	4337	14314	2018	208438
Mean	60860.4	8407.6	79797.1	10481.4	29302	4226.3	14675.9	2098.8	209849.5
Standard deviation	386.9	123.0	581.7	138.8	242.4	47.2	179.2	52.0	1379.2
Confidence Interval	239.8	76.2	360.5	86.0	150.3	29.3	111.1	32.3	854.8
Upper Limit	61100.2	8483.8	80157.6	10567.4	29452.3	4255.6	14787.0	2131.1	210704.3
Lower Limit	60620.6	8331.4	79436.6	10395.4	29151.7	4197.0	14564.8	2066.5	208994.7

Same values are calculated and reported in excel for each DC. Table above illustrates the format of the output of excel file.

**Table C.15. DCs' Single Performance Measures and Confidence Intervals –
Number of Outdated Units by Blood Group**

DC	Outdated								
[Isparta]	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	12475	65	18387	714	4782	4	1431	0	37858
Iteration 2	14034	184	20153	743	5457	4	1878	8	42461
Iteration 3	13816	137	20374	716	5180	24	1820	3	42070
Iteration 4	12991	177	20244	617	5025	6	1741	0	40801
Iteration 5	13769	209	19151	574	4838	24	1617	0	40182
Iteration 6	13407	187	20737	582	5379	36	1844	0	42172
Iteration 7	13234	124	19796	596	5022	21	1764	0	40557
Iteration 8	13894	147	20708	724	4996	24	1898	3	42394
Iteration 9	13377	142	19913	743	5014	12	1536	2	40739
Iteration 10	12787	151	18504	793	5046	38	1340	0	38659
Mean	13378.4	152.3	19796.7	680.2	5073.9	19.3	1686.9	1.6	40789.3
Standard deviation	513.95	40.58	847.46	79.55	212.78	12.45	196.02	2.59	1580.35
Confidence Interval	318.54	25.15	525.25	49.30	131.88	7.71	121.49	1.60	979.49
Upper Limit	13696.94	177.45	20321.95	729.50	5205.78	27.01	1808.39	3.20	41768.79
Lower Limit	13059.85	127.14	19271.44	630.89	4942.01	11.58	1565.40	-0.00	39809.80

Same values are calculated and reported in excel for each DC. Table above illustrates the format of the output of excel file.

Table C.16. DCs’ Single Performance Measures and Confidence Intervals –
Delivery Percentages

DC	Delivery Percentages							
	Percentage of the Number of Routine Deliveries	Percentage of the Kilometers of Routine Deliveries	Percentage of the Number of Ad-Hoc Deliveries to TCs	Percentage of kilometers of Ad-Hoc Deliveries to TCs	Percentage of the Number of Ad-Hoc Deliveries to RBC	Percentage of the Kilometers of Ad-Hoc Deliveries to RBC	Percentage of the Number of Emergency Deliveries to TCs	Percentage of the Kilometers of Emergency Deliveries to TCs
[spartaDC]								
Iteration 1	52.72	48.53	47.28	51.47	0.00	0.00	0.00	0.00
Iteration 2	52.64	48.59	47.36	51.41	0.00	0.00	0.00	0.00
Iteration 3	52.67	48.52	47.33	51.48	0.00	0.00	0.00	0.00
Iteration 4	52.73	48.62	47.27	51.38	0.00	0.00	0.00	0.00
Iteration 5	51.90	47.78	48.10	52.22	0.00	0.00	0.00	0.00
Iteration 6	52.29	48.16	47.71	51.84	0.00	0.00	0.00	0.00
Iteration 7	52.16	47.98	47.84	52.02	0.00	0.00	0.00	0.00
Iteration 8	52.24	48.10	47.76	51.90	0.00	0.00	0.00	0.00
Iteration 9	52.36	48.41	47.64	51.59	0.00	0.00	0.00	0.00
Iteration 10	52.25	48.07	47.75	51.93	0.00	0.00	0.00	0.00
Mean	52.40	48.28	47.60	51.72	0.00	0.00	0.00	0.00
Standard deviation	0.28	0.29	0.28	0.29	0.00	0.00	0.00	0.00
Confidence Interval	0.17	0.18	0.17	0.18	0.00	0.00	0.00	0.00
Upper Limit	52.57	48.46	47.78	51.90	0.00	0.00	0.00	0.00
Lower Limit	52.22	48.10	47.43	51.54	0.00	0.00	0.00	0.00

Same values are calculated and reported in excel for each DC. Table above illustrates the format of the output of excel file.

Table C.17. RBC's Single Performance Measures and Confidence Intervals – Mean Inventory Levels by Blood Group

RBC	Inventory Level								
[West-Mediterranean RBC]	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	2352.69	221.50	3100.73	355.24	1112.13	54.32	527.43	13.70	7737.74
Iteration 2	2430.35	249.73	3196.54	371.78	1163.17	92.37	557.27	16.88	8078.11
Iteration 3	2475.46	257.90	3245.91	394.30	1173.67	82.87	569.73	17.81	8217.66
Iteration 4	2474.60	238.75	3240.53	391.93	1171.57	91.78	570.22	15.16	8194.54
Iteration 5	2456.73	238.65	3243.06	377.17	1165.10	89.04	559.49	13.13	8142.36
Iteration 6	2371.27	203.10	3127.28	362.87	1124.92	73.36	529.55	10.25	7802.60
Iteration 7	2487.35	259.96	3272.31	392.56	1189.36	102.11	563.11	20.08	8286.84
Iteration 8	2442.80	246.45	3225.63	377.52	1166.11	86.13	565.68	19.65	8129.98
Iteration 9	2428.77	236.37	3187.92	381.11	1156.62	82.85	557.16	15.25	8046.05
Iteration 10	2430.01	212.74	3194.01	365.97	1162.61	81.20	554.16	14.16	8014.86
Mean	2435.00	236.52	3203.39	377.04	1158.53	83.60	555.38	15.61	8065.07
Standard deviation	43.97	18.85	54.48	13.35	23.03	12.87	15.15	3.05	175.91
Confidence Interval	27.25	11.68	33.77	8.27	14.27	7.98	9.39	1.89	109.03
Upper Limit	2462.26	248.20	3237.16	385.32	1172.80	91.58	564.77	17.50	8174.10
Lower Limit	2407.75	224.83	3169.63	368.77	1144.25	75.62	545.99	13.72	7956.05

Table C.18. RBC's Single Performance Measures and Confidence Intervals –
Deliveries Data

RBC	Deliveries Data									
[West-MediterraneanRBC]	Number of Routine Deliveries	Kilometers of Routine Deliveries	Number of Ad-Hoc Deliveries to TCs	Kilometers of Ad-Hoc Deliveries to TCs	Number of Ad-Hoc Deliveries to DCs	Kilometers of Ad-Hoc Deliveries to DCs	Number of Emergency Deliveries to TCs	Kilometers of Emergency Deliveries to TCs	total Number of Deliveries	total Kilometers of Deliveries
Iteration 1	47991	3147508	39309	2589401	0	0	0	0	87300	5736909
Iteration 2	48287	3160398	40427	2673384	0	0	0	0	88714	5833782
Iteration 3	48389	3172531	41057	2720005	0	0	0	0	89446	5892536
Iteration 4	48444	3175705	40730	2673494	0	0	0	0	89174	5849199
Iteration 5	48274	3162757	40607	2674975	0	0	0	0	88881	5837732
Iteration 6	48141	3155787	39429	2597745	0	0	0	0	87570	5753532
Iteration 7	48401	3167136	41319	2733980	0	0	0	0	89720	5901116
Iteration 8	48435	3180220	40421	2669021	0	0	0	0	88856	5849241
Iteration 9	48371	3164123	40417	2672399	0	0	0	0	88788	5836522
Iteration 10	48191	3160331	39935	2624038	0	0	0	0	88126	5784369
Mean	48292	3164649	40365	2662844	0.0	0.0	0.0	0.0	88657	5827493
Standard deviation	147.2	9694.9	646.9	47101.0	0.0	0.0	0.0	0.0	777.1	54115.5
Confidence Interval	91.2	6008.9	401.0	29192.9	0.0	0.0	0.0	0.0	481.6	33540.5
Upper Limit	48383	3170658	40766	2692037	0.0	0.0	0.0	0.0	89139	5861034
Lower Limit	48201	3158640	39964	2633651	0.0	0.0	0.0	0.0	88175	5793953

Table C.19. RBC's Single Performance Measures and Confidence Intervals –
Number of Units Used or Disposed in Responsibility Area of RBC by Blood Group

RBC	Units Used or Disposed in the Responsibility Area of RBC								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	134067	18587	175261	23090	64399	8993	32074	4605	461076
Iteration 2	135903	18815	177767	23544	65932	9372	32811	4795	468939
Iteration 3	138170	19190	180580	24071	66272	9386	33428	4783	475880
Iteration 4	137928	18795	180114	23941	66395	9583	33219	4586	474561
Iteration 5	136891	18819	179854	23346	65658	9342	32831	4734	471475
Iteration 6	133118	18277	174883	22974	64250	9096	31929	4476	459003
Iteration 7	138535	19359	181337	23976	66978	9606	33042	4745	477578
Iteration 8	136684	18879	179520	23503	66061	9368	33172	4764	471951
Iteration 9	136150	18637	177712	23511	65688	9358	32880	4630	468566
Iteration 10	135553	18312	177414	23183	65737	9279	32623	4632	466733
Mean	136299	18767	178444	23513	65737	9338	32800	4675	469576
Standard deviation	1747.7	340.6	2204.4	382.4	844.1	187.9	482.1	104.7	6068.3
Confidence Interval	1083.2	211.1	1366.3	237.0	523.2	116.4	298.8	64.9	3761.1
Upper Limit	137383	18978	179810	23750	66260	9454	33099	4739	473337
Lower Limit	135216	18555	177077	23276	65213	9221	32502	4610	465815

Table C.20. RBC's Single Performance Measures and Confidence Intervals –
Number of Outdated Units by Blood Group

RBC	Outdated								
[West-Mediterranean RBC]	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	14832	0	24500	45	3998	0	635	0	44010
Iteration 2	17066	0	28217	136	5435	0	1012	0	51866
Iteration 3	19014	0	30010	292	5421	0	1236	0	55973
Iteration 4	19166	10	28755	324	5498	0	1062	0	54815
Iteration 5	18642	0	29924	193	5297	0	823	0	54879
Iteration 6	15136	0	24457	162	4258	0	935	0	44948
Iteration 7	19705	35	31148	232	6000	0	1300	0	58420
Iteration 8	18163	0	29422	206	5840	0	1244	0	54875
Iteration 9	17517	0	27896	247	5101	0	1145	0	51906
Iteration 10	17030	0	27359	193	5121	0	1031	0	50734
Mean	17627.1	4.5	28168.8	203	5196.9	0	1042.3	0	52242.6
Standard deviation	1654.23	11.17	2241.79	79.36	632.45	0.00	206.05	0.00	4667.75
Confidence Interval	1025.28	6.92	1389.45	49.19	391.99	0.00	127.71	0.00	2893.05
Upper Limit	18652.38	11.42	29558.25	252.19	5588.89	0.00	1170.01	0.00	55135.65
Lower Limit	16601.82	-2.42	26779.35	153.81	4804.91	0.00	914.59	0.00	49349.55

Table C.21. RBC's Single Performance Measures and Confidence Intervals –
Delivery Percentages

RBC	Delivery Percentages							
[West-Mediterranean RBC]	Percentage of the Number of Routine Deliveries	Percentage of the Kilometers of Routine Deliveries	Percentage of the Number of Ad-Hoc Deliveries to TCs	Percentage of kilometers of Ad-Hoc Deliveries to TCs	Percentage of the Number of Ad-Hoc Deliveries to DCs	Percentage of the Kilometers of Ad-Hoc Deliveries to DCs	Percentage of the Number of Emergency Deliveries to TCs	Percentage of the Kilometers of Emergency Deliveries to TCs
Iteration 1	54.97	54.86	45.03	45.14	0.00	0.00	0.00	0.00
Iteration 2	54.43	54.17	45.57	45.83	0.00	0.00	0.00	0.00
Iteration 3	54.10	53.84	45.90	46.16	0.00	0.00	0.00	0.00
Iteration 4	54.33	54.29	45.67	45.71	0.00	0.00	0.00	0.00
Iteration 5	54.31	54.18	45.69	45.82	0.00	0.00	0.00	0.00
Iteration 6	54.97	54.85	45.03	45.15	0.00	0.00	0.00	0.00
Iteration 7	53.95	53.67	46.05	46.33	0.00	0.00	0.00	0.00
Iteration 8	54.51	54.37	45.49	45.63	0.00	0.00	0.00	0.00
Iteration 9	54.48	54.21	45.52	45.79	0.00	0.00	0.00	0.00
Iteration 10	54.68	54.64	45.32	45.36	0.00	0.00	0.00	0.00
Mean	54.47	54.31	45.53	45.69	0.00	0.00	0.00	0.00
Standard deviation	0.34	0.39	0.34	0.39	0.00	0.00	0.00	0.00
Confidence Interval	0.21	0.24	0.21	0.24	0.00	0.00	0.00	0.00
Upper Limit	54.68	54.55	45.73	45.93	0.00	0.00	0.00	0.00
Lower Limit	54.27	54.07	45.32	45.45	0.00	0.00	0.00	0.00

Table C.22. Cities (Excluding RBC and DCs) Performance Measures and
Confidence Intervals – Mean Inventory Levels by Blood Group

City	Inventory Level								
Antalya	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	234.69	46.35	306.76	56.36	124.46	43.88	71.80	38.76	923.07
Iteration 2	234.31	45.23	307.96	55.98	123.94	42.91	71.71	40.02	922.06
Iteration 3	235.86	45.30	308.54	55.56	124.91	43.50	71.04	38.98	923.68
Iteration 4	235.60	45.71	307.56	55.58	123.70	42.97	70.80	39.46	921.36
Iteration 5	236.42	45.63	307.65	56.48	123.62	42.95	71.13	38.97	922.84
Iteration 6	235.94	46.53	307.56	55.91	124.22	43.27	71.49	37.62	922.52
Iteration 7	234.54	45.24	308.17	55.63	123.58	42.51	71.64	39.11	920.42
Iteration 8	235.44	45.36	307.21	55.89	124.08	42.72	71.17	38.82	920.69
Iteration 9	233.98	46.24	309.10	55.91	124.05	43.17	71.61	39.19	923.27
Iteration 10	235.12	46.66	306.73	56.07	124.52	43.74	71.70	38.92	923.47
Mean	235.19	45.82	307.72	55.94	124.11	43.16	71.41	38.98	922.34
Standard deviation	0.79	0.57	0.75	0.31	0.43	0.44	0.34	0.61	1.16
Confidence Interval	0.49	0.35	0.46	0.19	0.27	0.27	0.21	0.38	0.72
Upper Limit	235.68	46.18	308.19	56.13	124.37	43.44	71.62	39.36	923.06
Lower Limit	234.70	45.47	307.26	55.74	123.84	42.89	71.20	38.61	921.62

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file

Table C.23. Cities (Excluding RBC and DCs) Performance Measures and
Confidence Intervals – Outdate Rates by Blood Group

City	Outdate Rate								
Antalya	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	18.00	13.41	16.23	26.96	24.63	18.80	29.73	32.51	19.49
Iteration 2	18.16	16.30	16.96	27.83	26.08	26.42	31.33	33.64	20.48
Iteration 3	18.47	16.57	16.83	31.48	26.12	23.10	31.55	32.95	20.65
Iteration 4	18.65	14.72	17.01	30.89	26.12	26.10	31.91	33.99	20.76
Iteration 5	18.63	14.17	16.90	31.17	26.36	25.42	31.80	30.65	20.66
Iteration 6	18.20	11.82	16.84	29.04	25.79	22.68	29.31	30.18	20.01
Iteration 7	18.44	16.10	16.97	30.71	26.07	27.10	31.87	35.55	20.75
Iteration 8	18.13	15.84	16.69	29.20	25.82	23.92	31.97	34.01	20.37
Iteration 9	18.49	14.76	16.97	30.65	25.90	23.63	30.98	34.36	20.55
Iteration 10	18.42	11.50	17.19	28.11	25.87	24.12	31.80	32.75	20.40
Mean	18.36	14.52	16.86	29.61	25.88	24.13	31.22	33.06	20.41
Standard deviation	0.22	1.81	0.26	1.59	0.47	2.39	0.95	1.65	0.39
Confidence Interval	0.14	1.12	0.16	0.99	0.29	1.48	0.59	1.02	0.24
Upper Limit	18.50	15.64	17.02	30.59	26.17	25.61	31.81	34.08	20.65
Lower Limit	18.22	13.40	16.70	28.62	25.58	22.65	30.63	32.04	20.17

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file

Table C.24. Cities (Excluding RBC and DCs) Performance Measures and
Confidence Intervals – Mismatch Rates by Blood Group

City	Mismatch Rate								
Antalya	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	1.56	7.65	2.29	6.37	3.99	6.31	5.16	12.39	3.13
Iteration 2	1.42	6.79	2.36	6.18	3.98	6.04	5.21	9.23	3.03
Iteration 3	1.35	6.29	2.33	5.95	4.02	5.97	5.37	9.39	2.99
Iteration 4	1.38	6.38	2.24	5.58	4.11	6.00	5.00	12.74	2.96
Iteration 5	1.45	7.28	2.28	5.94	4.03	6.12	5.24	10.31	3.04
Iteration 6	1.38	6.74	2.34	5.78	4.09	5.94	4.84	14.16	3.03
Iteration 7	1.45	7.61	2.38	6.31	4.35	5.77	4.93	10.66	3.13
Iteration 8	1.36	6.57	2.31	5.78	4.23	5.43	5.55	10.47	3.02
Iteration 9	1.36	6.62	2.27	5.63	3.98	6.28	4.90	11.38	2.95
Iteration 10	1.45	6.29	2.39	5.68	4.02	5.42	5.07	11.42	3.01
Mean	1.42	6.82	2.32	5.92	4.08	5.93	5.13	11.21	3.03
Standard deviation	0.07	0.52	0.05	0.28	0.12	0.31	0.22	1.54	0.06
Confidence Interval	0.04	0.32	0.03	0.17	0.07	0.19	0.14	0.95	0.04
Upper Limit	1.46	7.14	2.35	6.09	4.15	6.12	5.27	12.17	3.07
Lower Limit	1.38	6.50	2.29	5.74	4.00	5.74	4.99	10.26	2.99

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file.

**Table C.25. Cities (Excluding RBC and DCs) Performance Measures and
Confidence Intervals – Shortage Rates by Blood Group**

City	Shortage Rate								
Antalya	O+	O-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	1.82	0.43	0.13	0.04	0.05	0.01	0.00	0.00	0.60
Iteration 2	1.77	0.31	0.14	0.02	0.08	0.00	0.00	0.00	0.59
Iteration 3	1.78	0.33	0.15	0.02	0.07	0.00	0.00	0.00	0.60
Iteration 4	1.65	0.35	0.13	0.01	0.06	0.04	0.00	0.00	0.55
Iteration 5	1.77	0.36	0.13	0.03	0.08	0.00	0.00	0.00	0.59
Iteration 6	1.75	0.37	0.14	0.03	0.08	0.01	0.00	0.00	0.59
Iteration 7	1.73	0.38	0.13	0.03	0.06	0.00	0.00	0.00	0.58
Iteration 8	1.80	0.39	0.13	0.01	0.10	0.01	0.00	0.00	0.60
Iteration 9	1.79	0.40	0.13	0.01	0.07	0.04	0.00	0.00	0.60
Iteration 10	1.77	0.32	0.14	0.01	0.09	0.02	0.00	0.00	0.60
Mean	1.76	0.36	0.14	0.02	0.07	0.01	0.00	0.00	0.59
Standard deviation	0.04	0.04	0.01	0.01	0.01	0.01	0.00	0.00	0.02
Confidence Interval	0.03	0.02	0.00	0.01	0.01	0.01	0.00	0.00	0.01
Upper Limit	1.79	0.39	0.14	0.03	0.08	0.02	0.00	0.00	0.60
Lower Limit	1.74	0.34	0.13	0.01	0.06	0.00	0.00	0.00	0.58

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file.

Table C.26. Cities (Excluding RBC and DCs) Performance Measures and
Confidence Intervals – Number of Added Units by Blood Group

City	Added								
Antalya	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	117445	18424	148681	22788	59696	8904	31126	4614	411678
Iteration 2	118864	18838	149602	23375	60471	9424	31741	4753	417068
Iteration 3	118840	19130	150159	23673	60786	9334	32126	4822	418870
Iteration 4	118585	18822	151065	23626	60696	9628	32108	4579	419109
Iteration 5	118674	18834	150647	23268	60614	9306	32123	4745	418211
Iteration 6	117967	18240	150001	22740	59830	9121	30935	4447	413281
Iteration 7	118953	19257	150510	23771	61095	9568	31829	4776	419759
Iteration 8	118608	18977	150245	23351	60284	9399	31849	4739	417452
Iteration 9	118468	18723	149625	23294	60573	9361	31813	4649	416506
Iteration 10	118737	18216	150377	22955	60729	9271	31524	4615	416424
Mean	118514	18746	150091	23284	60477	9331	31717	4673	416835
Standard deviation	466.0	353.6	666.3	360.4	432.4	208.0	411.3	113.6	2575.4
Confidence Interval	288.9	219.1	413.0	223.4	268.0	128.9	254.9	70.4	1596.2
Upper Limit	118803	18965	150504	23507	60745	9460	31972	4744	418432
Lower Limit	118225	18527	149678	23060	60209	9202	31462	4603	415239

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file.

Table C.27. Cities (Excluding RBC and DCs) Performance Measures and
Confidence Intervals – Number of Outdated Units by Blood Group

City	Disposed								
Antalya	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	24126	2493	28447	6226	15859	1691	9536	1497	89875
Iteration 2	24686	3066	30156	6552	17193	2476	10279	1613	96021
Iteration 3	25516	3179	30391	7578	17311	2168	10545	1576	98264
Iteration 4	25717	2766	30639	7396	17341	2501	10599	1559	98518
Iteration 5	25500	2667	30392	7278	17306	2375	10440	1451	97409
Iteration 6	24231	2161	29448	6671	16567	2063	9357	1351	91849
Iteration 7	25552	3117	30774	7364	17462	2603	10531	1687	99090
Iteration 8	24785	2991	29957	6863	17060	2241	10605	1620	96122
Iteration 9	25178	2750	30151	7207	17012	2211	10187	1591	96287
Iteration 10	24971	2106	30505	6517	17008	2238	10374	1517	95236
Mean	25026.2	2729.6	30086	6965.2	17011.9	2256.7	10245.3	1546.2	95867.1
Standard deviation	563.8	381.1	688.0	458.4	477.2	260.3	444.4	96.2	2948.6
Confidence Interval	349.4	236.2	426.4	284.1	295.7	161.3	275.4	59.6	1827.6
Upper Limit	25375.6	2965.8	30512.4	7249.3	17307.6	2418.0	10520.7	1605.8	97694.7
Lower Limit	24676.8	2493.4	29659.6	6681.1	16716.2	2095.4	9969.9	1486.6	94039.5

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file.

Table C.28. Cities (Excluding RBC and DCs) Performance Measures and
Confidence Intervals – Number of Mismatched Units by Blood Group

City	Mismatched								
Antalya	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	1434	967	2809	1037	1806	416	1168	404	10041
Iteration 2	1315	859	2875	1026	1777	384	1172	294	9702
Iteration 3	1237	803	2839	947	1805	391	1216	307	9545
Iteration 4	1256	821	2748	889	1844	391	1122	404	9475
Iteration 5	1328	950	2797	934	1803	385	1189	347	9733
Iteration 6	1272	865	2881	913	1831	380	1088	468	9698
Iteration 7	1324	981	2906	1024	1965	366	1097	343	10006
Iteration 8	1255	844	2832	936	1893	350	1239	331	9680
Iteration 9	1245	854	2759	887	1791	409	1105	363	9413
Iteration 10	1337	803	2925	915	1815	346	1121	366	9628
Mean	1300.3	874.7	2837.1	950.8	1833	381.8	1151.7	362.7	9692.1
Standard deviation	60.2	67.0	59.9	57.3	56.6	22.7	52.6	51.6	203.6
Confidence Interval	37.3	41.5	37.1	35.5	35.1	14.1	32.6	32.0	126.2
Upper Limit	1337.6	916.2	2874.2	986.3	1868.1	395.9	1184.3	394.7	9818.3
Lower Limit	1263.0	833.2	2800.0	915.3	1797.9	367.7	1119.1	330.7	9565.9

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file.

Table C.29. Cities (Excluding RBC and DCs) Performance Measures and
Confidence Intervals – Number of Shortage Units by Blood Group

City	Shortage								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Antalya									
Iteration 1	3407	111	331	12	45	1	0	0	3907
Iteration 2	3330	79	343	5	73	0	0	0	3830
Iteration 3	3322	84	379	7	64	0	0	0	3856
Iteration 4	3081	89	314	4	51	5	0	0	3544
Iteration 5	3299	95	329	10	73	0	0	0	3806
Iteration 6	3280	96	355	8	74	1	0	0	3814
Iteration 7	3239	98	330	9	57	0	0	0	3733
Iteration 8	3368	100	326	4	86	1	0	0	3885
Iteration 9	3357	103	328	3	64	5	0	0	3860
Iteration 10	3325	82	352	4	80	2	0	0	3845
Mean	3300.8	93.7	338.7	6.6	66.7	1.5	0	0	3808
Standard deviation	90.31	10.11	18.86	3.06	12.94	1.96	0.00	0.00	104.32
Confidence Interval	55.98	6.27	11.69	1.90	8.02	1.21	0.00	0.00	64.66
Upper Limit	3356.78	99.97	350.39	8.50	74.72	2.71	0.00	0.00	3872.66
Lower Limit	3244.83	87.43	327.01	4.70	58.68	0.29	0.00	0.00	3743.34

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file

Table C.30. Cities (Excluding RBC and DCs) Performance Measures and
Confidence Intervals – Number of Transfused Units by Blood Group

City	Transfused								
Antalya	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	91721	12648	122569	16290	45242	6589	22620	3262	320941
Iteration 2	92464	12649	121791	16613	44661	6354	22478	3185	320195
Iteration 3	91542	12762	122097	15906	44922	6553	22639	3269	319690
Iteration 4	91259	12865	122719	15932	44845	6522	22425	3170	319737
Iteration 5	91490	13044	122528	15728	44698	6286	22699	3365	319838
Iteration 6	92004	12828	122943	15804	44771	6397	22458	3306	320511
Iteration 7	91495	12884	122098	16225	45218	6347	22233	3218	319718
Iteration 8	92136	12839	122613	16184	44756	6448	22310	3160	320446
Iteration 9	91654	12903	121749	15750	44961	6511	22568	3191	319287
Iteration 10	92227	12771	122351	16122	45199	6379	22124	3206	320379
Mean	91799	12819	122345	16055	44927	6438	22455	3233	320074
Standard deviation	387.8	119.3	399.7	282.2	221.8	101.2	187.0	66.0	500.2
Confidence Interval	240.4	74.0	247.7	174.9	137.4	62.7	115.9	40.9	310.0
Upper Limit	92039	12893	122593	16230	45064	6501	22571	3274	320384
Lower Limit	91558	12745	122098	15880	44789	6375	22339	3192	319764

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file

Table C.31. Cities (Excluding RBC and DCs) Performance Measures and
Confidence Intervals – Number of Requested Units by Blood Group

City	Requested								
Antalya	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	187609	25817	246240	32765	90571	13084	45531	6565	648182
Iteration 2	188209	25733	244873	33110	90108	12924	45159	6508	646624
Iteration 3	186519	25489	244757	32185	89986	13072	45625	6536	644169
Iteration 4	186178	25662	245714	32115	90335	13047	45252	6464	644767
Iteration 5	186238	26165	245458	31775	90477	12952	45894	6648	645607
Iteration 6	187150	25782	246315	31832	89908	12830	45087	6568	645472
Iteration 7	186966	26070	244840	32578	90887	12722	44974	6384	645421
Iteration 8	187186	25869	245879	32269	90373	13000	45025	6382	645983
Iteration 9	187888	25965	243930	31929	90481	13106	45024	6452	644775
Iteration 10	187795	25627	246141	31989	90188	12878	44677	6581	645876
Mean	187174	25818	245415	32255	90331	12962	45225	6509	645688
Standard deviation	706.87	207.02	787.88	435.44	294.48	124.73	360.41	87.48	1122.11
Confidence Interval	438.12	128.31	488.33	269.89	182.52	77.30	223.38	54.22	695.48
Upper Limit	187612	25946	245903	32525	90514	13039	45448	6563	646383
Lower Limit	186736	25690	244926	31985	90149	12884	45001	6455	644992

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file

Table C.32. Cities (Including RBC and DCs) Performance Measures and
Confidence Intervals – Mean Inventory Levels by Blood Group

City	Inventory Level								
Antalya	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	2587.4	267.8	3407.5	411.6	1236.6	98.2	599.2	52.5	8660.8
Iteration 2	2664.7	295.0	3504.5	427.8	1287.1	135.3	629.0	56.9	9000.2
Iteration 3	2711.3	303.2	3554.5	449.9	1298.6	126.4	640.8	56.8	9141.3
Iteration 4	2710.2	284.5	3548.1	447.5	1295.3	134.8	641.0	54.6	9115.9
Iteration 5	2693.1	284.3	3550.7	433.6	1288.7	132.0	630.6	52.1	9065.2
Iteration 6	2607.2	249.6	3434.8	418.8	1249.1	116.6	601.0	47.9	8725.1
Iteration 7	2721.9	305.2	3580.5	448.2	1312.9	144.6	634.7	59.2	9207.3
Iteration 8	2678.2	291.8	3532.8	433.4	1290.2	128.9	636.9	58.5	9050.7
Iteration 9	2662.7	282.6	3497.0	437.0	1280.7	126.0	628.8	54.4	8969.3
Iteration 10	2665.1	259.4	3500.7	422.0	1287.1	124.9	625.9	53.1	8938.3
Mean	2670.2	282.3	3511.1	433.0	1282.6	126.8	626.8	54.6	8987.4
Standard deviation	44.1	18.3	54.8	13.1	22.9	12.5	14.9	3.4	175.4
Confidence Interval	27.3	11.4	33.9	8.1	14.2	7.8	9.3	2.1	108.7
Upper Limit	2697.5	293.7	3545.1	441.1	1296.8	134.5	636.1	56.7	9096.1
Lower Limit	2642.9	271.0	3477.2	424.8	1268.5	119.0	617.5	52.5	8878.7

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file

**Table C.33. Cities (Including RBC and DCs) Performance Measures and
Confidence Intervals – Outdate Rates by Blood Group**

City	Outdate Rate								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Antalya									
Iteration 1	29.06	13.41	30.21	27.16	30.83	18.80	31.71	32.51	29.04
Iteration 2	30.72	16.30	32.84	28.41	34.32	26.42	34.41	33.64	31.54
Iteration 3	32.23	16.57	33.45	32.69	34.30	23.10	35.24	32.95	32.41
Iteration 4	32.54	14.77	32.98	32.25	34.40	26.10	35.10	33.99	32.31
Iteration 5	32.25	14.17	33.54	32.00	34.43	25.42	34.31	30.65	32.30
Iteration 6	29.57	11.82	30.82	29.74	32.41	22.68	32.23	30.18	29.80
Iteration 7	32.67	16.28	34.15	31.68	35.03	27.10	35.81	35.55	32.98
Iteration 8	31.42	15.84	33.08	30.08	34.66	23.92	35.72	34.01	31.99
Iteration 9	31.36	14.76	32.66	31.70	33.66	23.63	34.46	34.36	31.63
Iteration 10	30.98	11.50	32.62	28.94	33.66	24.12	34.96	32.75	31.27
Mean	31.28	14.54	32.63	30.47	33.77	24.13	34.40	33.06	31.53
Standard deviation	1.23	1.83	1.21	1.88	1.26	2.39	1.38	1.65	1.23
Confidence Interval	0.76	1.13	0.75	1.16	0.78	1.48	0.86	1.02	0.76
Upper Limit	32.04	15.67	33.39	31.63	34.55	25.61	35.25	34.08	32.29
Lower Limit	30.52	13.41	31.88	29.30	32.99	22.65	33.54	32.04	30.77

Same values are calculated and reported in excel for each city. Table above illustrates the format of the output of excel file

Table C.34. Regional (Excluding DCs and RBC) Performance Measures and
Confidence Intervals – Mean Inventory Levels by Blood Group

WestMediterranean	Mean Inventory Level								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	364.1	72.5	476.5	88.1	192.5	67.6	112.5	59.4	1433.3
Iteration 2	363.4	71.2	478.0	87.9	191.9	66.5	111.6	60.4	1430.9
Iteration 3	366.1	71.4	478.5	87.3	192.1	66.8	111.3	60.3	1433.9
Iteration 4	364.2	71.7	478.1	87.8	191.8	66.7	110.7	60.4	1431.4
Iteration 5	366.4	71.4	477.2	88.3	191.6	66.1	111.6	59.9	1432.3
Iteration 6	365.1	72.4	478.5	87.8	191.8	66.8	111.6	58.4	1432.4
Iteration 7	363.0	71.0	478.5	87.5	191.4	65.9	111.5	60.2	1429.0
Iteration 8	364.2	71.3	476.5	87.4	191.2	66.5	111.2	59.7	1428.0
Iteration 9	363.4	72.1	478.5	87.7	191.7	66.5	111.3	59.6	1430.8
Iteration 10	364.0	72.7	476.0	88.0	192.1	67.1	112.1	60.3	1432.4
Mean	364.4	71.8	477.6	87.8	191.8	66.6	111.5	59.8	1431.4
Standard deviation	1.15	0.61	0.99	0.32	0.37	0.49	0.51	0.64	1.85
Confidence Interval	0.71	0.38	0.62	0.20	0.23	0.30	0.31	0.40	1.15
Upper Limit	365.1	72.1	478.3	88.0	192.0	67.0	111.9	60.2	1432.6
Lower Limit	363.7	71.4	477.0	87.6	191.6	66.3	111.2	59.5	1430.3

Table C.35. Regional (Excluding DCs and RBC) Performance Measures and
Confidence Intervals – Outdate Rates by Blood Group

WestMediterranean	Outdate Rate								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	18.04	16.72	16.34	29.17	24.62	23.10	29.96	35.75	19.92
Iteration 2	18.16	18.66	16.88	29.64	25.75	27.23	31.35	35.79	20.62
Iteration 3	18.34	17.66	16.79	31.61	25.60	25.48	31.70	36.41	20.66
Iteration 4	18.56	16.97	16.99	31.19	25.78	27.75	31.89	36.42	20.84
Iteration 5	18.48	17.83	16.92	31.63	26.14	28.12	31.59	34.69	20.84
Iteration 6	18.25	16.11	16.95	30.22	25.67	25.81	30.09	35.00	20.45
Iteration 7	18.33	18.41	16.95	31.67	25.78	29.58	31.56	37.79	20.86
Iteration 8	18.13	18.05	16.59	30.16	25.71	26.56	31.69	36.84	20.51
Iteration 9	18.45	17.79	16.89	31.56	25.63	25.28	31.02	36.96	20.69
Iteration 10	18.33	15.82	17.04	30.01	25.57	27.52	31.83	35.19	20.64
Mean	18.31	17.40	16.83	30.69	25.63	26.64	31.27	36.08	20.60
Standard deviation	0.17	0.96	0.21	0.95	0.39	1.81	0.70	0.98	0.28
Confidence Interval	0.10	0.59	0.13	0.59	0.24	1.12	0.43	0.60	0.17
Upper Limit	18.41	17.99	16.97	31.27	25.87	27.77	31.70	36.69	20.78
Lower Limit	18.20	16.81	16.70	30.10	25.39	25.52	30.83	35.48	20.43

Table C.36. Regional (Excluding DCs and RBC) Performance Measures and
Confidence Intervals – Mismatch Rates by Blood Group

WestMediterranean	Mismatch Rate								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	1.53	7.72	2.17	6.59	4.35	6.68	5.34	13.33	3.16
Iteration 2	1.43	7.22	2.28	6.41	4.31	5.97	5.69	10.13	3.12
Iteration 3	1.40	6.71	2.22	6.46	4.47	6.88	5.80	9.55	3.12
Iteration 4	1.36	6.81	2.17	6.22	4.36	6.31	5.35	12.02	3.04
Iteration 5	1.43	7.38	2.17	6.13	4.38	6.08	5.43	10.69	3.07
Iteration 6	1.38	7.06	2.22	6.24	4.34	6.17	5.32	12.61	3.07
Iteration 7	1.45	7.61	2.24	6.66	4.48	5.79	5.44	10.02	3.14
Iteration 8	1.39	7.02	2.22	6.17	4.49	6.23	5.63	10.63	3.09
Iteration 9	1.39	6.99	2.13	6.21	4.41	6.59	5.60	11.20	3.07
Iteration 10	1.45	6.49	2.25	6.30	4.26	6.06	5.40	11.64	3.06
Mean	1.42	7.10	2.21	6.34	4.39	6.28	5.50	11.18	3.09
Standard deviation	0.05	0.39	0.05	0.18	0.08	0.34	0.17	1.21	0.04
Confidence Interval	0.03	0.24	0.03	0.11	0.05	0.21	0.10	0.75	0.02
Upper Limit	1.45	7.34	2.24	6.45	4.43	6.49	5.60	11.93	3.12
Lower Limit	1.39	6.86	2.18	6.22	4.34	6.06	5.40	10.43	3.07

Table C.37. Regional (Excluding DCs and RBC) Performance Measures and
Confidence Intervals – Shortage Rates by Blood Group

WestMediterranean	Shortage Rate								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	1.79	0.45	0.13	0.03	0.05	0.01	0.00	0.00	0.59
Iteration 2	1.66	0.34	0.12	0.01	0.07	0.00	0.00	0.00	0.55
Iteration 3	1.71	0.37	0.14	0.02	0.07	0.01	0.00	0.00	0.57
Iteration 4	1.69	0.34	0.13	0.02	0.07	0.03	0.00	0.00	0.56
Iteration 5	1.71	0.35	0.13	0.03	0.07	0.00	0.00	0.00	0.57
Iteration 6	1.68	0.32	0.13	0.03	0.09	0.02	0.00	0.00	0.56
Iteration 7	1.73	0.36	0.13	0.03	0.06	0.01	0.00	0.00	0.58
Iteration 8	1.73	0.37	0.13	0.01	0.10	0.01	0.00	0.00	0.58
Iteration 9	1.76	0.37	0.13	0.01	0.08	0.02	0.00	0.00	0.59
Iteration 10	1.75	0.34	0.13	0.02	0.08	0.02	0.00	0.00	0.58
Mean	1.72	0.36	0.13	0.02	0.07	0.01	0.00	0.00	0.57
Standard deviation	0.04	0.03	0.00	0.01	0.01	0.01	0.00	0.00	0.01
Confidence Interval	0.02	0.02	0.00	0.00	0.01	0.01	0.00	0.00	0.01
Upper Limit	1.75	0.38	0.13	0.03	0.08	0.02	0.00	0.00	0.58
Lower Limit	1.70	0.34	0.13	0.02	0.06	0.01	0.00	0.00	0.57

Table C.38. Regional (Including DCs and RBC) Performance Measures and
Confidence Intervals – Mean Inventory Level by Blood Group

Region	Inventory Level								
West-Mediterranean	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	4222.9	464.3	5566.1	687.0	2025.7	186.7	987.7	92.6	14233.0
Iteration 2	4333.3	492.9	5702.1	706.1	2096.8	225.6	1027.2	99.1	14683.0
Iteration 3	4369.4	491.3	5740.2	723.9	2093.6	215.1	1035.8	100.5	14769.8
Iteration 4	4356.5	470.9	5713.4	717.1	2084.3	226.9	1032.1	96.5	14697.8
Iteration 5	4359.3	487.2	5719.5	704.1	2079.7	226.3	1022.1	96.4	14694.7
Iteration 6	4267.5	450.5	5629.6	694.6	2050.3	209.3	999.7	93.0	14394.4
Iteration 7	4396.0	503.8	5771.4	727.6	2118.3	240.1	1035.9	103.1	14896.2
Iteration 8	4351.9	482.0	5739.0	710.7	2088.5	220.2	1036.0	102.7	14731.0
Iteration 9	4319.8	484.1	5687.1	720.3	2077.1	213.5	1020.5	98.4	14620.9
Iteration 10	4321.7	457.4	5666.7	701.9	2081.1	222.3	1014.0	92.9	14557.8
Mean	4329.8	478.4	5693.5	709.3	2079.5	218.6	1021.1	97.5	14627.9
Standard deviation	51.1	17.1	60.1	13.1	25.5	14.1	16.5	3.9	191.7
Confidence Interval	31.7	10.6	37.3	8.1	15.8	8.8	10.2	2.4	118.8
Upper Limit	4361.5	489.0	5730.8	717.4	2095.3	227.4	1031.3	100.0	14746.7
Lower Limit	4298.1	467.9	5656.2	701.2	2063.7	209.8	1010.9	95.1	14509.1

Table C.39. Regional (Including DCs and RBC) Performance Measures and
Confidence Intervals – Outdate Rates by Blood Group

Region	Outdate Rate								
West-Mediterranean	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Iteration 1	32.27	17.07	33.40	31.87	34.48	23.22	34.78	35.75	32.41
Iteration 2	34.05	19.41	35.82	32.59	37.69	27.44	37.60	35.93	34.71
Iteration 3	34.70	18.12	35.92	34.89	36.88	25.64	38.29	36.45	34.90
Iteration 4	34.60	17.71	35.71	34.16	37.01	27.96	37.81	36.48	34.77
Iteration 5	34.86	18.57	35.70	34.35	37.22	28.32	37.00	34.71	34.85
Iteration 6	33.12	16.85	34.86	32.80	36.11	26.15	36.26	35.00	33.63
Iteration 7	34.99	19.00	36.59	34.76	37.82	29.78	38.31	37.84	35.49
Iteration 8	34.38	18.65	35.86	33.14	37.37	26.81	38.34	36.89	34.83
Iteration 9	34.19	18.38	35.49	34.99	36.58	25.39	36.87	36.98	34.47
Iteration 10	33.64	16.53	35.06	33.39	36.43	27.90	37.18	35.25	34.03
Mean	34.08	18.03	35.44	33.69	36.76	26.86	37.24	36.13	34.41
Standard deviation	0.86	0.96	0.86	1.09	0.97	1.85	1.11	0.98	0.87
Confidence Interval	0.53	0.60	0.53	0.67	0.60	1.14	0.69	0.61	0.54
Upper Limit	34.61	18.62	35.97	34.37	37.36	28.01	37.93	36.74	34.95
Lower Limit	33.55	17.43	34.91	33.02	36.16	25.72	36.56	35.52	33.87

Table C.40. Regional (Including DCs and RBC) Performance Measures and
Confidence Intervals – Deliveries Data

Region	Deliveries Data									
WestAnatolia	Number of Routine Deliveries	Kilometers of Routine Deliveries	Number of Ad-Hoc Deliveries to TCs	Kilometers of Ad-Hoc Deliveries to TCs	Number of Ad-Hoc Deliveries to DCs and RBC	Kilometers of Ad-Hoc Deliveries to DCs and RBC	Number of Emergency Deliveries to TCs	Kilometers of Emergency Deliveries to TCs	total Number of Deliveries	total Kilometers of Deliveries
Iteration 1	75280	4427462	63143	3886548	0	0	0	0	138423	8314010
Iteration 2	75669	4447939	64587	3982998	0	0	0	0	140256	8430937
Iteration 3	75835	4465050	64905	4022996	0	0	0	0	140740	8488046
Iteration 4	75757	4461407	64524	3965667	0	0	0	0	140281	8427074
Iteration 5	75574	4442889	64854	3990303	0	0	0	0	140428	8433192
Iteration 6	75523	4440875	63651	3913236	0	0	0	0	139174	8354111
Iteration 7	75844	4457642	65683	4063322	0	0	0	0	141527	8520964
Iteration 8	75801	4464952	64548	3979452	0	0	0	0	140349	8444404
Iteration 9	75685	4446416	64468	3974870	0	0	0	0	140153	8421286
Iteration 10	75564	4444614	64157	3948348	0	0	0	0	139721	8392962
Mean	75653.2	4449924.6	64452	3972774	0	0	0	0	140105.2	8422698.6
Standard deviation	174.4	12140.0	695.8	50342.0	0.0	0.0	0.0	0.0	849.1	59626.9
Confidence Interval	108	7524	431	31202	0	0	0	0	526	36956
Upper Limit	75761	4457449	64883	4003976	0	0	0	0	140631	8459655
Lower Limit	75545	4442400	64021	3941572	0	0	0	0	139579	8385742

Table C.41. Regional (Including DCs and RBC) Performance Measures and
Confidence Intervals – Delivery Percentages

Region	Delivery_Percentages							
	Percentage of the Number of Routine Deliveries	Percentage of the Kilometers of Routine Deliveries	Percentage of the Number of Ad-Hoc Deliveries to TCs	Percentage of kilometers of Ad- Hoc Deliveries to TCs	Percentage of the Number of Ad-Hoc Deliveries to DCs and RBC	Percentage of the Kilometers of Ad-Hoc Deliveries to DCs and RBC	Percentage of the Number of Emergency Deliveries to TCs	Percentage of the Kilometers of Emergency Deliveries to TCs
WestAnatolia								
Iteration 1	54.38	53.25	45.62	46.75	0.00	0.00	0.00	0.00
Iteration 2	53.95	52.76	46.05	47.24	0.00	0.00	0.00	0.00
Iteration 3	53.88	52.60	46.12	47.40	0.00	0.00	0.00	0.00
Iteration 4	54.00	52.94	46.00	47.06	0.00	0.00	0.00	0.00
Iteration 5	53.82	52.68	46.18	47.32	0.00	0.00	0.00	0.00
Iteration 6	54.27	53.16	45.73	46.84	0.00	0.00	0.00	0.00
Iteration 7	53.59	52.31	46.41	47.69	0.00	0.00	0.00	0.00
Iteration 8	54.01	52.87	45.99	47.13	0.00	0.00	0.00	0.00
Iteration 9	54.00	52.80	46.00	47.20	0.00	0.00	0.00	0.00
Iteration 10	54.08	52.96	45.92	47.04	0.00	0.00	0.00	0.00
Mean	54.00	52.83	46.00	47.17	0.00	0.00	0.00	0.00
Standard deviation	0.22	0.27	0.22	0.27	0.00	0.00	0.00	0.00
Confidence Interval	0.14	0.17	0.14	0.17	0.00	0.00	0.00	0.00
Upper Limit	54.14	53.00	46.14	47.33	0.00	0.00	0.00	0.00
Lower Limit	53.86	52.67	45.86	47.00	0.00	0.00	0.00	0.00

Table C.42. Summary Tables – Regional (Including DCs and RBC) Performance
Measures Summary by Blood Group

Performance Measure	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Inventory Level	4330	478	5694	709	2080	219	1021	98	14628
Outdate Rate	34.08	18.03	35.44	33.70	36.76	26.86	37.25	36.13	34.41
Mismatch Rate	1.42	7.10	2.21	6.34	4.39	6.28	5.50	11.18	3.09
Shortage Rate	1.72	0.36	0.13	0.02	0.07	0.01	0.00	0.00	0.57

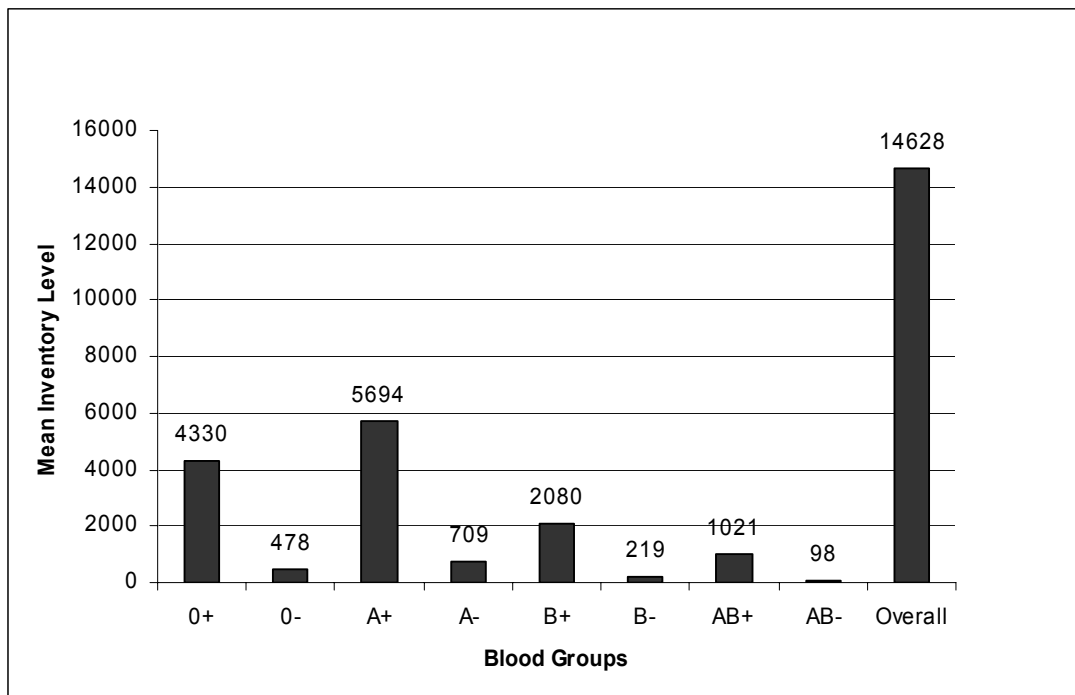


Figure C.1. Summary Graphics- Regional (Including DCs and RBC) - Mean Inventory Levels by Blood Group

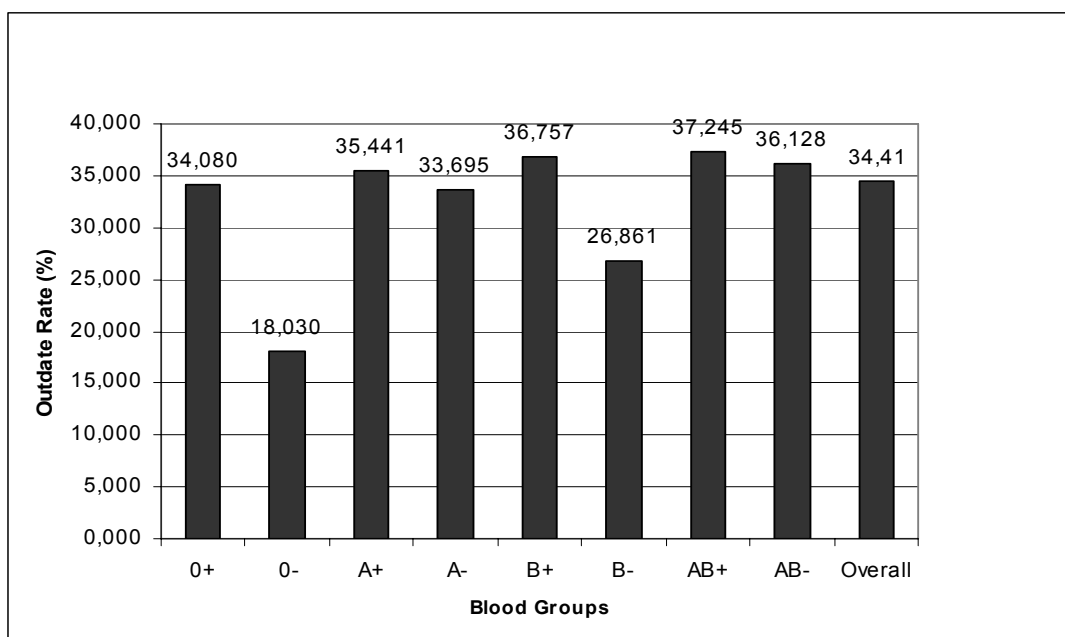


Figure C.2. Summary Graphics- Regional (Including DCs and RBC) - Outdate Rates by Blood Group

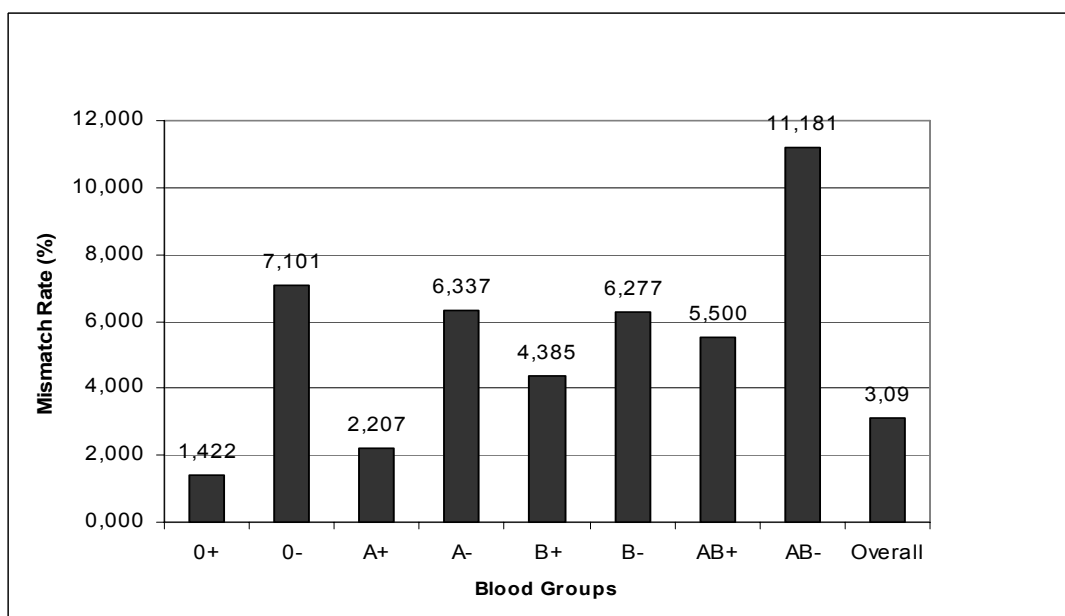


Figure C.3. Summary Graphics- Regional (Including DCs and RBC) - Mismatch Rates by Blood Group

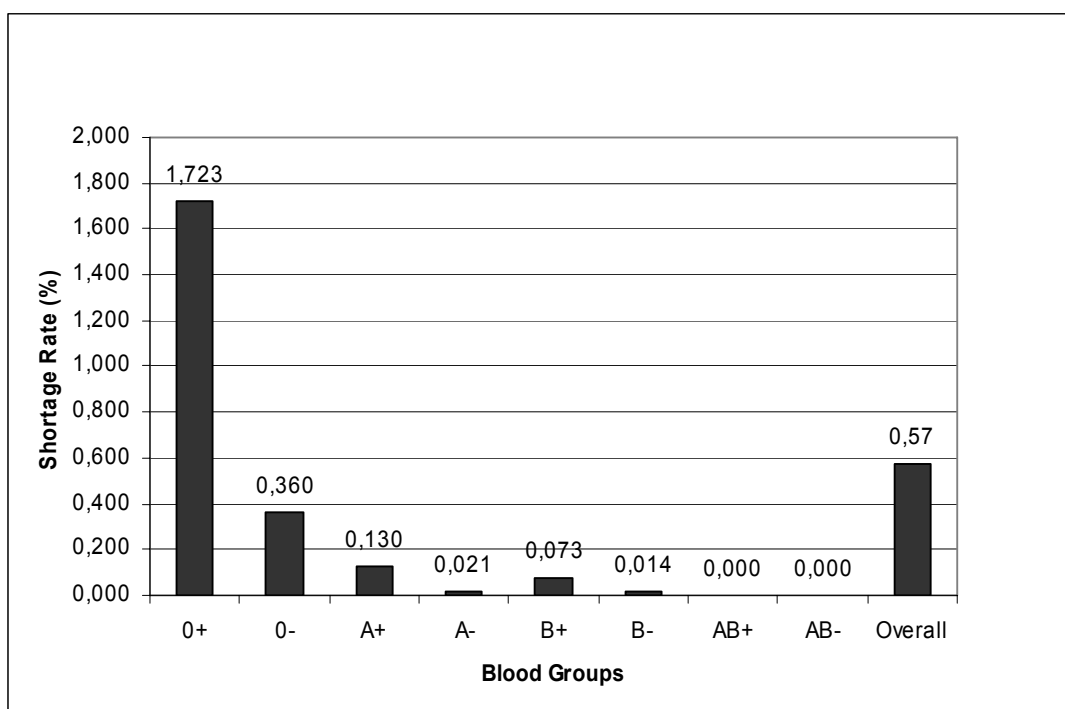


Figure C.4. Summary Graphics- Regional (Including DCs and RBC) - Shortage Rates by Blood Group

Table C.43. Summary Tables – Regional (Including DCs and RBC) - Deliveries Data Summary by Blood Group

Deliveries Data				
Delivery Type	Quantity	Distance (km)	Percentage(%) (in quantities)	Percentage(%) (in Kms)
Routine Deliveries to TCs	75653	4449925	54.00	52.83
Ad-Hoc Deliveries to TCs	64452	3972774	46.00	47.17
Emergency Deliveries to TCs	0	0	0.00	0.00
Ad-hoc Deliveries Between DCs and RBC	0	0	0.00	0.00
All Deliveries	140105	8422699	100.00	100.00

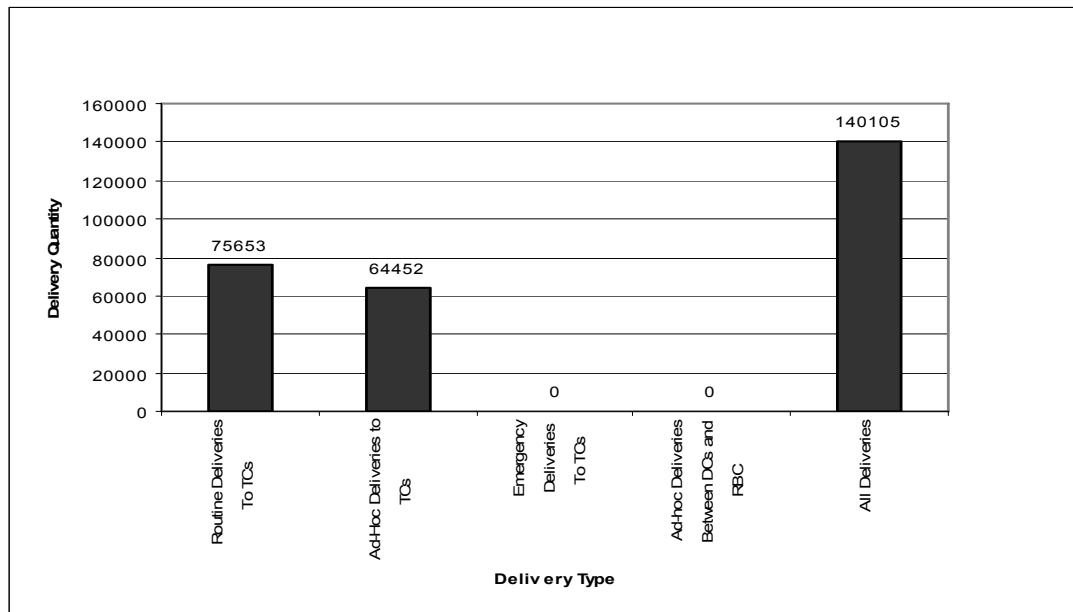


Figure C.5. Summary Graphics- Regional (Including DCs and RBC) - Quantities of Deliveries

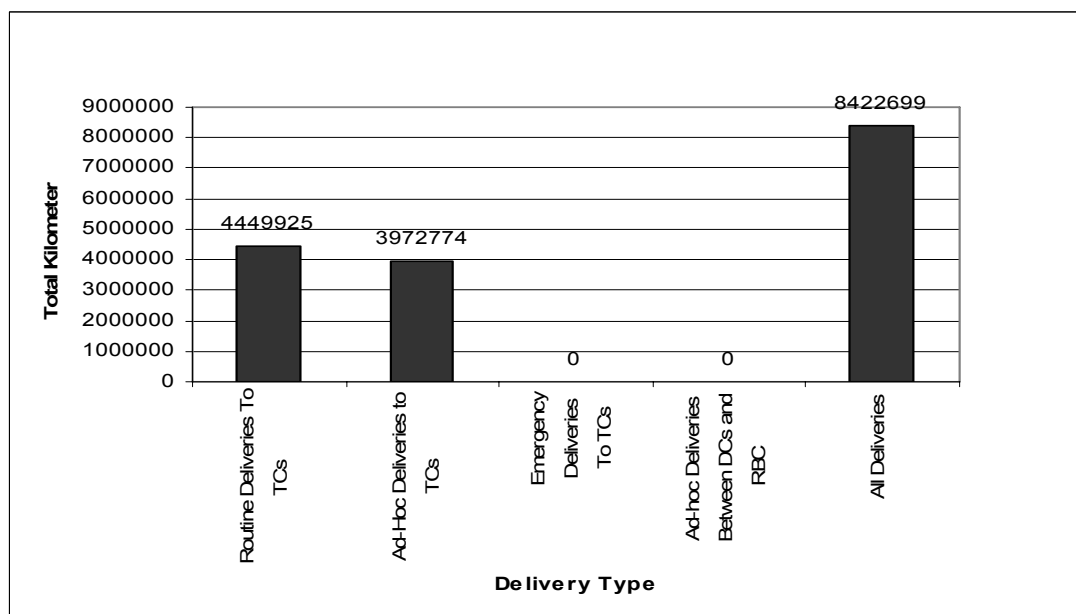


Figure C.6. Summary Graphics- Regional (Including DCs and RBC) - Delivery Distances

Table C.44. Summary Tables – Regional (Excluding DCs and RBC) Performance
Measures Summary by Blood Group

Performance Measures	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Inventory Levels	364	72	478	88	192	67	112	60	1431
Outdate Rates	18.31	17.40	16.83	30.69	25.63	26.64	31.27	36.08	20.60
Mismatch Rates	1.42	7.10	2.21	6.34	4.39	6.28	5.50	11.18	3.09
Shortage Rates	1.72	0.36	0.13	0.02	0.07	0.01	0.00	0.00	0.57

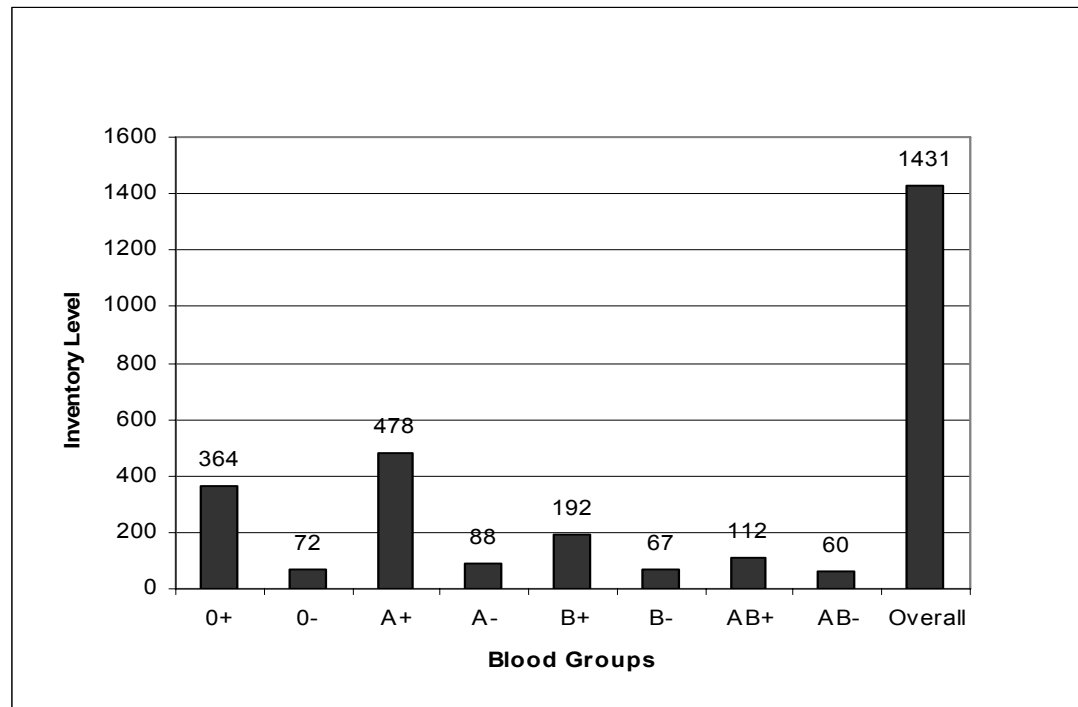


Figure C.7. Summary Graphics- Regional (Excluding DCs and RBC) – Mean Inventory Levels

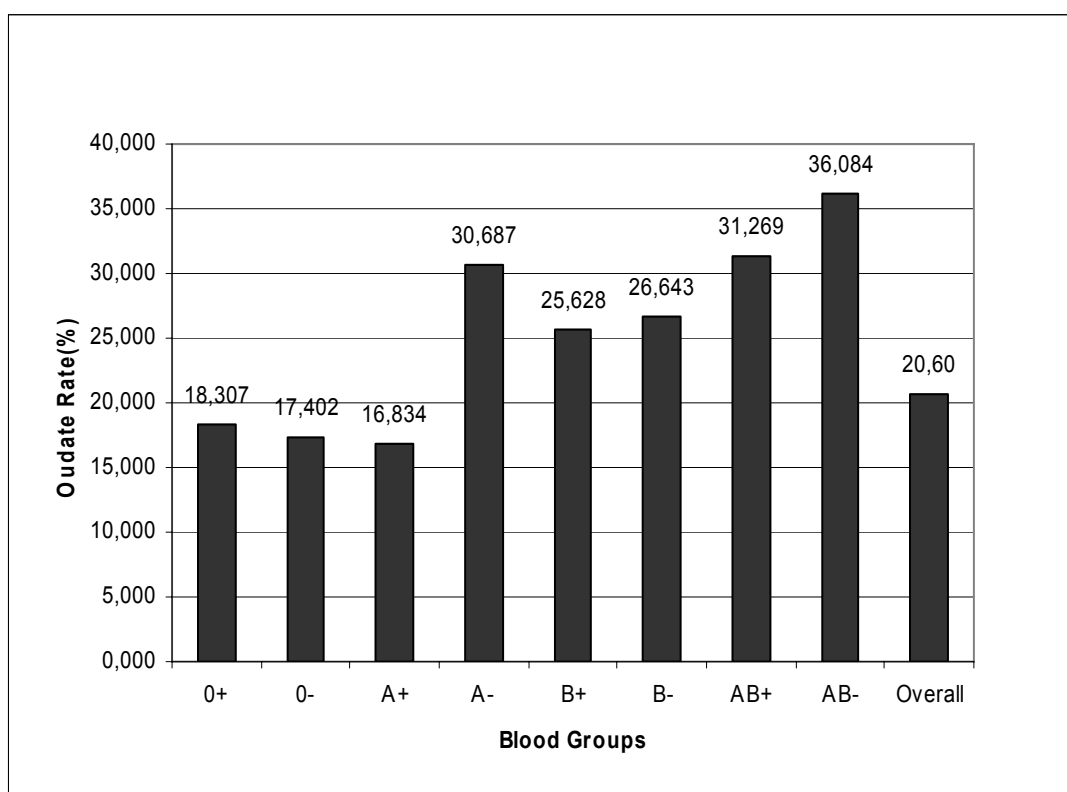


Figure C.8. Summary Graphics- Regional (Excluding DCs and RBC) – Outdate Rates

Table C.45. Summary Tables – Comparison of Outdate Rates of Regional Performance of RBCs and DCs included. and Excluded Cases. And, TCs’ Single Performances Means

Cases	Outdate Rates (%)								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Regional (Including DCs and RBC) Performance	34.08	18.03	35.44	33.69	36.76	26.86	37.24	36.13	34.41
Regional (Excluding DCs and RBC) Performance	18.31	17.40	16.83	30.69	25.63	26.64	31.27	36.08	20.60
TCs’ Single Performances Mean	27.78	20.90	27.07	37.71	36.00	35.73	40.66	46.62	30.51

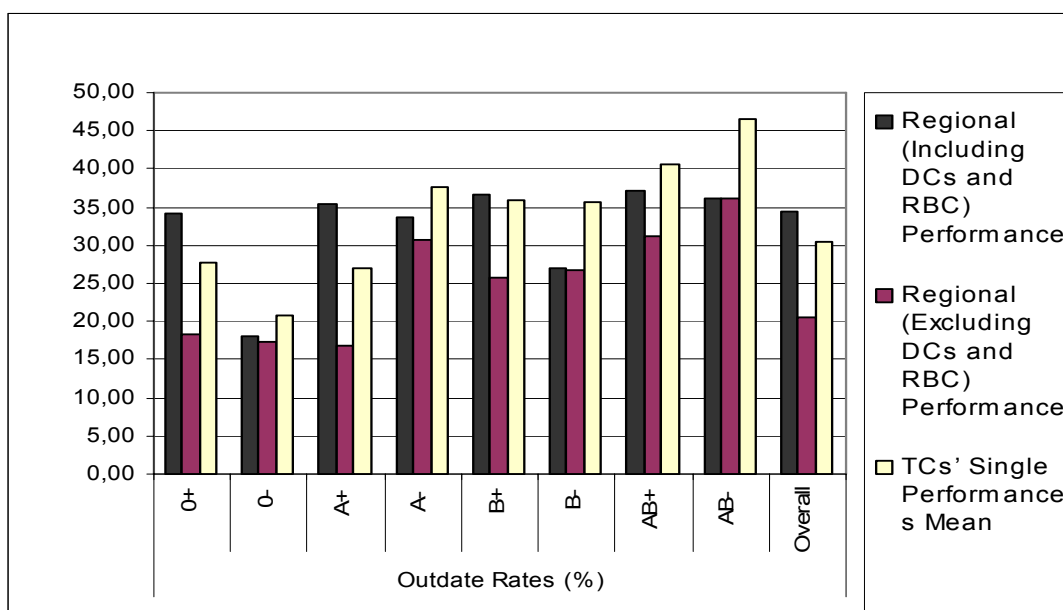


Figure C.9. Summary Graphics- Comparison of Outdate Rates of Regional Performance of RBCs and DCs included and excluded cases and TCs Single Performances Means

Table C.46. Summary Tables – Comparison of Mismatch Rates of Regional Performance (Excluding RBCs and DCs) and TCs' Single Performances Means

Cases	Mismatch Rates (%)								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Regional (Excluding DCs and RBC) Performance	1.42	7.10	2.21	6.34	4.39	6.28	5.50	11.18	3.09
TCs' Single Performances Mean	2.76	6.75	4.37	6.65	5.89	5.01	6.46	9.82	4.56

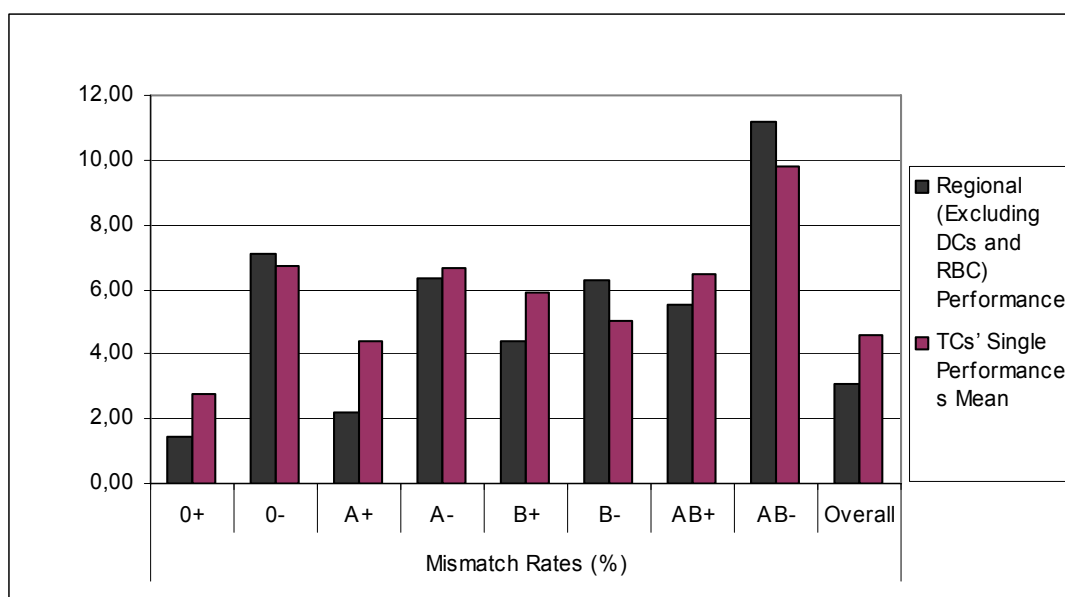


Figure C.10. Summary Graphics- Comparison of Mismatch Rates of Regional Performance (Excluding RBCs and DCs) and TCs' Single Performances Means

Table C.47. Summary Tables – Comparison of Shortage Rates of Regional Performance (Excluding RBCs and DCs) and TCs' Single Performances Means

Cases	Shortage Rates (%)								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Regional (Excluding DCs and RBC) Performance	1.72	0.36	0.13	0.02	0.07	0.01	0.00	0.00	0.57
TCs' Single Performances Mean	3.21	0.64	0.28	0.05	0.13	0.02	0.00	0.00	1.08

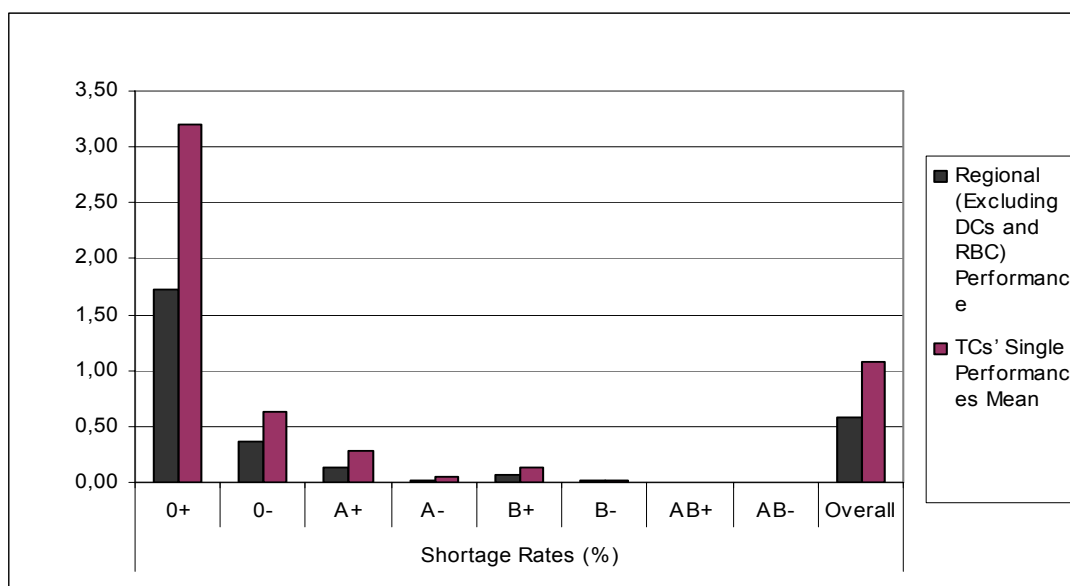


Figure C.11. Summary Graphics- Comparison of Shortage Rates of Regional Performance (Excluding RBCs and DCs) and TCs' Single Performances Means

Table C.48. Summary Tables – Comparison of Performances Between TCs

Hospital	Mean Inventory Level	Outdate Rate	Mismatch Rate	Shortage Rate
TC1	97.99	14.14	1.32	0.02
TC2	27.85	26.83	3.86	0.66
TC3	19.76	31.80	5.23	1.43
TC4	16.71	35.02	5.28	1.18
TC5	15.23	35.21	5.41	1.34
TC6	21.08	29.43	5.32	1.15
TC7	18.23	33.99	4.92	1.29
TC8	16.22	32.74	5.67	1.37
TC9	13.98	35.89	5.94	1.56
TC10	16.31	33.88	5.61	1.33
TC11	19.58	31.47	5.26	1.47
TC12	13.52	37.02	5.69	1.53
TC13	14.19	36.78	5.66	1.47
TC14	25.15	28.23	3.91	1.07
TC15	16.73	33.26	5.58	1.54
TC16	15.37	36.24	5.75	1.33
TC17	14.04	36.19	6.47	1.57
TC18	170.54	10.12	0.76	0.00
TC19	74.71	15.80	1.76	0.05
TC20	48.02	19.85	2.71	0.25
TC21	14.24	37.23	5.40	1.37
TC22	18.98	31.13	5.10	1.68
TC23	27.65	26.04	4.06	0.82
TC24	19.74	31.66	5.18	1.44
TC25	15.10	34.59	5.76	1.28
TC26	13.61	38.48	5.74	1.43
TC27	25.14	27.87	4.21	1.10
TC28	21.66	28.50	4.99	1.27
TC29	47.02	20.23	2.66	0.24
TC30	13.52	37.22	5.65	1.62
TC31	30.45	24.83	3.73	0.61
TC32	43.89	19.79	3.06	0.24
TC33	18.22	32.73	5.00	1.29
TC34	47.70	18.79	2.66	0.29
TC35	15.26	34.88	5.59	1.29
TC36	13.10	38.89	5.52	1.23
TC37	17.76	29.89	5.31	1.61
TC38	77.77	17.98	1.60	0.05
TC39	27.83	28.26	3.95	0.66
TC40	43.78	22.68	2.79	0.27
TC41	45.69	22.76	2.58	0.29
TC42	13.47	41.97	5.31	1.54
TC43	13.99	40.59	5.77	1.69
TC44	16.12	36.65	5.65	1.47
TC45	13.72	39.44	5.92	1.66
TC46	13.48	41.18	5.39	1.61
TC47	16.50	35.30	5.25	1.70
TC48	57.36	20.03	2.15	0.12
TC49	13.44	41.64	5.34	1.52
Mean	29.21	30.51	4.56	1.08
Median	18.22	32.73	5.26	1.29
Max	170.54	41.97	6.47	1.70
Min	13.10	10.12	0.76	0.00
Percentile (%10)	13.52	19.59	2.49	0.22
Percentile (%25)	14.24	26.04	3.86	0.66
Percentile (%50)	18.22	32.73	5.26	1.29
Percentile (%75)	27.85	36.24	5.61	1.52
Percentile (%90)	49.88	39.00	5.75	1.61

Table C.49. Summary Tables – Single TCs’ Performances Means - Comparison of Outdate Rates of Blood Groups

	Outdate Rate								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Mean	27.78	20.90	27.07	37.71	36.00	35.73	40.66	46.62	30.51
Median	29.71	20.23	29.42	38.29	39.23	39.21	42.94	53.00	32.73
Max	37.21	38.94	37.33	54.08	46.72	60.88	53.01	70.65	41.97
Min	9.50	6.21	8.18	14.14	13.72	4.64	16.58	3.77	10.12
Percentile (%10)	17.76	11.47	17.15	26.70	23.87	14.93	26.76	17.10	19.59
Percentile (%25)	24.04	15.58	23.62	32.94	31.70	23.21	36.88	34.59	26.04
Percentile (%50)	29.71	20.23	29.42	38.29	39.23	39.21	42.94	53.00	32.73
Percentile (%75)	32.52	25.29	32.21	43.61	42.42	46.73	48.01	61.85	36.24
Percentile (%90)	35.13	31.94	34.46	48.46	44.60	56.12	50.20	66.19	39.00

Table C.50. Summary Tables – Single TCs’ Performances Means - Comparison of Mismatch Rates of Blood Groups

Hospital	Mismatch Rate								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Mean	2.76	6.75	4.37	6.65	5.89	5.01	6.46	9.82	4.56
Median	2.98	6.40	5.41	6.49	6.15	4.70	6.66	9.20	5.26
Max	5.38	10.66	7.28	9.97	8.95	13.43	10.38	20.70	6.47
Min	0.00	3.74	0.00	3.41	0.21	2.19	1.59	2.47	0.76
Percentile (%10)	0.60	4.67	0.50	5.09	4.64	2.95	4.32	4.19	2.49
Percentile (%25)	1.79	5.23	2.82	5.80	5.53	3.67	5.37	7.62	3.86
Percentile (%50)	2.98	6.40	5.41	6.49	6.15	4.70	6.66	9.20	5.26
Percentile (%75)	3.81	8.08	6.13	7.46	6.75	6.04	7.27	12.02	5.61
Percentile (%90)	4.78	8.91	6.68	8.47	7.17	6.96	8.74	14.91	5.75

Table C.51. Summary Tables – Single TCs’ Performances Means - Comparison of Mismatch Rates of Blood Groups

Hospital	Shortage Rate								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Mean	3.21	0.64	0.28	0.05	0.13	0.02	0.00	0.00	1.08
Median	3.85	0.66	0.33	0.04	0.13	0.00	0.00	0.00	1.29
Max	5.05	1.35	0.57	0.13	0.35	0.16	0.00	0.00	1.70
Min	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.68	0.18	0.01	0.00	0.02	0.00	0.00	0.00	0.22
Percentile (%25)	2.05	0.39	0.09	0.00	0.07	0.00	0.00	0.00	0.66
Percentile (%50)	3.85	0.66	0.33	0.04	0.13	0.00	0.00	0.00	1.29
Percentile (%75)	4.49	0.86	0.42	0.08	0.19	0.03	0.00	0.00	1.52
Percentile (%90)	4.72	1.07	0.52	0.11	0.22	0.09	0.00	0.00	1.61

Table C.52. Summary Tables - Comparison of General Performance Measures of Cities (Including DCs and RBC)

Performance Measure (Cities Including RBC and DCs)	Antalya	Burdur	Isparta	Overall
Inventory Level	8987	1568	4072	14628
Outdate Rate	31.53	35.74	40.31	34.41
Mismatch Rate	3.03	3.67	3.02	3.09
Shortage Rate	0.59	0.64	0.51	0.57

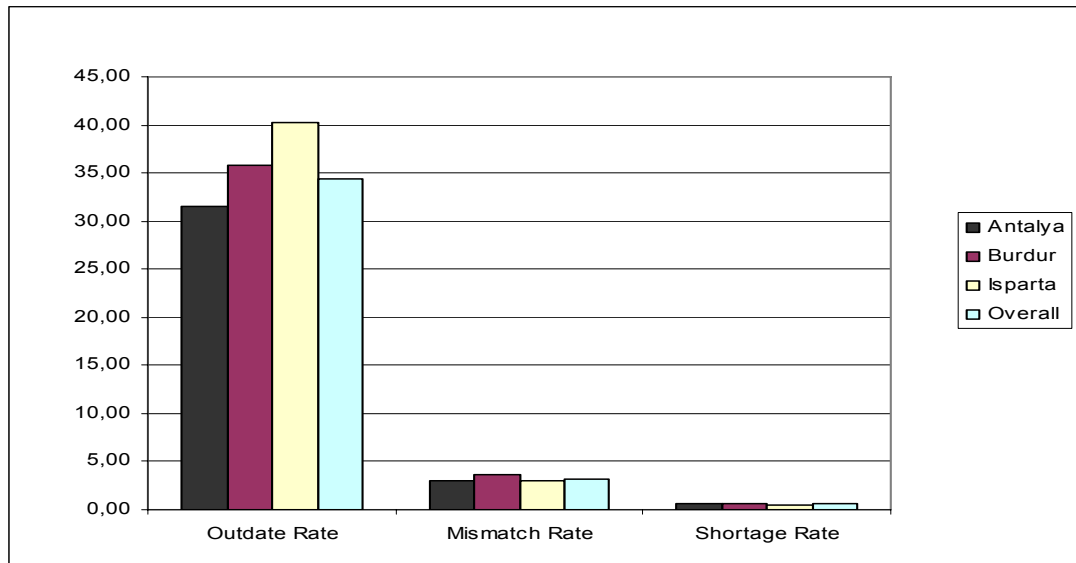


Figure C.12. Summary Tables - Comparison of General Performance Measures of Cities (Including DCs and RBC)

Table C.53. Summary Tables - Comparison of Deliveries Percentages of Cities (Including DCs and RBC)

Delivery Type (Percentages)	Antalya	Burdur	Isparta	Overall
Routine Deliveries to TCs (% in quantities)	54.5	54.8	52.4	54.0
Ad-Hoc Deliveries to TCs (% in quantities)	45.5	45.2	47.6	46.0
Emergency Deliveries to TCs (% in quantities)	0.0	0.0	0.0	0.0
Ad-hoc Deliveries Between DCs and RBC (% in quantities)	0.0	0.0	0.0	0.0

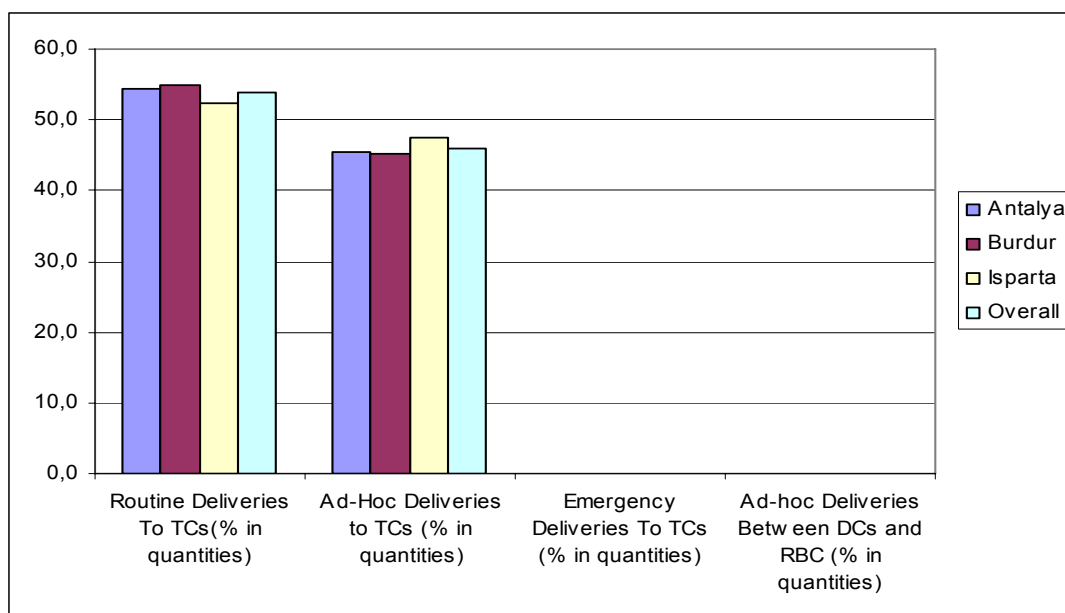


Figure C.13. Summary Tables - Comparison of Delivery Percentages of Cities
(Including DCs and RBC)

Table C.54. Summary Tables - Comparison of Deliveries Quantities of Cities
(Including DCs and RBC)

Delivery Type	Antalya	Burdur	Isparta	Overall
Routine Deliveries to TCs	48292.4	9197.5	18163.3	75653.2
Ad-Hoc Deliveries to TCs	40365.1	7583.7	16503.2	64452.0
Emergency Deliveries to TCs	0.0	0.0	0.0	0.0
Ad-hoc Deliveries Between DCs and RBC	0.0	0.0	0.0	0.0
total	48292.4	9197.5	18163.3	75653.2

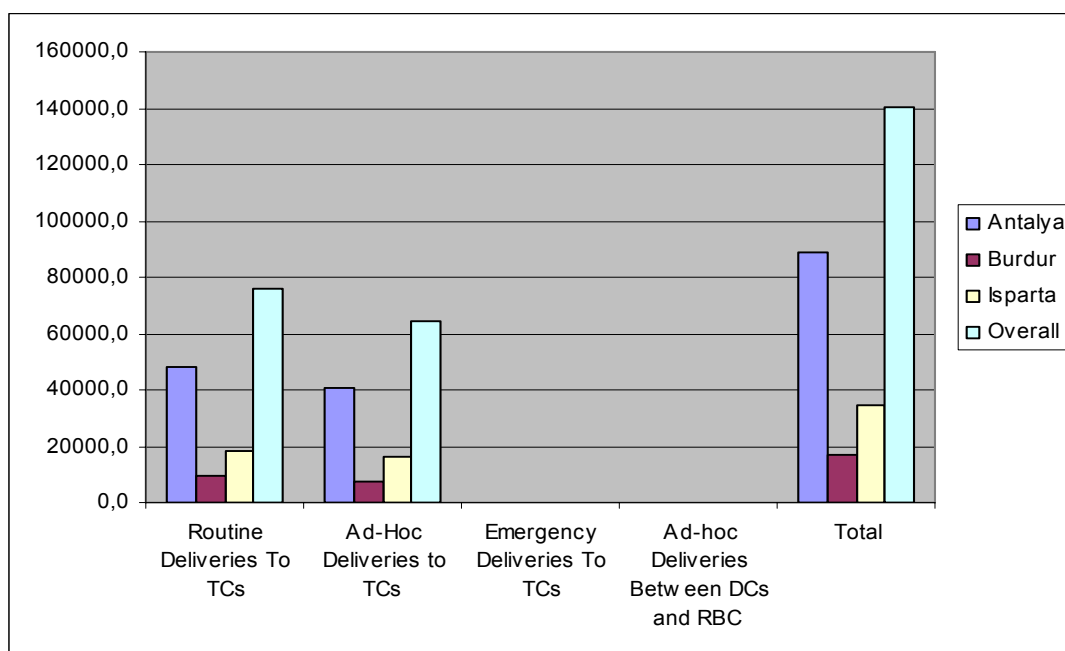


Figure C.14. Summary Tables - Comparison of Delivery Quantities of Cities (Including DCs and RBC)

Table C.55. Summary Tables - Comparison of Outdate Rates of Cities (Including DCs and RBC)

City	Outdate Rates								Overall
	0+	0-	A+	A-	B+	B-	AB+	AB-	
Antalya	31.28	14.54	32.63	30.47	33.77	24.13	34.40	33.06	31.53
Burdur	35.19	16.01	36.70	35.75	39.27	27.42	38.29	42.76	35.74
Isparta	39.90	26.55	41.20	40.08	42.45	32.63	43.18	40.28	40.31
Overall	18.31	17.40	16.83	30.69	25.63	26.64	31.27	36.08	20.60

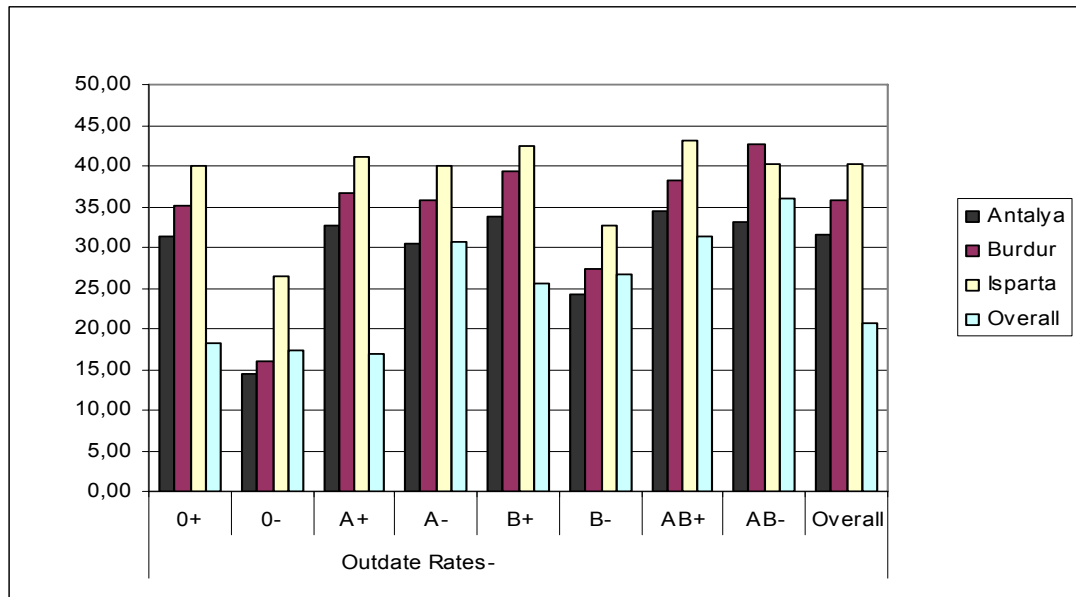


Figure C.15. Summary Tables - Comparison of Outdate Rates of Cities (Including DCs and RBC)

Table C.56. Summary Tables - Comparison of Outdate Rates of Cities (Excluding DCs and RBC)

City	Outdate Rates								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Antalya	18.36	14.52	16.86	29.61	25.88	24.13	31.22	33.06	20.41
Burdur	18.99	14.97	17.78	29.38	25.46	26.58	30.41	42.54	20.98
Isparta	39.90	26.55	41.20	40.08	42.45	32.63	43.18	40.28	40.31
Overall	18.31	17.40	16.83	30.69	25.63	26.64	31.27	36.08	20.60

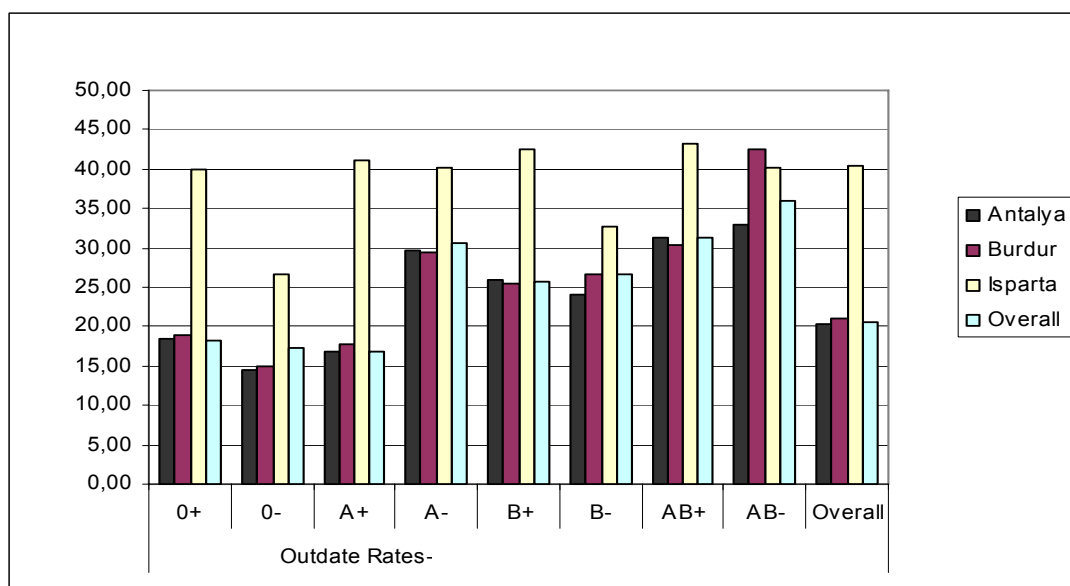


Figure C.16. Summary Tables - Comparison of Outdate Rates of Cities (Excluding DCs and RBC)

Table C.57. Summary Tables - Comparison of Mismatch Rates of Cities

City	Mismatch Rates								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Antalya	1.42	6.82	2.32	5.92	4.08	5.93	5.13	11.21	3.028
Burdur	1.67	7.91	2.35	7.73	5.88	8.69	5.96	17.54	3.672
Isparta	1.33	7.47	1.86	6.81	4.54	6.14	6.25	8.28	3.018
Overall	1.42	7.10	2.21	6.34	4.39	6.28	5.50	11.18	3.094

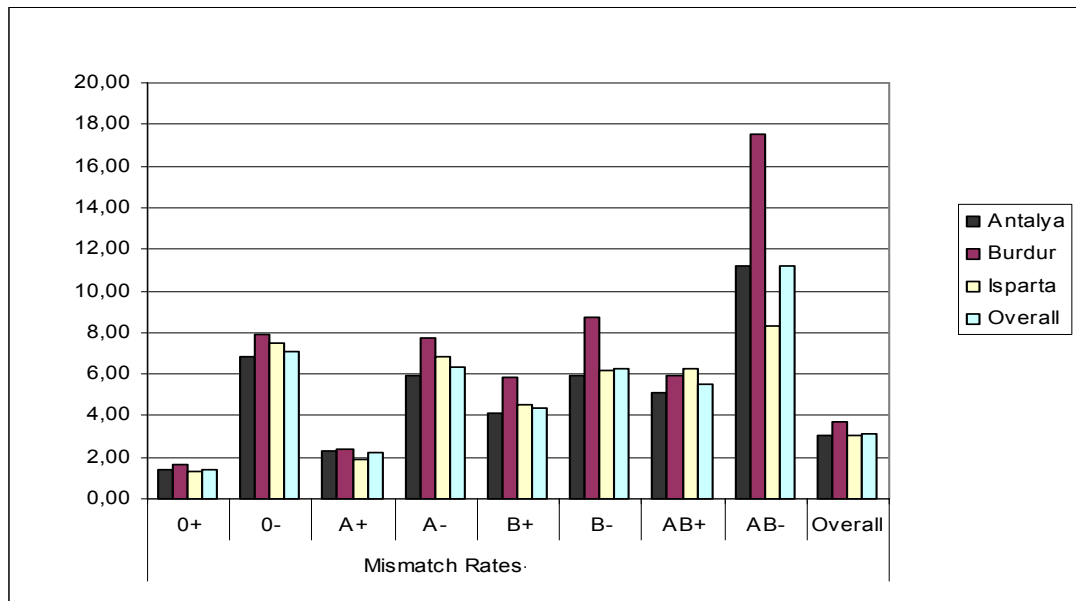


Figure C.17. Summary Tables - Comparison of Mismatch Rates of Cities

Table C.58. Summary Tables - Comparison of Shortage Rates of Cities

City	Shortage Rates								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
Antalya	1.76	0.36	0.14	0.02	0.07	0.01	0.00	0.00	0.58
Burdur	1.92	0.42	0.13	0.03	0.09	0.04	0.00	0.00	0.64
Isparta	1.53	0.32	0.11	0.02	0.06	0.01	0.00	0.00	0.50
Overall	1.72	0.36	0.13	0.02	0.07	0.01	0.00	0.00	0.57

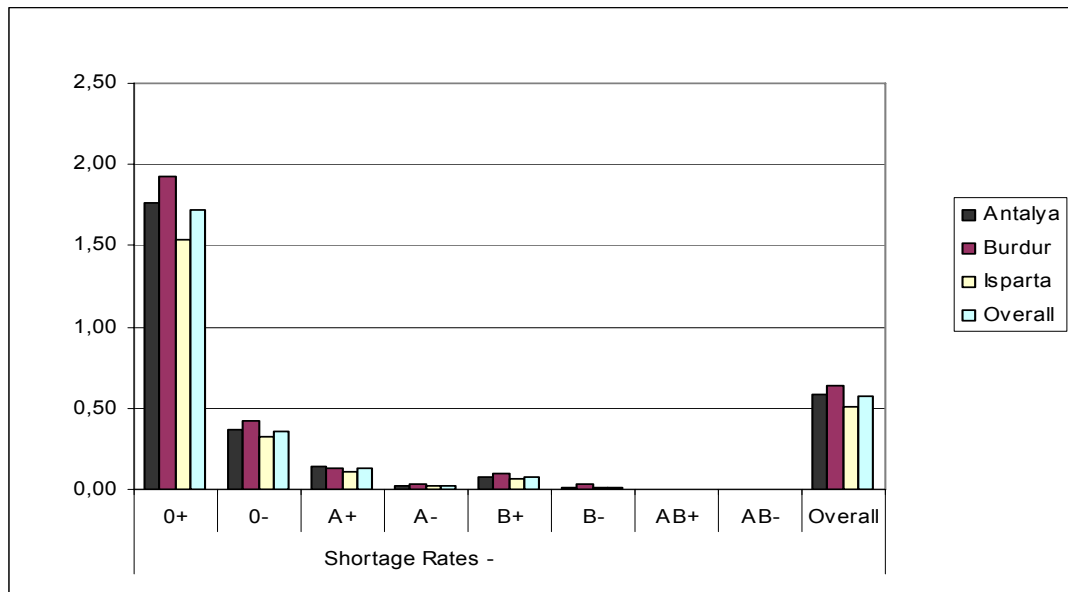


Figure C.18. Summary Tables - Comparison of Shortage Rates of Cities

Table C. 59. Summary Tables - Comparison of Mean Inventory Levels of Cities
Using TCs Single Performances

	Mean Inventory Level			
	Antalya	Burdur	Isparta	Overall
Mean	29.75	25.99	29.43	29.21
Median	18.98	17.99	16.31	18.22
Max	170.54	47.70	77.77	170.54
Min	13.52	13.10	13.44	13.10
Percentile (%10)	13.98	14.18	13.47	13.52
Percentile (%25)	15.16	15.89	13.66	14.24
Percentile (%50)	18.98	17.99	16.31	18.22
Percentile (%75)	26.40	37.47	44.26	27.85
Percentile (%90)	48.02	45.79	56.20	49.88

Table C. 60. Summary Tables - Comparison of Outdate Rates of Cities Using TCs
Single Performances

	Outdate Rates			
	Antalya	Burdur	Isparta	Overall
Mean	30.05	29.16	32.37	30.51
Median	31.80	31.31	35.98	32.73
Max	38.48	38.89	41.97	41.97
Min	10.12	18.79	17.98	10.12
Percentile (%10)	19.85	19.29	20.29	19.59
Percentile (%25)	27.35	22.31	22.74	26.04
Percentile (%50)	31.80	31.31	35.98	32.73
Percentile (%75)	35.55	34.34	40.74	36.24
Percentile (%90)	37.02	36.88	41.60	39.00

Table C. 61. Summary Tables - Comparison of Mismatch Rates of Cities Using TCs
Single Performances

	Mismatch Rates			
	Antalya	Burdur	Isparta	Overall
Mean	4.66	4.52	4.31	4.56
Median	5.26	5.15	5.28	5.26
Max	6.47	5.59	5.92	6.47
Min	0.76	2.66	1.60	0.76
Percentile (%10)	2.66	2.86	2.19	2.49
Percentile (%25)	3.99	3.54	2.74	3.86
Percentile (%50)	5.26	5.15	5.28	5.26
Percentile (%75)	5.65	5.46	5.46	5.61
Percentile (%90)	5.75	5.55	5.75	5.75

Table C. 62. Summary Tables - Comparison of Shortage Rates of Cities using TCs
Single Performances

	Shortage Rates			
	Antalya	Burdur	Isparta	Overall
Mean	1.11	0.99	1.05	1.08
Median	1.33	1.26	1.49	1.29
Max	1.68	1.61	1.70	1.70
Min	0.00	0.24	0.05	0.00
Percentile (%10)	0.24	0.27	0.13	0.22
Percentile (%25)	0.94	0.52	0.28	0.66
Percentile (%50)	1.33	1.26	1.49	1.29
Percentile (%75)	1.46	1.29	1.62	1.52
Percentile (%90)	1.56	1.45	1.68	1.61

Table C. 63 Summary Tables - Comparison of the outdate Rates of RBC, DCs and
Region (Excluding RBC and DCs)

	Outdate Rates								
	0+	0-	A+	A-	B+	B-	AB+	AB-	Overall
West-Mediterranean RBC	12.92	0.02	15.77	0.86	7.90	0.00	3.17	0.00	11.12
BurdurDC	16.20	1.04	18.92	6.37	13.80	0.83	7.88	0.21	14.76
IspartaDC	21.98	1.81	24.80	6.48	17.31	0.45	11.48	0.08	19.43
Regional Performance (Excluding RBC and DCs)	18.31	17.40	16.83	30.69	25.63	26.64	31.27	36.08	20.60

APPENDIX D

VALUES OF PARAMETER USED FOR EACH POLICY

Table D.1. Configuration Parameters' Values Used for Each Policy

File Name	Policy/Group	0																				TPP	TPP
			Policy No	BDP	BDP	BDP	BDP	DC	DC	IAPP	IAPP	IAPP	IAPP	IAPP	IAPP	IAPP	IAPP	IAPP	RBC	RBC	TC	TC	TPP
																						CM	CMTX
1	0	0	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	4	1	4	72	0.5	
	1	1	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	4	1	4	60	0.5	
	2	2	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	4	1	4	48	0.5	
	3	3	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	4	1	4	36	0.5	
2	4	4	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	4	1	4	24	0.5	
	1	1	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	4	1	4	24	0.55	
	2	2	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	4	1	4	24	0.6	
	3	3	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	4	1	4	24	0.65	
3	4	4	35	30	30	30	4	4	0.3	0.5	20	0.1	20	0.1	0	0	1	4	1	4	24	0.7	
	1	1	35	25	25	25	2	2	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.2	2	1	4	24	0.7
	2	2	35	25	25	25	2	2	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.3	2	1	4	24	0.7
	3	3	35	25	25	25	2	2	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.4	2	1	4	24	0.7
	4	4	35	25	25	25	2	2	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.5	2	1	4	24	0.7
	5	5	35	25	25	25	3	3	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.2	3	1	4	24	0.7
	6	6	35	25	25	25	3	3	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.3	3	1	4	24	0.7
	7	7	35	25	25	25	3	3	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.4	3	1	4	24	0.7
	8	8	35	25	25	25	3	3	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.5	3	1	4	24	0.7
	9	9	35	25	25	25	4	4	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.2	4	1	4	24	0.7
	10	10	35	25	25	25	4	4	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.3	4	1	4	24	0.7
	11	11	35	25	25	25	4	4	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.4	4	1	4	24	0.7
	12	12	35	25	25	25	4	4	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	13	13	35	25	25	25	5	5	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.2	5	1	4	24	0.7
	14	14	35	25	25	25	5	5	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.3	5	1	4	24	0.7
	15	15	35	25	25	25	5	5	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.4	5	1	4	24	0.7
	16	16	35	25	25	25	5	5	0.3	0.5	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	17	17	35	25	25	25	2	2	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.2	2	1	4	24	0.7
	18	18	35	25	25	25	2	2	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.3	2	1	4	24	0.7
	19	19	35	25	25	25	2	2	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.4	2	1	4	24	0.7
	20	20	35	25	25	25	2	2	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	2	1	4	24	0.7
	21	21	35	25	25	25	3	3	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.2	3	1	4	24	0.7
	22	22	35	25	25	25	3	3	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.3	3	1	4	24	0.7
	23	23	35	25	25	25	3	3	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.4	3	1	4	24	0.7
	24	24	35	25	25	25	3	3	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	3	1	4	24	0.7
	25	25	35	25	25	25	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.2	4	1	4	24	0.7
	26	26	35	25	25	25	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.3	4	1	4	24	0.7
	27	27	35	25	25	25	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.4	4	1	4	24	0.7
	28	28	35	25	25	25	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	29	29	35	25	25	25	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.2	5	1	4	24	0.7
	30	30	35	25	25	25	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.3	5	1	4	24	0.7
	31	31	35	25	25	25	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.4	5	1	4	24	0.7
	32	32	35	25	25	25	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
33	33	35	25	25	25	2	2	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.2	2	1	4	24	0.7	

Table D.1. (Continued)

3	34	35	25	25	25	2	2	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.3	2	1	4	24	0.7
	35	35	25	25	25	2	2	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.4	2	1	4	24	0.7
	36	35	25	25	25	2	2	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.5	2	1	4	24	0.7
	37	35	25	25	25	3	3	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.2	3	1	4	24	0.7
	38	35	25	25	25	3	3	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.3	3	1	4	24	0.7
	39	35	25	25	25	3	3	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.4	3	1	4	24	0.7
	40	35	25	25	25	3	3	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.5	3	1	4	24	0.7
	41	35	25	25	25	4	4	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.2	4	1	4	24	0.7
	42	35	25	25	25	4	4	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.3	4	1	4	24	0.7
	43	35	25	25	25	4	4	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.4	4	1	4	24	0.7
	44	35	25	25	25	4	4	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	45	35	25	25	25	5	5	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.2	5	1	4	24	0.7
	46	35	25	25	25	5	5	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.3	5	1	4	24	0.7
	47	35	25	25	25	5	5	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.4	5	1	4	24	0.7
	48	35	25	25	25	5	5	0.3	0.3	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	49	35	25	25	25	2	2	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.2	2	1	4	24	0.7
	50	35	25	25	25	2	2	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.3	2	1	4	24	0.7
	51	35	25	25	25	2	2	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.4	2	1	4	24	0.7
	52	35	25	25	25	2	2	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.5	2	1	4	24	0.7
	53	35	25	25	25	3	3	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.2	3	1	4	24	0.7
	54	35	25	25	25	3	3	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.3	3	1	4	24	0.7
	55	35	25	25	25	3	3	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.4	3	1	4	24	0.7
	56	35	25	25	25	3	3	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.5	3	1	4	24	0.7
	57	35	25	25	25	4	4	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.2	4	1	4	24	0.7
	58	35	25	25	25	4	4	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.3	4	1	4	24	0.7
	59	35	25	25	25	4	4	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.4	4	1	4	24	0.7
	60	35	25	25	25	4	4	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	61	35	25	25	25	5	5	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.2	5	1	4	24	0.7
	62	35	25	25	25	5	5	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.3	5	1	4	24	0.7
	63	35	25	25	25	5	5	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.4	5	1	4	24	0.7
	64	35	25	25	25	5	5	0.3	0.2	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	65	35	25	25	25	2	2	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.2	2	1	4	24	0.7
	66	35	25	25	25	2	2	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.3	2	1	4	24	0.7
	67	35	25	25	25	2	2	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.4	2	1	4	24	0.7
	68	35	25	25	25	2	2	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.5	2	1	4	24	0.7
	69	35	25	25	25	3	3	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.2	3	1	4	24	0.7
	70	35	25	25	25	3	3	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.3	3	1	4	24	0.7
	71	35	25	25	25	3	3	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.4	3	1	4	24	0.7
	72	35	25	25	25	3	3	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.5	3	1	4	24	0.7
	73	35	25	25	25	4	4	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.2	4	1	4	24	0.7
	74	35	25	25	25	4	4	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.3	4	1	4	24	0.7
	75	35	25	25	25	4	4	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.4	4	1	4	24	0.7
	76	35	25	25	25	4	4	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	77	35	25	25	25	5	5	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.2	5	1	4	24	0.7
	78	35	25	25	25	5	5	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.3	5	1	4	24	0.7
	79	35	25	25	25	5	5	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.4	5	1	4	24	0.7
	80	35	25	25	25	5	5	0.3	0.1	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	32.1	35	25	25	25	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	32.2	35	25	25	25	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	32.3	35	25	25	25	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
32.4	35	25	25	25	9	9	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	9	1	4	24	0.7	
32.5	35	25	25	25	10	10	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	10	1	4	24	0.7	
4	1	34	29	29	29	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	2	33	28	28	28	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	3	32	27	27	27	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	4	31	26	26	26	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	5	30	25	25	25	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	6	29	24	24	24	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	7	28	23	23	23	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	8	27	22	22	22	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	9	26	21	21	21	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	10	25	20	20	20	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	11	35	25	25	25	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	12	34	24	24	24	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	13	33	23	23	23	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7

Table D.1. (Continued)

4	14	32	22	22	22	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	15	31	21	21	21	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	16	30	20	20	20	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	17	29	19	19	19	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	18	28	18	18	18	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	19	27	17	17	17	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	20	26	16	16	16	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	21	25	15	15	15	4	4	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	4	1	4	24	0.7
	22	34	29	29	29	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	23	33	28	28	28	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	24	32	27	27	27	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	25	31	26	26	26	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	26	30	25	25	25	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	27	29	24	24	24	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	28	28	23	23	23	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	29	27	22	22	22	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	30	26	21	21	21	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	31	25	20	20	20	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	32	35	25	25	25	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	33	34	24	24	24	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	34	33	23	23	23	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	35	32	22	22	22	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	36	31	21	21	21	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	37	30	20	20	20	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	38	29	19	19	19	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	39	28	18	18	18	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	40	27	17	17	17	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	41	26	16	16	16	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	42	25	15	15	15	5	5	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	5	1	4	24	0.7
	43	34	29	29	29	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	44	33	28	28	28	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	45	32	27	27	27	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	46	31	26	26	26	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	47	30	25	25	25	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	48	29	24	24	24	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	49	28	23	23	23	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	50	27	22	22	22	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	51	26	21	21	21	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	52	25	20	20	20	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	53	35	25	25	25	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	54	34	24	24	24	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	55	33	23	23	23	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	56	32	22	22	22	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	57	31	21	21	21	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	58	30	20	20	20	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	59	29	19	19	19	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	60	28	18	18	18	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	61	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	62	26	16	16	16	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	63	25	15	15	15	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	64	34	29	29	29	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	65	33	28	28	28	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7

Table D.1. (Continued)

4	66	32	27	27	27	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	67	31	26	26	26	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	68	30	25	25	25	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	69	29	24	24	24	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	70	28	23	23	23	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	71	27	22	22	22	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	72	26	21	21	21	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	73	25	20	20	20	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	74	35	25	25	25	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	75	34	24	24	24	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	76	33	23	23	23	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	77	32	22	22	22	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	78	31	21	21	21	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	79	30	20	20	20	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	80	29	19	19	19	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	81	28	18	18	18	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	82	27	17	17	17	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	83	26	16	16	16	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	84	25	15	15	15	7	7	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	7	1	4	24	0.7
	85	34	29	29	29	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	86	33	28	28	28	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	87	32	27	27	27	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	88	31	26	26	26	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	89	30	25	25	25	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	90	29	24	24	24	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	91	28	23	23	23	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	92	27	22	22	22	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	93	26	21	21	21	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	94	25	20	20	20	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	95	35	25	25	25	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	96	34	24	24	24	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	97	33	23	23	23	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	98	32	22	22	22	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	99	31	21	21	21	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	100	30	20	20	20	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	101	29	19	19	19	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	102	28	18	18	18	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	103	27	17	17	17	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	104	26	16	16	16	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
	105	25	15	15	15	8	8	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	8	1	4	24	0.7
5	1	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	2	24	0.7
	2	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	3	24	0.7
	3	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	4	24	0.7
	4	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	5	24	0.7
	5	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	1	6	24	0.7
	6	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	1	2	24	0.7
	7	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	1	3	24	0.7
	8	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	1	4	24	0.7
	9	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	1	5	24	0.7
	10	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	1	6	24	0.7
	11	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	1	2	24	0.7
	12	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	1	3	24	0.7
	13	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	1	4	24	0.7
	14	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	1	5	24	0.7
	15	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	1	6	24	0.7

Table D.1. (Continued)

5	16	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	1	2	24	0.7
	17	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	1	3	24	0.7
	18	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	1	4	24	0.7
	19	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	1	5	24	0.7
	20	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	1	6	24	0.7
	21	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	2	2	24	0.7
	22	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	2	3	24	0.7
	23	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	2	4	24	0.7
	24	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	2	5	24	0.7
	25	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	2	6	24	0.7
	26	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	2	2	24	0.7
	27	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	2	3	24	0.7
	28	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	2	4	24	0.7
	29	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	2	5	24	0.7
	30	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	2	6	24	0.7
	31	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	2	2	24	0.7
	32	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	2	3	24	0.7
	33	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	2	4	24	0.7
	34	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	2	5	24	0.7
	35	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	2	6	24	0.7
	36	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	2	2	24	0.7
	37	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	2	3	24	0.7
	38	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	2	4	24	0.7
	39	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	2	5	24	0.7
	40	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	2	6	24	0.7
	41	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	3	2	24	0.7
	42	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	3	3	24	0.7
	43	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	3	4	24	0.7
	44	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	3	5	24	0.7
	45	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	0	1	0.5	6	3	6	24	0.7
	46	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	3	2	24	0.7
	47	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	3	3	24	0.7
	48	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	3	4	24	0.7
	49	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	3	5	24	0.7
	50	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	3	6	24	0.7
	50	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	3	6	24	0.7
	51	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	3	2	24	0.7
	52	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	3	3	24	0.7
	53	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	3	4	24	0.7
	54	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	3	5	24	0.7
55	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	0	1	1	0.5	6	3	6	24	0.7	
56	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	3	2	24	0.7	
57	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	3	3	24	0.7	
58	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	3	4	24	0.7	
59	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	3	5	24	0.7	
60	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	1	1	0.5	6	3	6	24	0.7	
6	1	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	*	24	0.7
	2	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	0-=0	24	0.7
	3	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	A+=0	24	0.7
	4	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	B-=0	24	0.7
	5	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	AB-=0	24	0.7
	6	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	Ab+=0	24	0.7
	7	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7

Table D.1. (Continued)

7	1	27	17	17	17	6	6	0.4	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7
	2	27	17	17	17	6	6	0.5	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7
	3	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	0.9	0.5	6	*	**	24	0.7
	4	27	17	17	17	6	6	0.4	0.4	1.1	0.1	1.1	0.1	1	0	0.9	0.5	6	*	**	24	0.7
	5	27	17	17	17	6	6	0.5	0.4	1.1	0.1	1.1	0.1	1	0	0.9	0.5	6	*	**	24	0.7
	6	27	17	17	17	6	6	0.3	0.4	1.1	0.1	1.1	0.1	1	0	0.8	0.5	6	*	**	24	0.7
	7	27	17	17	17	6	6	0.4	0.4	1.1	0.1	1.1	0.1	1	0	0.8	0.5	6	*	**	24	0.7
	8	27	17	17	17	6	6	0.5	0.4	1.1	0.1	1.1	0.1	1	0	0.8	0.5	6	*	**	24	0.7
8	1	27	17	17	17	7	6	0.4	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7
	2	27	17	17	17	8	6	0.4	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7
	3	27	17	17	17	9	6	0.4	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7
	4	27	17	17	17	10	6	0.4	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7
	5	27	17	17	17	11	6	0.4	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7
	6	27	17	17	17	12	6	0.4	0.4	1.1	0.1	1.1	0.1	1	0	1	0.5	6	*	**	24	0.7
9	1	27	17	17	17	9	6	0.4	0.4	1.2	0.2	1.2	0.2	1	0	1	0.5	6	*	**	24	0.7
	2	27	17	17	17	9	6	0.4	0.4	1.3	0.3	1.3	0.3	1	0	1	0.5	6	*	**	24	0.7
	3	27	17	17	17	9	6	0.4	0.4	1.4	0.4	1.4	0.4	1	0	1	0.5	6	*	**	24	0.7
	4	27	17	17	17	9	6	0.4	0.4	1.5	0.5	1.5	0.5	1	0	1	0.5	6	*	**	24	0.7
	5	27	17	17	17	9	6	0.4	0.4	1.6	0.6	1.6	0.6	1	0	1	0.5	6	*	**	24	0.7

* Values in Table 5.4. is used
0- =0 AtbOneg values of each TC is 0, other values are same with the ones in the 5.2
A- =0 AtbAneg values of each TC is 0, other values are same with the ones in the 5.2
B- =0 AtbBneg values of each TC is 0, other values are same with the ones in the 5.2
AB- =0 AtbABneg values of each TC is 0, other values are same with the ones in the 5.2
Ab+ =0 AtbABpos values of each TC is 0, other values are same with the ones in the 5.2
** Values in Table 5.5. is used

APPENDIX E

RESULTS OF SIMULATION ANALYSES AND COMPARISONS

Table E.1. Cities Performances and Performance of Region Including DCs and RBC of Group 1 Policies

Performance Measure		0 (Baseline)	1	2	3	4
Inventory Level	Antalya	8987.41	9080.80	9180.91	9302.71	9394.00
	Burdur	1568.05	1592.43	1591.91	1611.47	1629.28
	Isparta	4072.39	4136.38	4172.25	4208.85	4242.77
	Overall	14627.86	14809.61	14945.07	15123.03	15266.04
Outdate Rate	Antalya	31.53	31.24	31.16	31.09	31.02
	Burdur	35.74	36.19	35.38	35.05	35.18
	Isparta	40.31	40.68	40.60	40.47	40.49
	Overall	34.41	34.40	34.23	34.12	34.09
Mismatch Rate	Antalya	3.03	2.28	1.65	1.13	0.71
	Burdur	3.67	2.78	2.02	1.45	0.91
	Isparta	3.02	2.23	1.56	1.07	0.67
	Overall	3.09	2.32	1.67	1.15	0.72
Shortage Rate	Antalya	0.59	0.36	0.20	0.11	0.05
	Burdur	0.64	0.36	0.20	0.10	0.04
	Isparta	0.51	0.29	0.16	0.08	0.04
	Overall	0.57	0.34	0.19	0.10	0.04

Table E.2. Delivery Performance Measures of Group 1 Policies

Delivery Performances	Delivery Type	0 (Baseline)	1	2	3	4
Quantity	Routine Deliveries To TCs	75653.20	76093.00	76300.40	76474.70	76508.90
	Ad-Hoc Deliveries to TCs	64452.00	63886.10	63151.90	62571.80	62129.00
	Emergency Deliveries To TCs	0.00	0.00	0.00	0.00	0.00
	Ad-hoc Deliveries Between DCs and RBC	0.00	0.00	0.00	0.00	0.00
	Total	140105.20	139979.10	139452.30	139046.50	138637.90
Percentage	Routine Deliveries To TCs	54.00	54.36	54.71	55.00	55.19
	Ad-Hoc Deliveries to TCs	46.00	45.64	45.29	45.00	44.81
	Emergency Deliveries To TCs	0.00	0.00	0.00	0.00	0.00
	Ad-hoc Deliveries Between DCs and RBC	0.00	0.00	0.00	0.00	0.00

Table E.3. Selection Criterion Performance of Group 1 Policies

Performance Measure	Case	0 (Baseline)	1	2	3	4
Outdate Rate	Region Including Dcs and RBC	34.41	34.40	34.23	34.12	34.09
	Region Excluding DCs And RBC	20.60	20.29	20.25	19.71	19.47
	Single TCs' Means	30.51	30.30	30.18	29.75	29.51
Mismatch Rate	Region Including Dcs and RBC	3.09	2.32	1.67	1.15	0.72
	Region Excluding DCs And RBC	3.09	2.32	1.67	1.15	0.72
	Single TCs' Means	4.56	3.53	2.62	1.87	1.21
Shortage Rate	Region Including Dcs and RBC	0.57	0.34	0.19	0.10	0.04
	Region Excluding DCs And RBC	0.57	0.34	0.19	0.10	0.04
	Single TCs' Means	1.08	0.68	0.40	0.21	0.10
Selection Criterion Performance		38.08	37.06	36.09	35.37	34.86

Table E.4. Single TC Performances of Group 1 Policies - Mean Inventory Levels

TC	0 (Baseline)	1	2	3	4
[TC1]	97.99	108.97	119.36	130.08	140.81
[TC2]	27.85	30.43	32.73	34.92	37.46
[TC3]	19.76	21.08	22.62	24.06	25.51
[TC4]	16.71	17.56	18.62	19.72	20.75
[TC5]	15.23	16.14	17.12	18.09	19.07
[TC6]	21.08	22.65	24.46	25.95	27.76
[TC7]	18.23	19.44	20.59	21.87	23.11
[TC8]	16.22	17.35	18.34	19.52	20.71
[TC9]	13.98	14.97	15.77	16.64	17.54
[TC10]	16.31	17.35	18.51	19.55	20.73
[TC11]	19.58	21.08	22.45	23.93	25.45
[TC12]	13.52	14.24	15.00	15.91	16.65
[TC13]	14.19	14.90	15.78	16.60	17.47
[TC14]	25.15	27.06	29.11	31.18	33.27
[TC15]	16.73	17.81	19.00	20.09	21.32
[TC16]	15.37	16.25	17.20	18.24	19.20
[TC17]	14.04	14.92	15.67	16.54	17.53
[TC18]	170.54	189.56	208.83	228.23	247.31
[TC19]	74.71	82.88	90.92	98.97	107.07
[TC20]	48.02	52.73	57.87	62.69	67.55
[TC21]	14.24	14.99	15.91	16.60	17.54
[TC22]	18.98	20.36	21.85	23.22	24.76
[TC23]	27.65	30.07	32.35	34.93	37.31
[TC24]	19.74	21.08	22.44	23.86	25.36
[TC25]	15.10	16.04	17.01	17.99	19.06
[TC26]	13.61	14.30	15.09	15.81	16.62
[TC27]	25.14	27.24	29.24	31.41	33.36
[TC28]	21.66	23.29	25.05	26.73	28.54
[TC29]	47.02	51.69	56.56	61.09	65.83
[TC30]	13.52	14.31	15.07	15.96	16.74
[TC31]	30.45	33.22	35.95	38.69	41.40
[TC32]	43.89	48.47	52.74	57.16	61.65
[TC33]	18.22	19.43	20.65	21.87	23.16
[TC34]	47.70	52.55	57.34	62.26	67.16
[TC35]	15.26	16.21	17.20	18.12	19.07
[TC36]	13.10	13.76	14.45	15.17	15.98
[TC37]	17.76	19.00	20.29	21.68	22.97
[TC38]	77.77	86.03	94.45	102.83	111.17
[TC39]	27.83	30.37	32.80	35.40	37.78
[TC40]	43.78	48.14	52.55	57.13	61.59
[TC41]	45.69	50.26	54.92	59.38	64.04
[TC42]	13.47	14.27	14.95	15.73	16.49
[TC43]	13.99	14.74	15.66	16.48	17.37
[TC44]	16.12	17.18	18.26	19.42	20.57
[TC45]	13.72	14.63	15.43	16.28	17.23
[TC46]	13.48	14.19	14.94	15.69	16.55
[TC47]	16.50	17.59	18.72	19.96	21.26
[TC48]	57.36	63.79	69.87	75.88	82.07
[TC49]	13.44	14.19	14.96	15.72	16.52
Mean	29.21	31.81	34.42	37.04	39.70
Median	18.22	19.43	20.59	21.87	23.11
Max	170.54	189.56	208.83	228.23	247.31
Min	13.10	13.76	14.45	15.17	15.98
Percentile (%10)	13.52	14.30	15.05	15.89	16.64
Percentile (%25)	14.24	14.99	15.91	16.64	17.54
Percentile (%50)	18.22	19.43	20.59	21.87	23.11
Percentile (%75)	27.85	30.43	32.80	35.40	37.78
Percentile (%90)	49.88	54.94	60.27	65.33	70.46

Table E.5. Single TC Performances of Group 1 Policies - Outdate Rates

TC	0 (Baseline)	1	2	3	4
[TC1]	14.14	13.58	13.54	13.04	12.82
[TC2]	26.83	26.83	26.57	25.83	25.89
[TC3]	31.80	30.97	31.32	30.70	30.54
[TC4]	35.02	34.60	34.41	34.35	34.06
[TC5]	35.21	35.17	34.79	34.57	34.34
[TC6]	29.43	28.78	29.00	28.52	28.35
[TC7]	33.99	33.83	33.43	33.41	33.20
[TC8]	32.74	33.19	32.53	31.99	32.00
[TC9]	35.89	36.22	35.73	36.17	35.57
[TC10]	33.88	33.25	33.52	33.19	32.86
[TC11]	31.47	31.48	31.24	30.72	30.33
[TC12]	37.02	36.78	36.54	36.49	36.36
[TC13]	36.78	36.47	36.27	36.72	36.29
[TC14]	28.23	27.63	27.60	27.22	26.77
[TC15]	33.26	33.35	33.41	32.99	31.97
[TC16]	36.24	35.83	35.63	35.63	35.49
[TC17]	36.19	36.08	35.97	35.02	35.18
[TC18]	10.12	9.64	9.60	9.23	9.08
[TC19]	15.80	15.16	15.36	14.73	14.38
[TC20]	19.85	19.39	19.25	18.70	18.18
[TC21]	37.23	37.33	37.49	36.77	36.63
[TC22]	31.13	31.07	30.95	30.69	30.52
[TC23]	26.04	25.69	25.58	25.30	24.86
[TC24]	31.66	31.82	31.06	30.95	30.71
[TC25]	34.59	34.57	34.74	34.65	34.33
[TC26]	38.48	38.40	38.27	38.54	38.57
[TC27]	27.87	27.54	27.09	26.77	26.24
[TC28]	28.50	28.16	28.08	27.47	27.07
[TC29]	20.23	19.49	19.89	18.81	19.01
[TC30]	37.22	37.16	37.01	36.44	36.61
[TC31]	24.83	24.67	24.64	24.12	23.78
[TC32]	19.79	19.45	19.27	18.24	18.07
[TC33]	32.73	32.98	32.55	31.98	31.50
[TC34]	18.79	18.73	18.17	17.44	17.11
[TC35]	34.88	34.99	34.71	33.83	33.93
[TC36]	38.89	38.85	39.03	38.59	38.38
[TC37]	29.89	30.08	29.65	28.96	28.56
[TC38]	17.98	17.48	17.67	16.87	16.74
[TC39]	28.26	28.26	27.94	27.31	26.86
[TC40]	22.68	22.29	22.30	21.58	21.36
[TC41]	22.76	22.65	22.76	21.80	21.84
[TC42]	41.97	41.69	41.94	41.95	41.37
[TC43]	40.59	40.42	40.09	40.20	39.93
[TC44]	36.65	36.41	36.40	35.99	35.94
[TC45]	39.44	39.25	39.27	38.44	38.80
[TC46]	41.18	40.83	40.75	40.28	39.61
[TC47]	35.30	35.21	35.11	34.52	34.25
[TC48]	20.03	19.62	19.34	18.68	18.50
[TC49]	41.64	41.29	41.36	41.11	41.16
Mean	30.51	30.30	30.18	29.75	29.51
Median	32.73	32.98	32.53	31.98	31.50
Max	41.97	41.69	41.94	41.95	41.37
Min	10.12	9.64	9.60	9.23	9.08
Percentile (%10)	19.59	19.25	19.04	18.08	17.88
Percentile (%25)	26.04	25.69	25.58	25.30	24.86
Percentile (%50)	32.73	32.98	32.53	31.98	31.50
Percentile (%75)	36.24	36.22	35.97	35.99	35.57
Percentile (%90)	39.00	38.93	39.08	38.55	38.62

Table E.6. Single TC Performances of Group 1 Policies - Mismatch Rates

TC	0 (Baseline)	1	2	3	4
[TC1]	1.32	0.94	0.61	0.39	0.21
[TC2]	3.86	2.84	1.93	1.27	0.68
[TC3]	5.23	3.89	2.98	2.14	1.29
[TC4]	5.28	4.14	3.20	2.44	1.68
[TC5]	5.41	4.40	3.29	2.30	1.46
[TC6]	5.32	3.92	2.87	1.83	1.16
[TC7]	4.92	3.71	2.86	1.88	1.37
[TC8]	5.67	4.51	3.49	2.55	1.77
[TC9]	5.94	5.11	3.66	2.74	1.78
[TC10]	5.61	4.69	3.52	2.56	1.67
[TC11]	5.26	4.11	2.96	2.07	1.33
[TC12]	5.69	4.53	3.61	2.68	1.73
[TC13]	5.66	4.75	3.43	2.68	1.77
[TC14]	3.91	3.02	2.27	1.51	0.88
[TC15]	5.58	4.32	3.34	2.29	1.53
[TC16]	5.75	4.40	3.63	2.52	1.72
[TC17]	6.47	4.92	3.77	2.97	1.91
[TC18]	0.76	0.50	0.32	0.18	0.10
[TC19]	1.76	1.21	0.83	0.51	0.29
[TC20]	2.71	1.93	1.30	0.82	0.46
[TC21]	5.40	4.72	3.36	2.66	1.84
[TC22]	5.10	4.04	2.87	2.09	1.45
[TC23]	4.06	2.87	2.09	1.27	0.75
[TC24]	5.18	4.07	3.04	2.10	1.31
[TC25]	5.76	4.62	3.41	2.45	1.55
[TC26]	5.74	4.47	3.48	2.55	1.59
[TC27]	4.21	2.96	2.02	1.43	0.90
[TC28]	4.99	3.56	2.55	1.81	1.07
[TC29]	2.66	1.83	1.23	0.84	0.50
[TC30]	5.65	4.77	3.52	2.80	1.80
[TC31]	3.73	2.67	1.91	1.19	0.76
[TC32]	3.06	2.15	1.48	1.10	0.62
[TC33]	5.00	3.68	2.95	2.12	1.35
[TC34]	2.66	2.00	1.36	0.93	0.57
[TC35]	5.59	4.50	3.34	2.54	1.68
[TC36]	5.52	4.24	3.63	2.46	1.74
[TC37]	5.31	4.38	3.22	2.25	1.51
[TC38]	1.60	1.09	0.69	0.43	0.26
[TC39]	3.95	2.88	1.93	1.19	0.69
[TC40]	2.79	2.08	1.33	0.91	0.54
[TC41]	2.58	1.83	1.22	0.80	0.43
[TC42]	5.31	4.51	3.21	2.31	1.66
[TC43]	5.77	4.44	3.27	2.47	1.68
[TC44]	5.65	4.38	3.42	2.52	1.53
[TC45]	5.92	4.47	3.44	2.57	1.74
[TC46]	5.39	4.42	3.48	2.54	1.77
[TC47]	5.25	3.98	3.07	2.00	1.31
[TC48]	2.15	1.49	0.99	0.65	0.37
[TC49]	5.34	4.01	3.23	2.39	1.71
Mean	4.56	3.53	2.62	1.87	1.21
Median	5.26	4.04	3.04	2.12	1.37
Max	6.47	5.11	3.77	2.97	1.91
Min	0.76	0.50	0.32	0.18	0.10
Percentile (%10)	2.49	1.76	1.18	0.77	0.42
Percentile (%25)	3.86	2.84	1.93	1.19	0.69
Percentile (%50)	5.26	4.04	3.04	2.12	1.37
Percentile (%75)	5.61	4.47	3.42	2.52	1.68
Percentile (%90)	5.75	4.69	3.54	2.66	1.77

Table E.7. Single TC Performances of Group 1 Policies - Shortage Rates

TC	0 (Baseline)	1	2	3	4
[TC1]	0.02	0.00	0.00	0.00	0.00
[TC2]	0.66	0.36	0.16	0.06	0.02
[TC3]	1.43	0.95	0.51	0.29	0.11
[TC4]	1.18	0.74	0.39	0.23	0.13
[TC5]	1.34	0.83	0.49	0.24	0.10
[TC6]	1.15	0.71	0.40	0.18	0.08
[TC7]	1.29	0.89	0.46	0.22	0.11
[TC8]	1.37	0.94	0.49	0.30	0.11
[TC9]	1.56	1.00	0.66	0.39	0.24
[TC10]	1.33	0.96	0.56	0.24	0.10
[TC11]	1.47	0.90	0.51	0.28	0.14
[TC12]	1.53	1.21	0.66	0.39	0.21
[TC13]	1.47	1.03	0.60	0.36	0.23
[TC14]	1.07	0.65	0.40	0.17	0.08
[TC15]	1.54	0.91	0.53	0.33	0.12
[TC16]	1.33	0.77	0.45	0.18	0.12
[TC17]	1.57	1.03	0.64	0.38	0.21
[TC18]	0.00	0.00	0.00	0.00	0.00
[TC19]	0.05	0.01	0.00	0.00	0.00
[TC20]	0.25	0.10	0.05	0.02	0.00
[TC21]	1.37	0.85	0.55	0.34	0.19
[TC22]	1.68	1.06	0.57	0.34	0.16
[TC23]	0.82	0.41	0.22	0.10	0.02
[TC24]	1.44	0.95	0.56	0.27	0.14
[TC25]	1.28	0.86	0.51	0.25	0.09
[TC26]	1.43	0.97	0.61	0.37	0.19
[TC27]	1.10	0.64	0.36	0.17	0.06
[TC28]	1.27	0.80	0.40	0.24	0.08
[TC29]	0.24	0.11	0.02	0.01	0.01
[TC30]	1.62	1.04	0.71	0.41	0.18
[TC31]	0.61	0.32	0.16	0.06	0.01
[TC32]	0.24	0.14	0.04	0.02	0.01
[TC33]	1.29	0.74	0.47	0.21	0.10
[TC34]	0.29	0.11	0.05	0.01	0.00
[TC35]	1.29	0.84	0.43	0.23	0.11
[TC36]	1.23	0.80	0.59	0.33	0.17
[TC37]	1.61	0.88	0.57	0.31	0.12
[TC38]	0.05	0.02	0.00	0.00	0.00
[TC39]	0.66	0.34	0.20	0.09	0.01
[TC40]	0.27	0.15	0.05	0.01	0.01
[TC41]	0.29	0.14	0.04	0.01	0.00
[TC42]	1.54	1.08	0.53	0.34	0.17
[TC43]	1.69	1.10	0.58	0.34	0.15
[TC44]	1.47	0.83	0.61	0.25	0.11
[TC45]	1.66	1.03	0.71	0.34	0.22
[TC46]	1.61	1.13	0.68	0.36	0.22
[TC47]	1.70	0.97	0.55	0.30	0.13
[TC48]	0.12	0.04	0.02	0.00	0.00
[TC49]	1.52	0.92	0.66	0.37	0.14
Mean	1.08	0.68	0.40	0.21	0.10
Median	1.29	0.83	0.49	0.24	0.11
Max	1.70	1.21	0.71	0.41	0.24
Min	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.22	0.09	0.02	0.01	0.00
Percentile (%25)	0.66	0.34	0.16	0.06	0.01
Percentile (%50)	1.29	0.83	0.49	0.24	0.11
Percentile (%75)	1.52	0.96	0.57	0.34	0.15
Percentile (%90)	1.61	1.05	0.66	0.37	0.21

Table E.8. Cities Performances and Performance of Region Including DCs and RBC of Group 2 Policies

Performance Measure		1.4.	1	2	3	4
Inventory Level	Antalya	9394.00	9338.43	9058.39	8646.71	7245.30
	Burdur	1629.28	1618.02	1592.28	1545.63	1443.70
	Isparta	4242.77	4227.02	4221.94	4160.27	4091.46
	Overall	15266.04	15183.47	14872.61	14352.61	12780.46
Outdate Rate	Antalya	31.02	24.49	17.13	10.26	3.47
	Burdur	35.18	28.93	22.51	16.15	9.34
	Isparta	40.49	34.42	28.94	22.60	16.34
	Overall	34.09	27.71	21.00	14.32	7.67
Mismatch Rate	Antalya	0.71	0.60	0.53	0.53	0.70
	Burdur	0.91	0.79	0.71	0.69	0.85
	Isparta	0.67	0.54	0.44	0.38	0.32
	Overall	0.72	0.60	0.52	0.51	0.62
Shortage Rate	Antalya	0.05	0.03	0.02	0.02	0.04
	Burdur	0.04	0.03	0.02	0.02	0.01
	Isparta	0.04	0.03	0.02	0.01	0.01
	Overall	0.04	0.03	0.02	0.02	0.03

Table E.9. Delivery Performance Measures of Group 2 Policies

Delivery Performances	Delivery Type	1.4.	1	2	3	4
Quantity	Routine Deliveries To TCs	76508.90	76268.20	75649.50	74871.40	72997.90
	Ad-Hoc Deliveries to TCs	62129.00	62873.90	62793.30	62477.80	62070.30
	Emergency Deliveries To TCs	0.00	0.00	0.00	0.00	0.00
	Ad-hoc Deliveries Between DCs and RBC	0.00	0.00	0.00	0.00	0.00
	Total	138637.90	139142.10	138442.80	137349.20	135068.20
Percentage	Routine Deliveries To TCs	55.19	54.81	54.64	54.51	54.04
	Ad-Hoc Deliveries to TCs	44.81	45.19	45.36	45.49	45.96
	Emergency Deliveries To TCs	0.00	0.00	0.00	0.00	0.00
	Ad-hoc Deliveries Between DCs and RBC	0.00	0.00	0.00	0.00	0.00

Table E.10. Selection Criterion Performance of Group 2 Policies

Performance Measure	Case	1.4.	1	2	3	4
Outdate Rate	Region Including Dcs and RBC	34.09	27.71	21.00	14.32	7.67
	Region Excluding DCs And RBC	19.47	15.94	12.23	8.70	4.72
	Single TCs' Means	29.51	24.66	19.56	14.49	8.30
Mismatch Rate	Region Including Dcs and RBC	0.72	0.60	0.52	0.51	0.62
	Region Excluding DCs And RBC	0.72	0.60	0.52	0.51	0.62
	Single TCs' Means	1.21	1.00	0.85	0.79	0.94
Shortage Rate	Region Including Dcs and RBC	0.04	0.03	0.02	0.02	0.03
	Region Excluding DCs And RBC	0.04	0.03	0.02	0.02	0.03
	Single TCs' Means	0.10	0.07	0.05	0.03	0.06
Selection Criterion Performance		34.86	28.35	21.55	14.85	8.32

Table E.11. Single TC Performances of Group 2 Policies - Mean Inventory Levels

TC	1.4.	1	2	3	4
[TC1]	140.81	141.85	143.00	143.84	144.29
[TC2]	37.46	37.57	37.82	37.96	37.93
[TC3]	25.51	25.61	25.66	25.76	25.67
[TC4]	20.75	20.85	20.97	20.96	20.92
[TC5]	19.07	19.11	19.28	19.24	19.20
[TC6]	27.76	27.92	27.98	28.09	28.02
[TC7]	23.11	23.14	23.30	23.32	23.40
[TC8]	20.71	20.72	20.87	20.95	20.80
[TC9]	17.54	17.49	17.58	17.53	17.60
[TC10]	20.73	20.71	20.78	20.83	20.76
[TC11]	25.45	25.42	25.57	25.67	25.56
[TC12]	16.65	16.69	16.69	16.85	16.71
[TC13]	17.47	17.44	17.55	17.59	17.56
[TC14]	33.27	33.43	33.58	33.68	33.69
[TC15]	21.32	21.32	21.46	21.57	21.40
[TC16]	19.20	19.21	19.20	19.37	19.23
[TC17]	17.53	17.44	17.64	17.50	17.50
[TC18]	247.31	249.34	251.24	252.97	253.43
[TC19]	107.07	107.95	108.71	109.58	109.76
[TC20]	67.55	68.04	68.53	68.91	68.96
[TC21]	17.54	17.60	17.58	17.63	17.58
[TC22]	24.76	24.76	24.76	24.97	24.84
[TC23]	37.31	37.57	37.62	37.88	37.85
[TC24]	25.36	25.45	25.54	25.57	25.55
[TC25]	19.06	19.02	19.09	19.16	19.12
[TC26]	16.62	16.65	16.71	16.77	16.75
[TC27]	33.36	33.69	33.77	33.80	33.89
[TC28]	28.54	28.61	28.80	28.96	28.87
[TC29]	65.83	66.24	66.74	67.05	67.24
[TC30]	16.74	16.68	16.86	16.79	16.75
[TC31]	41.40	41.66	41.83	42.01	41.99
[TC32]	61.65	62.17	62.59	62.80	63.00
[TC33]	23.16	23.19	23.25	23.18	23.21
[TC34]	67.16	67.62	68.02	68.43	68.70
[TC35]	19.07	19.16	19.07	19.11	19.14
[TC36]	15.98	15.83	15.88	15.80	15.82
[TC37]	22.97	23.07	23.12	23.08	23.05
[TC38]	111.17	111.99	112.84	113.85	114.60
[TC39]	37.78	38.09	38.24	38.46	38.70
[TC40]	61.59	61.97	62.49	62.89	63.27
[TC41]	64.04	64.42	64.90	65.30	65.84
[TC42]	16.49	16.50	16.53	16.58	16.56
[TC43]	17.37	17.33	17.31	17.37	17.41
[TC44]	20.57	20.58	20.61	20.69	20.70
[TC45]	17.23	17.22	17.18	17.15	17.27
[TC46]	16.55	16.46	16.49	16.51	16.54
[TC47]	21.26	21.30	21.32	21.41	21.44
[TC48]	82.07	82.68	83.30	83.96	84.56
[TC49]	16.52	16.53	16.53	16.53	16.56
Mean	39.70	39.90	40.13	40.32	40.39
Median	23.11	23.14	23.25	23.18	23.21
Max	247.31	249.34	251.24	252.97	253.43
Min	15.98	15.83	15.88	15.80	15.82
Percentile (%10)	16.64	16.67	16.71	16.79	16.74
Percentile (%25)	17.54	17.60	17.64	17.63	17.60
Percentile (%50)	23.11	23.14	23.25	23.18	23.21
Percentile (%75)	37.78	38.09	38.24	38.46	38.70
Percentile (%90)	70.46	70.97	71.48	71.92	72.08

Table E.12. Single TC Performances of Group 2 Policies - Outdate Rates

TC	1.4.	1	2	3	4
[TC1]	12.82	8.38	4.47	1.77	0.27
[TC2]	25.89	20.53	14.85	9.28	3.06
[TC3]	30.54	25.41	19.15	13.38	5.26
[TC4]	34.06	29.08	22.94	16.50	7.68
[TC5]	34.34	29.22	23.32	16.78	7.89
[TC6]	28.35	23.27	16.91	11.67	4.22
[TC7]	33.20	28.21	22.16	15.65	7.01
[TC8]	32.00	27.09	21.27	15.17	6.66
[TC9]	35.57	30.06	24.61	18.20	8.70
[TC10]	32.86	28.42	21.94	16.28	7.17
[TC11]	30.33	25.31	19.77	13.37	5.40
[TC12]	36.36	31.73	25.32	19.51	9.37
[TC13]	36.29	30.90	24.91	18.39	9.11
[TC14]	26.77	21.97	15.81	10.33	3.58
[TC15]	31.97	27.18	21.63	15.50	6.51
[TC16]	35.49	30.02	24.22	17.73	8.52
[TC17]	35.18	29.91	24.52	18.17	8.64
[TC18]	9.08	5.31	2.46	0.84	0.10
[TC19]	14.38	9.94	5.59	2.46	0.40
[TC20]	18.18	13.48	8.50	4.49	0.97
[TC21]	36.63	31.97	25.88	18.93	9.54
[TC22]	30.52	25.29	19.18	13.19	5.52
[TC23]	24.86	20.39	13.89	8.62	2.75
[TC24]	30.71	25.49	19.67	13.41	5.39
[TC25]	34.33	28.72	23.64	16.80	8.07
[TC26]	38.57	32.81	26.83	20.37	10.61
[TC27]	26.24	21.29	15.45	9.84	3.51
[TC28]	27.07	21.87	16.29	10.90	4.00
[TC29]	19.01	13.73	8.76	4.56	1.07
[TC30]	36.61	31.47	25.62	19.20	9.87
[TC31]	23.78	18.80	13.08	8.01	2.44
[TC32]	18.07	13.40	9.37	5.71	2.66
[TC33]	31.50	26.34	21.94	16.75	10.87
[TC34]	17.11	12.47	8.43	5.24	2.33
[TC35]	33.93	29.70	23.90	18.79	13.25
[TC36]	38.38	32.89	28.43	23.83	16.34
[TC37]	28.56	23.55	19.26	14.32	8.93
[TC38]	16.74	12.34	8.73	5.77	3.26
[TC39]	26.86	22.28	18.56	14.29	10.48
[TC40]	21.36	16.62	12.92	9.27	6.20
[TC41]	21.84	17.06	12.99	9.49	6.30
[TC42]	41.37	36.70	32.44	28.22	23.77
[TC43]	39.93	35.46	31.26	27.02	22.37
[TC44]	35.94	31.31	27.13	22.94	18.77
[TC45]	38.80	34.47	30.68	25.32	21.34
[TC46]	39.61	35.60	31.58	27.01	22.17
[TC47]	34.25	30.01	25.53	21.15	16.84
[TC48]	18.50	14.07	10.30	7.20	4.30
[TC49]	41.16	36.67	32.53	28.53	23.37
Mean	29.51	24.66	19.56	14.49	8.30
Median	31.50	26.34	21.27	15.17	7.01
Max	41.37	36.70	32.53	28.53	23.77
Min	9.08	5.31	2.46	0.84	0.10
Percentile (%10)	17.88	13.22	8.68	5.10	2.08
Percentile (%25)	24.86	20.39	13.89	9.28	3.58
Percentile (%50)	31.50	26.34	21.27	15.17	7.01
Percentile (%75)	35.57	30.06	24.91	18.79	9.87
Percentile (%90)	38.62	33.21	28.88	24.13	19.28

Table E.13. Single TC Performances of Group 2 Policies - Mismatch Rates

TC	1.4.	1	2	3	4
[TC1]	0.21	0.20	0.18	0.23	0.30
[TC2]	0.68	0.63	0.54	0.54	0.78
[TC3]	1.29	1.17	0.91	0.96	1.17
[TC4]	1.68	1.22	1.07	0.95	1.25
[TC5]	1.46	1.37	1.11	0.97	1.31
[TC6]	1.16	0.97	0.83	0.79	1.10
[TC7]	1.37	1.14	0.96	0.79	1.09
[TC8]	1.77	1.42	1.26	1.04	1.37
[TC9]	1.78	1.45	1.25	1.21	1.50
[TC10]	1.67	1.36	1.19	1.15	1.38
[TC11]	1.33	1.11	1.02	0.93	1.22
[TC12]	1.73	1.48	1.26	1.14	1.43
[TC13]	1.77	1.39	1.21	1.20	1.38
[TC14]	0.88	0.77	0.61	0.68	1.01
[TC15]	1.53	1.22	1.04	0.95	1.23
[TC16]	1.72	1.19	1.11	1.01	1.26
[TC17]	1.91	1.52	1.25	1.16	1.44
[TC18]	0.10	0.10	0.11	0.14	0.19
[TC19]	0.29	0.27	0.28	0.32	0.45
[TC20]	0.46	0.42	0.40	0.43	0.60
[TC21]	1.84	1.41	1.33	1.17	1.36
[TC22]	1.45	1.12	0.99	0.95	1.13
[TC23]	0.75	0.57	0.58	0.62	0.86
[TC24]	1.31	1.15	0.98	0.93	1.24
[TC25]	1.55	1.30	1.13	1.02	1.32
[TC26]	1.59	1.46	1.24	1.16	1.35
[TC27]	0.90	0.71	0.65	0.71	1.01
[TC28]	1.07	0.91	0.82	0.74	1.12
[TC29]	0.50	0.43	0.35	0.43	0.56
[TC30]	1.80	1.45	1.23	1.12	1.42
[TC31]	0.76	0.61	0.47	0.54	0.80
[TC32]	0.62	0.59	0.55	0.57	0.75
[TC33]	1.35	1.18	0.97	0.89	1.06
[TC34]	0.57	0.51	0.49	0.49	0.63
[TC35]	1.68	1.32	1.19	1.08	1.23
[TC36]	1.74	1.50	1.32	1.07	1.24
[TC37]	1.51	1.19	0.98	1.01	1.17
[TC38]	0.26	0.22	0.20	0.18	0.18
[TC39]	0.69	0.59	0.43	0.40	0.31
[TC40]	0.54	0.45	0.33	0.32	0.24
[TC41]	0.43	0.34	0.28	0.25	0.22
[TC42]	1.66	1.30	1.14	0.82	0.79
[TC43]	1.68	1.25	1.11	0.94	0.84
[TC44]	1.53	1.29	1.11	0.88	0.72
[TC45]	1.74	1.49	1.08	0.90	0.69
[TC46]	1.77	1.32	1.14	1.04	0.77
[TC47]	1.31	1.12	0.89	0.62	0.52
[TC48]	0.37	0.31	0.27	0.20	0.19
[TC49]	1.71	1.35	0.95	0.92	0.66
Mean	1.21	1.00	0.85	0.79	0.94
Median	1.37	1.17	0.98	0.90	1.06
Max	1.91	1.52	1.33	1.21	1.50
Min	0.10	0.10	0.11	0.14	0.18
Percentile (%10)	0.42	0.33	0.28	0.30	0.29
Percentile (%25)	0.69	0.59	0.54	0.54	0.66
Percentile (%50)	1.37	1.17	0.98	0.90	1.06
Percentile (%75)	1.68	1.35	1.14	1.02	1.25
Percentile (%90)	1.77	1.45	1.25	1.15	1.38

Table E.14. Single TC Performances of Group 2 Policies - Shortage Rates

TC	1.4.	1	2	3	4
[TC1]	0.00	0.00	0.00	0.00	0.00
[TC2]	0.02	0.01	0.01	0.00	0.03
[TC3]	0.11	0.10	0.05	0.04	0.06
[TC4]	0.13	0.06	0.05	0.04	0.06
[TC5]	0.10	0.09	0.04	0.04	0.08
[TC6]	0.08	0.04	0.03	0.02	0.07
[TC7]	0.11	0.07	0.07	0.05	0.10
[TC8]	0.11	0.10	0.06	0.04	0.09
[TC9]	0.24	0.14	0.09	0.05	0.18
[TC10]	0.10	0.07	0.05	0.03	0.12
[TC11]	0.14	0.08	0.08	0.03	0.07
[TC12]	0.21	0.13	0.10	0.04	0.15
[TC13]	0.23	0.18	0.09	0.09	0.13
[TC14]	0.08	0.06	0.03	0.03	0.04
[TC15]	0.12	0.10	0.05	0.04	0.12
[TC16]	0.12	0.08	0.03	0.04	0.10
[TC17]	0.21	0.13	0.09	0.06	0.16
[TC18]	0.00	0.00	0.00	0.00	0.00
[TC19]	0.00	0.00	0.00	0.00	0.00
[TC20]	0.00	0.00	0.00	0.00	0.01
[TC21]	0.19	0.17	0.11	0.08	0.12
[TC22]	0.16	0.12	0.07	0.06	0.07
[TC23]	0.02	0.01	0.01	0.01	0.03
[TC24]	0.14	0.15	0.07	0.04	0.09
[TC25]	0.09	0.07	0.04	0.03	0.10
[TC26]	0.19	0.13	0.08	0.06	0.16
[TC27]	0.06	0.04	0.04	0.03	0.07
[TC28]	0.08	0.07	0.04	0.02	0.04
[TC29]	0.01	0.01	0.00	0.00	0.00
[TC30]	0.18	0.13	0.10	0.10	0.12
[TC31]	0.01	0.02	0.01	0.00	0.02
[TC32]	0.01	0.00	0.00	0.00	0.00
[TC33]	0.10	0.08	0.07	0.04	0.03
[TC34]	0.00	0.00	0.00	0.00	0.00
[TC35]	0.11	0.07	0.05	0.03	0.03
[TC36]	0.17	0.10	0.10	0.08	0.08
[TC37]	0.12	0.11	0.05	0.06	0.05
[TC38]	0.00	0.00	0.00	0.00	0.00
[TC39]	0.01	0.01	0.01	0.00	0.00
[TC40]	0.01	0.00	0.00	0.00	0.00
[TC41]	0.00	0.00	0.00	0.00	0.00
[TC42]	0.17	0.13	0.11	0.05	0.04
[TC43]	0.15	0.12	0.12	0.06	0.05
[TC44]	0.11	0.09	0.04	0.03	0.03
[TC45]	0.22	0.16	0.11	0.05	0.05
[TC46]	0.22	0.11	0.09	0.07	0.03
[TC47]	0.13	0.10	0.05	0.04	0.02
[TC48]	0.00	0.00	0.00	0.00	0.00
[TC49]	0.14	0.13	0.09	0.07	0.04
Mean	0.10	0.07	0.05	0.03	0.06
Median	0.11	0.08	0.05	0.04	0.05
Max	0.24	0.18	0.12	0.10	0.18
Min	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.00	0.00	0.00	0.00	0.00
Percentile (%25)	0.01	0.01	0.01	0.00	0.02
Percentile (%50)	0.11	0.08	0.05	0.04	0.05
Percentile (%75)	0.15	0.12	0.08	0.05	0.09
Percentile (%90)	0.21	0.13	0.10	0.07	0.12

Table E.15. Cities Performances and Performance of Region Including DCs and RBC of Group 3 Policies

Performance Measure	Inventory Level				Outdate Rate				Mismatch Rate				Shortage Rate			
	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall
2.4.	7245	1444	4091	12780	3.47	9.34	16.34	7.67	0.70	0.85	0.32	0.62	0.04	0.01	0.01	0.03
1	1994	461	1156	3611	0.57	1.98	1.28	0.90	0.95	1.44	0.44	0.87	0.04	0.24	0.01	0.05
2	1998	468	1191	3656	0.56	2.12	1.34	0.93	0.97	1.25	0.43	0.87	0.04	0.18	0.01	0.05
3	1997	468	1151	3616	0.57	2.17	1.29	0.92	0.94	1.34	0.43	0.85	0.04	0.26	0.01	0.05
4	2005	459	1188	3653	0.58	2.17	1.38	0.95	0.93	1.42	0.45	0.86	0.04	0.37	0.01	0.07
5	2213	417	976	3607	0.52	1.51	0.89	0.72	0.90	1.49	0.45	0.85	0.03	0.16	0.01	0.04
6	2214	393	980	3587	0.52	1.27	0.97	0.71	0.90	1.79	0.45	0.88	0.03	0.27	0.01	0.05
7	2231	410	985	3627	0.53	1.44	0.97	0.74	0.86	1.66	0.43	0.84	0.04	0.21	0.01	0.05
8	2217	402	987	3605	0.53	1.37	0.99	0.73	0.88	1.63	0.43	0.85	0.03	0.25	0.01	0.05
9	2562	413	1047	4022	0.58	1.01	0.68	0.65	0.68	1.71	0.50	0.75	0.02	0.18	0.01	0.03
10	2556	408	1045	4010	0.58	0.98	0.67	0.64	0.67	1.63	0.53	0.74	0.02	0.15	0.01	0.03
11	2575	417	1044	4036	0.59	1.04	0.67	0.66	0.63	1.66	0.54	0.72	0.01	0.14	0.01	0.03
12	2564	408	1043	4015	0.59	0.98	0.67	0.65	0.66	1.73	0.58	0.76	0.02	0.15	0.01	0.03
13	2917	432	1175	4524	0.63	0.85	0.73	0.68	0.55	1.86	0.43	0.66	0.01	0.22	0.01	0.03
14	2875	431	1172	4479	0.61	0.86	0.70	0.66	0.62	1.79	0.51	0.72	0.02	0.13	0.01	0.03
15	2915	428	1174	4516	0.62	0.85	0.70	0.67	0.59	1.87	0.44	0.69	0.01	0.21	0.01	0.03
16	2907	430	1172	4509	0.61	0.81	0.70	0.66	0.60	1.80	0.48	0.70	0.01	0.18	0.01	0.03
17	1992	462	1174	3627	0.57	2.15	1.35	0.94	0.94	1.37	0.44	0.86	0.04	0.22	0.01	0.05
18	1997	468	1138	3604	0.57	2.13	1.24	0.91	0.89	1.39	0.44	0.83	0.03	0.34	0.01	0.06
19	1989	463	1172	3623	0.57	2.18	1.33	0.94	0.96	1.44	0.42	0.87	0.04	0.30	0.01	0.06
20	1976	460	1181	3616	0.56	2.19	1.36	0.94	0.97	1.47	0.44	0.89	0.04	0.29	0.01	0.06
21	2224	405	976	3605	0.53	1.44	0.91	0.72	0.88	1.65	0.49	0.86	0.03	0.28	0.01	0.05
22	2231	403	979	3613	0.53	1.38	0.95	0.73	0.85	1.58	0.45	0.83	0.03	0.22	0.01	0.04
23	2241	395	984	3620	0.54	1.36	0.96	0.73	0.84	1.82	0.45	0.84	0.02	0.39	0.01	0.06
24	2227	398	981	3606	0.53	1.36	0.93	0.72	0.86	1.76	0.42	0.85	0.03	0.26	0.01	0.05
25	2561	407	1045	4014	0.59	0.99	0.67	0.65	0.66	1.74	0.55	0.75	0.01	0.18	0.01	0.03
26	2564	399	1050	4013	0.60	0.96	0.70	0.66	0.64	1.84	0.51	0.73	0.02	0.32	0.01	0.05
27	2573	404	1044	4022	0.58	0.98	0.67	0.65	0.64	1.74	0.56	0.74	0.01	0.18	0.01	0.03
28	2564	405	1046	4014	0.59	0.96	0.68	0.65	0.65	1.69	0.53	0.73	0.01	0.18	0.01	0.03
29	2919	440	1173	4532	0.63	0.84	0.72	0.67	0.57	1.64	0.50	0.67	0.01	0.13	0.01	0.02
30	2896	426	1175	4497	0.62	0.85	0.72	0.67	0.60	1.84	0.45	0.69	0.02	0.20	0.01	0.04
31	2887	433	1169	4489	0.62	0.88	0.67	0.66	0.60	1.66	0.50	0.69	0.01	0.11	0.01	0.02
32	2921	435	1175	4531	0.63	0.86	0.71	0.67	0.55	1.75	0.46	0.65	0.01	0.17	0.01	0.03
33	1968	467	1169	3603	0.55	2.09	1.28	0.90	1.02	1.26	0.46	0.90	0.06	0.23	0.01	0.07
34	1982	455	1181	3617	0.56	1.92	1.41	0.92	0.99	1.47	0.43	0.90	0.05	0.30	0.01	0.06
35	1983	460	1144	3588	0.56	2.14	1.29	0.91	0.96	1.36	0.46	0.88	0.04	0.23	0.01	0.05
36	2000	451	1179	3630	0.57	1.99	1.32	0.91	0.95	1.57	0.41	0.88	0.04	0.37	0.01	0.07
37	2216	395	978	3588	0.53	1.30	0.92	0.71	0.87	1.74	0.44	0.85	0.03	0.25	0.01	0.05
38	2213	403	971	3587	0.54	1.30	0.91	0.71	0.87	1.47	0.47	0.83	0.03	0.23	0.01	0.04
39	2214	407	973	3595	0.52	1.39	0.91	0.71	0.90	1.60	0.48	0.87	0.02	0.21	0.01	0.04
40	2237	390	986	3612	0.54	1.26	0.95	0.72	0.85	1.91	0.43	0.86	0.02	0.35	0.01	0.05
41	2544	396	1047	3987	0.59	0.91	0.70	0.65	0.67	1.90	0.53	0.76	0.02	0.24	0.01	0.04
42	2560	405	1049	4013	0.59	0.97	0.69	0.66	0.65	1.73	0.52	0.73	0.02	0.18	0.01	0.03
43	2558	408	1047	4013	0.58	0.96	0.68	0.64	0.65	1.73	0.53	0.73	0.01	0.18	0.01	0.03
44	2563	407	1047	4017	0.58	0.96	0.68	0.64	0.67	1.73	0.55	0.75	0.01	0.22	0.01	0.03
45	2866	426	1172	4464	0.61	0.85	0.71	0.66	0.62	1.87	0.48	0.72	0.02	0.21	0.01	0.04
46	2914	422	1176	4513	0.62	0.81	0.71	0.66	0.57	1.96	0.45	0.69	0.01	0.26	0.01	0.04

Table E.15. (Continued)

47	2892	435	1173	4500	0.62	0.85	0.73	0.67	0.61	1.79	0.46	0.70	0.01	0.16	0.01	0.03
48	2908	434	1171	4513	0.62	0.87	0.70	0.67	0.58	1.76	0.45	0.67	0.01	0.14	0.01	0.02
49	1979	462	1167	3608	0.56	2.07	1.36	0.92	0.98	1.45	0.44	0.89	0.07	0.29	0.01	0.08
50	1992	488	1225	3705	0.57	2.28	1.47	0.98	0.99	1.25	0.40	0.87	0.04	0.20	0.01	0.05
51	1970	464	1210	3644	0.57	2.14	1.41	0.95	1.00	1.49	0.43	0.91	0.04	0.26	0.01	0.06
52	1978	471	1174	3623	0.56	2.27	1.37	0.95	0.96	1.34	0.43	0.87	0.03	0.30	0.01	0.06
53	2242	400	982	3624	0.54	1.34	0.93	0.72	0.84	1.72	0.43	0.83	0.02	0.23	0.01	0.04
54	2240	404	980	3624	0.53	1.39	0.94	0.73	0.85	1.63	0.45	0.83	0.02	0.25	0.01	0.04
55	2213	405	986	3604	0.52	1.33	0.95	0.72	0.90	1.66	0.46	0.87	0.02	0.22	0.01	0.04
56	2220	394	984	3598	0.52	1.27	0.97	0.71	0.92	1.77	0.44	0.89	0.02	0.31	0.01	0.05
57	2546	406	1046	3999	0.58	0.91	0.68	0.64	0.67	1.85	0.51	0.76	0.01	0.20	0.01	0.03
58	2554	405	1046	4005	0.58	0.92	0.67	0.64	0.67	1.75	0.55	0.75	0.02	0.16	0.01	0.03
59	2563	400	1053	4016	0.58	0.88	0.70	0.64	0.64	1.83	0.48	0.73	0.02	0.19	0.01	0.03
60	2561	401	1047	4009	0.58	0.93	0.69	0.65	0.67	1.75	0.52	0.75	0.02	0.19	0.01	0.04
61	2904	429	1173	4506	0.61	0.85	0.71	0.66	0.59	1.79	0.46	0.69	0.01	0.19	0.01	0.03
62	2868	431	1172	4471	0.61	0.84	0.72	0.66	0.63	1.85	0.48	0.72	0.02	0.17	0.01	0.03
63	2895	428	1173	4497	0.62	0.85	0.70	0.66	0.61	1.80	0.46	0.70	0.01	0.19	0.01	0.03
64	2881	434	1171	4486	0.61	0.89	0.70	0.66	0.63	1.83	0.48	0.72	0.01	0.16	0.01	0.03
65	1975	478	1163	3616	0.56	2.18	1.23	0.91	0.95	1.25	0.43	0.85	0.04	0.22	0.01	0.05
66	1985	472	1220	3677	0.57	2.27	1.44	0.97	0.99	1.35	0.43	0.89	0.03	0.31	0.01	0.06
67	2009	475	1190	3674	0.57	2.22	1.35	0.94	0.94	1.40	0.45	0.86	0.04	0.27	0.01	0.06
68	2007	460	1167	3635	0.57	2.07	1.27	0.91	0.93	1.32	0.47	0.86	0.03	0.29	0.01	0.05
69	2226	407	979	3612	0.53	1.36	0.93	0.72	0.88	1.58	0.45	0.84	0.03	0.23	0.01	0.05
70	2237	405	981	3623	0.53	1.40	0.94	0.73	0.84	1.71	0.43	0.83	0.02	0.22	0.01	0.04
71	2224	404	986	3613	0.54	1.33	0.96	0.73	0.88	1.61	0.45	0.85	0.03	0.18	0.01	0.04
72	2215	404	982	3601	0.52	1.34	0.96	0.72	0.90	1.71	0.44	0.87	0.03	0.26	0.01	0.05
73	2556	398	1049	4003	0.59	0.94	0.68	0.65	0.67	1.89	0.52	0.76	0.02	0.21	0.01	0.04
74	2575	397	1047	4019	0.59	0.87	0.68	0.64	0.64	1.81	0.51	0.73	0.01	0.17	0.01	0.03
75	2545	406	1050	4002	0.58	0.99	0.70	0.66	0.70	1.68	0.49	0.75	0.02	0.21	0.01	0.04
76	2556	408	1048	4011	0.58	0.94	0.68	0.64	0.69	1.73	0.53	0.76	0.02	0.19	0.01	0.03
77	2872	428	1172	4472	0.61	0.84	0.69	0.66	0.63	1.78	0.49	0.72	0.03	0.19	0.01	0.04
78	2895	433	1170	4498	0.62	0.87	0.70	0.67	0.59	1.82	0.47	0.69	0.01	0.16	0.01	0.03
79	2914	429	1172	4515	0.62	0.87	0.70	0.67	0.58	1.74	0.51	0.68	0.01	0.16	0.01	0.03
80	2891	435	1170	4496	0.62	0.90	0.71	0.67	0.61	1.70	0.46	0.69	0.03	0.15	0.01	0.04

Table E.16. Delivery Performance Measures of Group 3 Policies

Delivery Performances	Quantity					Percentage			
Delivery Type	Routine Deliveries To TCs	Ad-Hoc Deliveries To TCs	Emergency Deliveries To TCs	Ad-hoc Deliveries Between DCs and RBC	Total Number Of Deliveries	Routine Deliveries To TCs	Ad-Hoc Deliveries To TCs	Emergency Deliveries To TCs	Ad-hoc Deliveries Between DCs and RBC
2.4.	72998	62070	0	0	135068	54	46	0	0
1	69133	58667	0	3294	131094	53	45	0	3
2	69329	58636	0	3288	131253	53	45	0	3
3	69153	58573	0	3331	131058	53	45	0	3
4	69177	58793	0	3284	131254	53	45	0	3
5	69337	57575	0	3026	129938	53	44	0	2
6	69354	57736	0	2968	130058	53	44	0	2
7	69330	57777	0	3018	130125	53	44	0	2
8	69348	57779	0	3030	130157	53	44	0	2
9	69443	56750	0	2923	129116	54	44	0	2
10	69447	56758	0	2933	129138	54	44	0	2
11	69456	56582	0	2953	128990	54	44	0	2
12	69453	56788	0	2878	129119	54	44	0	2
13	69397	56647	0	2622	128666	54	44	0	2
14	69421	56679	0	2605	128705	54	44	0	2
15	69425	56729	0	2602	128756	54	44	0	2
16	69454	56684	0	2649	128787	54	44	0	2
17	69174	58700	0	3270	131144	53	45	0	2
18	69225	58473	0	3304	131003	53	45	0	3
19	69266	58607	0	3251	131125	53	45	0	2
20	69134	58832	0	3262	131228	53	45	0	2
21	69320	57713	0	3012	130046	53	44	0	2
22	69364	57420	0	3027	129811	53	44	0	2
23	69299	57816	0	2990	130105	53	44	0	2
24	69297	57736	0	2985	130018	53	44	0	2
25	69405	56931	0	2917	129253	54	44	0	2
26	69306	56945	0	2909	129160	54	44	0	2
27	69386	56805	0	2896	129087	54	44	0	2
28	69454	56670	0	2927	129051	54	44	0	2
29	69493	56422	0	2662	128576	54	44	0	2
30	69400	56656	0	2620	128676	54	44	0	2
31	69500	56606	0	2628	128734	54	44	0	2
32	69473	56396	0	2673	128542	54	44	0	2
33	69204	58911	0	3319	131434	53	45	0	3
34	69164	58900	0	3268	131332	53	45	0	2
35	69177	58528	0	3254	130959	53	45	0	2
36	69193	58909	0	3259	131362	53	45	0	2
37	69233	57763	0	2971	129967	53	44	0	2
38	69367	57500	0	3035	129903	53	44	0	2
39	69352	57660	0	3034	130045	53	44	0	2
40	69359	57743	0	2962	130064	53	44	0	2
41	69425	57016	0	2842	129282	54	44	0	2
42	69377	56782	0	2932	129091	54	44	0	2
43	69470	56764	0	2925	129158	54	44	0	2
44	69410	56746	0	2927	129083	54	44	0	2

Table E.16. (Continued)

45	69411	56827	0	2593	128831	54	44	0	2
46	69467	56687	0	2608	128763	54	44	0	2
47	69477	56581	0	2612	128670	54	44	0	2
48	69398	56527	0	2629	128554	54	44	0	2
49	69191	58823	0	3276	131290	53	45	0	2
50	69228	58860	0	3366	131454	53	45	0	3
51	69220	58887	0	3255	131362	53	45	0	2
52	69249	58644	0	3293	131187	53	45	0	3
53	69410	57498	0	2995	129904	53	44	0	2
54	69394	57558	0	3024	129976	53	44	0	2
55	69326	57648	0	3020	129994	53	44	0	2
56	69374	57703	0	2983	130060	53	44	0	2
57	69352	56812	0	2923	129087	54	44	0	2
58	69387	56887	0	2898	129173	54	44	0	2
59	69379	56877	0	2911	129168	54	44	0	2
60	69368	57012	0	2879	129258	54	44	0	2
61	69455	56598	0	2625	128677	54	44	0	2
62	69436	56732	0	2623	128790	54	44	0	2
63	69411	56619	0	2636	128666	54	44	0	2
64	69398	56619	0	2636	128652	54	44	0	2
65	69240	58562	0	3336	131137	53	45	0	3
66	69231	58901	0	3299	131431	53	45	0	3
67	69269	58693	0	3327	131289	53	45	0	3
68	69264	58476	0	3264	131003	53	45	0	2
69	69313	57661	0	3034	130009	53	44	0	2
70	69319	57476	0	3031	129825	53	44	0	2
71	69379	57591	0	3021	129990	53	44	0	2
72	69265	57714	0	3033	130011	53	44	0	2
73	69316	56967	0	2889	129172	54	44	0	2
74	69422	56720	0	2871	129012	54	44	0	2
75	69460	56792	0	2950	129201	54	44	0	2
76	69477	56798	0	2880	129155	54	44	0	2
77	69349	56773	0	2602	128725	54	44	0	2
78	69473	56589	0	2623	128684	54	44	0	2
79	69426	56641	0	2625	128691	54	44	0	2
80	69309	56690	0	2638	128637	54	44	0	2

Table E.17. Selection Criterion Performance of Group 3 Policies

Performance Measure	Outdate Rate			Mismatch Rate			Shortage Rate			Selection Criterion Performance
Case	Region Including Dcs and RBC	Region Excluding DCs And RBC	Single TCs' Means	Region Including Dcs and RBC	Region Excluding DCs And RBC	Single TCs' Means	Region Including Dcs and RBC	Region Excluding DCs And RBC	Single TCs' Means	
2.4.	7.67	4.72	8.30	0.62	0.62	0.94	0.03	0.03	0.06	8.32
1	0.90	0.88	1.86	0.87	0.87	1.32	0.05	0.05	0.11	1.82
2	0.93	0.91	1.90	0.87	0.87	1.32	0.05	0.05	0.10	1.84
3	0.92	0.90	1.90	0.85	0.85	1.30	0.05	0.05	0.11	1.83
4	0.95	0.93	1.93	0.86	0.86	1.30	0.07	0.07	0.13	1.88
5	0.72	0.71	1.53	0.85	0.85	1.27	0.04	0.04	0.08	1.61
6	0.71	0.70	1.52	0.88	0.88	1.32	0.05	0.05	0.10	1.64
7	0.74	0.73	1.56	0.84	0.84	1.26	0.05	0.05	0.10	1.62
8	0.73	0.72	1.56	0.85	0.85	1.27	0.05	0.05	0.09	1.63
9	0.65	0.65	1.44	0.75	0.75	1.11	0.03	0.03	0.07	1.43
10	0.64	0.64	1.42	0.74	0.74	1.10	0.03	0.03	0.06	1.41
11	0.66	0.65	1.44	0.72	0.72	1.06	0.03	0.03	0.06	1.40
12	0.65	0.65	1.44	0.76	0.76	1.12	0.03	0.03	0.06	1.44
13	0.68	0.68	1.50	0.66	0.66	0.98	0.03	0.03	0.07	1.37
14	0.66	0.66	1.47	0.72	0.72	1.05	0.03	0.03	0.05	1.41
15	0.67	0.67	1.48	0.69	0.69	1.02	0.03	0.03	0.06	1.39
16	0.66	0.66	1.46	0.70	0.70	1.03	0.03	0.03	0.06	1.39
17	0.94	0.92	1.92	0.86	0.86	1.32	0.05	0.05	0.11	1.85
18	0.91	0.89	1.87	0.83	0.83	1.26	0.06	0.06	0.12	1.80
19	0.94	0.91	1.90	0.87	0.87	1.33	0.06	0.06	0.12	1.87
20	0.94	0.91	1.90	0.89	0.89	1.35	0.06	0.06	0.12	1.88
21	0.72	0.71	1.53	0.86	0.86	1.29	0.05	0.05	0.10	1.63
22	0.73	0.72	1.55	0.83	0.83	1.24	0.04	0.04	0.09	1.60
23	0.73	0.72	1.55	0.84	0.84	1.27	0.06	0.06	0.11	1.63
24	0.72	0.72	1.54	0.85	0.85	1.26	0.05	0.05	0.10	1.62
25	0.65	0.65	1.44	0.75	0.75	1.12	0.03	0.03	0.06	1.43
26	0.66	0.66	1.46	0.73	0.73	1.09	0.05	0.05	0.10	1.44
27	0.65	0.65	1.43	0.74	0.74	1.09	0.03	0.03	0.06	1.42
28	0.65	0.65	1.44	0.73	0.73	1.08	0.03	0.03	0.06	1.41
29	0.67	0.67	1.49	0.67	0.67	0.98	0.02	0.02	0.05	1.36
30	0.67	0.67	1.48	0.69	0.69	1.02	0.04	0.04	0.07	1.40
31	0.66	0.66	1.46	0.69	0.69	1.02	0.02	0.02	0.05	1.37
32	0.67	0.67	1.50	0.65	0.65	0.96	0.03	0.03	0.05	1.35
33	0.90	0.88	1.86	0.90	0.90	1.38	0.07	0.07	0.13	1.87
34	0.92	0.90	1.89	0.90	0.90	1.38	0.06	0.06	0.13	1.89
35	0.91	0.89	1.87	0.88	0.88	1.33	0.05	0.05	0.11	1.84
36	0.91	0.89	1.86	0.88	0.88	1.35	0.07	0.07	0.13	1.86
37	0.71	0.70	1.53	0.85	0.85	1.28	0.05	0.05	0.10	1.62
38	0.71	0.70	1.53	0.83	0.83	1.26	0.04	0.04	0.09	1.59
39	0.71	0.70	1.52	0.87	0.87	1.30	0.04	0.04	0.08	1.62
40	0.72	0.71	1.54	0.86	0.86	1.28	0.05	0.05	0.10	1.63
41	0.65	0.65	1.44	0.76	0.76	1.15	0.04	0.04	0.08	1.46
42	0.66	0.66	1.45	0.73	0.73	1.09	0.03	0.03	0.07	1.42
43	0.64	0.64	1.42	0.73	0.73	1.09	0.03	0.03	0.06	1.41
44	0.64	0.64	1.42	0.75	0.75	1.11	0.03	0.03	0.07	1.43

Table E.17. (Continued)

45	0.66	0.66	1.47	0.72	0.72	1.07	0.04	0.04	0.07	1.42
46	0.66	0.66	1.47	0.69	0.69	1.02	0.04	0.04	0.07	1.39
47	0.67	0.67	1.48	0.70	0.70	1.03	0.03	0.03	0.06	1.39
48	0.67	0.67	1.48	0.67	0.67	0.99	0.02	0.02	0.05	1.36
49	0.92	0.90	1.89	0.89	0.89	1.36	0.08	0.08	0.15	1.89
50	0.98	0.96	1.99	0.87	0.87	1.33	0.05	0.05	0.10	1.90
51	0.95	0.93	1.93	0.91	0.91	1.38	0.06	0.06	0.12	1.92
52	0.95	0.92	1.93	0.87	0.87	1.32	0.06	0.06	0.11	1.87
53	0.72	0.71	1.54	0.83	0.83	1.25	0.04	0.04	0.08	1.59
54	0.73	0.72	1.55	0.83	0.83	1.25	0.04	0.04	0.08	1.60
55	0.72	0.71	1.53	0.87	0.87	1.30	0.04	0.04	0.08	1.63
56	0.71	0.70	1.52	0.89	0.89	1.33	0.05	0.05	0.10	1.65
57	0.64	0.64	1.41	0.76	0.76	1.12	0.03	0.03	0.07	1.43
58	0.64	0.64	1.42	0.75	0.75	1.12	0.03	0.03	0.07	1.42
59	0.64	0.64	1.42	0.73	0.73	1.08	0.03	0.03	0.07	1.40
60	0.65	0.65	1.43	0.75	0.75	1.11	0.04	0.04	0.08	1.43
61	0.66	0.66	1.47	0.69	0.69	1.01	0.03	0.03	0.06	1.38
62	0.66	0.66	1.46	0.72	0.72	1.07	0.03	0.03	0.07	1.42
63	0.66	0.66	1.47	0.70	0.70	1.03	0.03	0.03	0.06	1.39
64	0.66	0.66	1.47	0.72	0.72	1.06	0.03	0.03	0.06	1.41
65	0.91	0.88	1.87	0.85	0.85	1.30	0.05	0.05	0.10	1.81
66	0.97	0.95	1.98	0.89	0.89	1.34	0.06	0.06	0.11	1.91
67	0.94	0.92	1.92	0.86	0.86	1.30	0.06	0.06	0.11	1.86
68	0.91	0.89	1.87	0.86	0.86	1.31	0.05	0.05	0.11	1.82
69	0.72	0.71	1.54	0.84	0.84	1.27	0.05	0.05	0.10	1.61
70	0.73	0.72	1.54	0.83	0.83	1.24	0.04	0.04	0.08	1.59
71	0.73	0.72	1.56	0.85	0.85	1.28	0.04	0.04	0.08	1.62
72	0.72	0.71	1.54	0.87	0.87	1.31	0.05	0.05	0.10	1.64
73	0.65	0.65	1.44	0.76	0.76	1.14	0.04	0.04	0.07	1.45
74	0.64	0.64	1.42	0.73	0.73	1.10	0.03	0.03	0.06	1.40
75	0.66	0.66	1.45	0.75	0.75	1.13	0.04	0.04	0.07	1.44
76	0.64	0.64	1.43	0.76	0.76	1.13	0.03	0.03	0.07	1.44
77	0.66	0.66	1.46	0.72	0.72	1.06	0.04	0.04	0.08	1.41
78	0.67	0.67	1.47	0.69	0.69	1.02	0.03	0.03	0.06	1.38
79	0.67	0.67	1.48	0.68	0.68	1.00	0.03	0.03	0.06	1.38
80	0.67	0.67	1.48	0.69	0.69	1.02	0.04	0.04	0.08	1.40

Table E.18. Regression Model Summary of Policy Group 3 - Outdate Rate of Region Including DCs And RBC

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of Estimate
1	0.95	0.90	0.89	0.03
Predictors: (Constant), LLC, ADPD, ADa				

Table E.19. Regression Model Anova Table of Policy Group 3 - Outdate Rate of Region Including DCs And RBC

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.43	3.00	0.14	222.70	1.49
	Residual	0.05	76.00	0.00		
	Total	0.47	79.00			
Predictors: (Constant), LLC, ADPD, ADa						
Dependent Variable: OutdateRate						

Table E.20. Regression Model Coefficient Table of Policy Group 3 - Outdate Rate of Region Including DCs And RBC

Coefficients						
Model		Unstandardized Coefficients		Standardized Coef.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.03	0.01		72.53	0.00
	ADa	-0.07	0.00	-0.95	-25.82	0.00
	ADPD	-0.02	0.02	-0.04	-1.21	0.23
	LLC	0.00	0.03	0.00	-0.03	0.97
Dependent Variable: OutdateRate						

Table E.21. Regression Model Summary of Policy Group 3 - Mismatch Rate of Region Including DCs And RBC

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of Estimate
1	0.88	0.77	0.76	0.01
Predictors: (Constant), LLC, ADPD, ADa				

Table E.22. Regression Model Summary of Policy Group 3 - Mismatch Rate of Region Including DCs And RBC

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.04	3.00	0.01	84.07	0.00
	Residual	0.01	76.00	0.00		
	Total	0.05	79.00			
Predictors: (Constant), LLC, ADPD, ADa						
Dependent Variable: MismatchRate						

Table E.23. Regression Model Coefficient Table of Policy Group 3 - Mismatch Rate of Region Including DCs And RBC

Coefficients						
Model		Unstandardized Coefficients		Standardized Coef.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.15	0.01		22.77	0.00
	ADa	-0.02	0.00	-0.88	-15.88	0.00
	ADPD	0.00	0.01	0.00	-0.01	1.00
	LLC	0.00	0.01	-0.01	-0.13	0.90
Dependent Variable: MismatchRate						

Table E.24. Regression Model Summary of Policy Group 3 - Shortage Rate of Region Including DCs And RBC

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of Estimate
1	0.23	0.05	0.02	362.21
Predictors: (Constant), LLC, ADPD, ADa				

Table E.25. Regression Model Anova Table of Policy Group 3 - Mismatch Rate of Region Including DCs And RBC

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	553046.51	3.00	184348.84	1.41	0.25
	Residual	9971114.12	76.00	131198.87		
	Total	10524160.62	79.00			
Predictors: (Constant), LLC, ADPD, ADa						
Dependent Variable: ShortageRate						

Table E.26. Regression Model Coefficient Table of Policy Group 3 - Shortage Rate of Region Including DCs and RBC

Coefficients						
Model		Unstandardized Coefficients		Standardized Coef.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3981.55	202.89		19.62	0.00
	ADa	-58.50	36.22	-0.18	-1.62	0.11
	ADPD	1.06	286.36	0.00	0.00	1.00
	LLC	459.12	362.21	0.14	1.27	0.21
Dependent Variable: ShortageRate						

Table E.27. Regression Model Summary of Policy Group 3 - Sum of Main Performance Measures

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of Estimate
1	0.95	0.91	0.91	0.06
Predictors: (Constant), LLC, ADPD, ADa				

Table E.28. Regression Model Anova Table of Policy Group 3 - Sum of Main Performance Measures

ANOVA(b)						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.90	3.00	0.97	252.79	0.00
	Residual	0.29	76.00	0.00		
	Total	3.20	79.00			
Predictors: (Constant), LLC, ADPD, ADa						
Dependent Variable: SelectionCriterion						

Table E.29. Regression Model Coefficient Table of Policy Group 3 - Sum of Main Performance Measures

Coefficients(a)						
Model		Unstandardized Coefficients		Standardized Coef.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.22	0.03		63.94	0.00
	ADa	-0.17	0.01	-0.95	-27.53	0.00
	ADPD	-0.03	0.05	-0.02	-0.51	0.61
	LLC	0.01	0.06	0.01	0.17	0.87
Dependent Variable: SelectionCriterion						

Table E.30. Regression Model Summary of Policy Group 3 - Total Number of Deliveries

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.29	0.08	0.05	952.92
Predictors: (Constant), LLC, ADPD, ADa				

Table E.31. Regression Model Anova Table of Policy Group 3 -Total Number of Deliveries

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6269197.05	3.00	2089732.35	2.30	0.08
	Residual	69012639.66	76.00	908061.05		
	Total	75281836.71	79.00			
Predictors: (Constant), LLC, ADPD, ADa						
Dependent Variable: TotalNumDel						

Table E.32. Regression Model Coefficient Table of Policy Group 3 - Total Number of Deliveries

Coefficients						
Model		Unstandardized Coefficients		Standardized Coef.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	130486.14	533.76		244.46	0.00
	ADa	43.12	95.29	0.05	0.45	0.65
	ADPD	-41.19	753.35	-0.01	-0.05	0.96
	LLC	-2465.87	952.92	-0.28	-2.59	0.01
Dependent Variable: TotalDel						

Table E.33. Cities Performances and Performance of Region Including DCs and RBC of Policies Derived From Policy 3.32

Performance Measure		3.32.	3.32.1	3.32.2	3.32.3	3.32.4	3.32.5
Inventory Level	Antalya	2920.67	3241.82	3600.68	3940.63	4307.71	4646.30
	Burdur	434.78	483.09	539.82	597.66	634.84	686.87
	Isparta	1175.14	1304.28	1445.31	1579.98	1719.34	1857.68
	Overall	4530.59	5029.20	5585.81	6118.27	6661.89	7190.84
Outdate Rate	Antalya	0.63	0.65	0.69	0.74	0.81	0.87
	Burdur	0.86	0.88	0.91	0.92	0.84	0.87
	Isparta	0.71	0.74	0.77	0.74	0.79	0.83
	Overall	0.67	0.70	0.74	0.76	0.81	0.86
Mismatch Rate	Antalya	0.55	0.58	0.56	0.52	0.48	0.48
	Burdur	1.75	1.54	1.48	1.41	1.32	1.17
	Isparta	0.46	0.44	0.39	0.44	0.41	0.39
	Overall	0.65	0.65	0.61	0.59	0.55	0.53
Shortage Rate	Antalya	0.01	0.01	0.02	0.01	0.02	0.01
	Burdur	0.17	0.10	0.10	0.05	0.04	0.02
	Isparta	0.01	0.01	0.01	0.01	0.01	0.01
	Overall	0.03	0.02	0.02	0.01	0.02	0.01

Table E.34. Delivery Performance Measures of Policies Derived From Policy 3.32.

Delivery Performances	Delivery Type	3.32.	3.32.1	3.32.2	3.32.3	3.32.4	3.32.5
Quantity	Routine Deliveries To TCs	69472.90	69471.70	69407.10	69442.50	69403.50	69576.90
	Ad-Hoc Deliveries to TCs	56396.20	56461.10	56614.40	56534.70	56732.70	56876.80
	Emergency Deliveries To TCs	0.00	0.00	0.00	0.00	0.00	0.00
	Ad-hoc Deliveries Between DCs and RBC	2673.20	2430.00	2250.30	2002.60	1880.80	1743.60
	Total	128542.30	128362.80	128271.80	127979.80	128017.00	128197.30
Percentage	Routine Deliveries To TCs	54.05	54.12	54.11	54.26	54.21	54.27
	Ad-Hoc Deliveries to TCs	43.87	43.99	44.14	44.17	44.32	44.37
	Emergency Deliveries To TCs	0.00	0.00	0.00	0.00	0.00	0.00
	Ad-hoc Deliveries Between DCs and RBC	2.08	1.89	1.75	1.56	1.47	1.36

Table E.35. Selection Criterion Performance of Policies Derived From Policy 3.32.

Performance Measure	Case	3.32.	3.32.1	3.32.2	3.32.3	3.32.4	3.32.5
Outdate Rate	Region Including Dcs and RBC	0.67	0.70	0.74	0.76	0.81	0.86
	Region Excluding DCs And RBC	0.67	0.70	0.74	0.76	0.81	0.86
	Single TCs' Means	1.50	1.55	1.63	1.68	1.79	1.90
Mismatch	Region Including Dcs and RBC	0.65	0.65	0.61	0.59	0.55	0.53
	Region Excluding DCs And RBC	0.65	0.65	0.61	0.59	0.55	0.53
	Single TCs' Means	0.96	0.96	0.90	0.88	0.82	0.79
Shortage Rate	Region Including Dcs and RBC	0.03	0.02	0.02	0.01	0.02	0.01
	Region Excluding DCs And RBC	0.03	0.02	0.02	0.01	0.02	0.01
	Single TCs' Means	0.05	0.04	0.05	0.03	0.04	0.02
Selection Criterion Performance		1.35	1.37	1.37	1.37	1.38	1.40

Table E.36. Single TC Performances of Policies Derived From Policy 3.32. - Mean Inventory Levels

TC	3.32.	3.32.1	3.32.2	3.32.3	3.32.4	3.32.5
[TC1]	144.93	144.81	144.85	144.92	144.91	144.97
[TC2]	38.16	38.12	38.25	38.10	38.25	38.21
[TC3]	25.86	25.88	25.86	25.88	25.91	25.93
[TC4]	21.20	21.13	21.06	21.18	21.15	21.22
[TC5]	19.43	19.41	19.35	19.42	19.42	19.42
[TC6]	28.18	28.29	28.30	28.29	28.19	28.17
[TC7]	23.52	23.51	23.50	23.47	23.48	23.47
[TC8]	21.03	20.96	21.02	21.02	21.07	21.04
[TC9]	17.77	17.77	17.73	17.78	17.82	17.72
[TC10]	20.95	20.99	20.90	21.00	20.98	20.98
[TC11]	25.87	25.74	25.81	25.80	25.73	25.74
[TC12]	16.94	17.00	16.89	16.90	16.87	16.91
[TC13]	17.81	17.76	17.79	17.68	17.79	17.72
[TC14]	33.88	33.82	33.91	33.94	33.95	33.95
[TC15]	21.66	21.68	21.67	21.63	21.69	21.64
[TC16]	19.47	19.53	19.48	19.47	19.46	19.52
[TC17]	17.80	17.69	17.80	17.76	17.81	17.80
[TC18]	254.13	254.41	254.33	254.55	254.39	254.76
[TC19]	110.18	110.20	110.01	110.27	110.14	110.31
[TC20]	69.31	69.31	69.28	69.35	69.28	69.42
[TC21]	17.85	17.75	17.81	17.80	17.81	17.84
[TC22]	25.02	25.09	25.10	25.09	24.98	25.01
[TC23]	38.06	38.11	38.10	38.09	38.07	38.12
[TC24]	25.87	25.69	25.71	25.92	25.84	25.81
[TC25]	19.27	19.37	19.31	19.37	19.27	19.32
[TC26]	17.02	17.00	16.91	16.92	16.90	16.88
[TC27]	34.02	33.98	34.03	34.11	34.07	34.09
[TC28]	29.02	29.06	29.12	29.15	29.05	29.06
[TC29]	67.50	67.42	67.42	67.55	67.48	67.61
[TC30]	17.02	16.99	17.01	16.98	16.96	16.96
[TC31]	42.15	42.22	42.18	42.23	42.17	42.18
[TC32]	61.81	62.26	62.49	62.49	62.61	62.85
[TC33]	22.95	23.12	23.19	23.18	23.26	23.34
[TC34]	67.45	67.82	67.98	68.21	68.30	68.50
[TC35]	18.82	19.07	19.15	19.08	19.17	19.24
[TC36]	15.74	15.90	15.83	15.82	15.93	15.91
[TC37]	22.70	22.87	22.99	22.93	23.01	23.10
[TC38]	114.56	114.56	114.68	114.69	114.66	114.71
[TC39]	38.86	38.92	39.01	38.92	38.99	38.98
[TC40]	63.42	63.42	63.56	63.44	63.44	63.39
[TC41]	65.95	66.03	66.02	66.02	65.96	65.94
[TC42]	17.04	17.04	17.10	17.08	17.01	17.12
[TC43]	17.82	17.90	17.90	17.91	17.84	17.98
[TC44]	21.16	21.15	21.14	21.17	21.24	21.20
[TC45]	17.84	17.69	17.78	17.78	17.77	17.80
[TC46]	17.09	17.08	17.11	16.96	17.04	17.12
[TC47]	21.88	21.86	21.89	21.87	21.88	21.85
[TC48]	84.63	84.62	84.66	84.57	84.61	84.74
[TC49]	17.07	17.16	17.15	17.05	17.14	17.02
Mean	40.56	40.60	40.61	40.63	40.63	40.66
Median	22.95	23.12	23.19	23.18	23.26	23.34
Max	254.13	254.41	254.33	254.55	254.39	254.76
Min	15.74	15.90	15.83	15.82	15.93	15.91
Percentile (%10)	17.06	17.08	17.10	17.04	17.03	17.10
Percentile (%25)	17.85	17.90	17.90	17.91	17.84	17.98
Percentile (%50)	22.95	23.12	23.19	23.18	23.26	23.34
Percentile (%75)	38.86	38.92	39.01	38.92	38.99	38.98
Percentile (%90)	72.38	72.37	72.36	72.39	72.35	72.48

Table E.37. Single TC Performances of Policies Derived From Policy 3.32. -
Outdate Rates

TC	3.32.	3.32.1	3.32.2	3.32.3	3.32.4	3.32.5
[TC1]	0.01	0.01	0.01	0.02	0.01	0.02
[TC2]	0.49	0.48	0.55	0.55	0.64	0.69
[TC3]	1.14	1.10	1.20	1.26	1.43	1.60
[TC4]	1.82	1.93	1.93	2.27	2.29	2.48
[TC5]	2.06	2.29	2.32	2.42	2.74	2.88
[TC6]	0.86	0.92	0.95	1.09	1.17	1.24
[TC7]	1.58	1.57	1.72	1.77	1.99	2.14
[TC8]	1.59	1.62	1.70	1.85	2.09	2.09
[TC9]	2.60	2.62	2.84	3.01	3.38	3.48
[TC10]	1.66	1.79	1.79	2.00	2.17	2.24
[TC11]	1.13	1.18	1.25	1.26	1.39	1.53
[TC12]	2.83	2.92	3.03	3.44	3.41	3.62
[TC13]	2.54	2.68	2.87	2.91	3.28	3.56
[TC14]	0.59	0.63	0.67	0.74	0.76	0.85
[TC15]	1.74	1.80	1.86	1.96	2.21	2.25
[TC16]	2.05	2.28	2.53	2.66	2.85	3.00
[TC17]	2.57	2.53	2.76	2.84	3.23	3.36
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.02	0.02	0.02	0.03	0.03	0.03
[TC20]	0.09	0.10	0.09	0.11	0.11	0.14
[TC21]	2.82	2.86	2.99	3.12	3.34	3.69
[TC22]	1.08	1.18	1.31	1.46	1.46	1.59
[TC23]	0.45	0.48	0.51	0.54	0.59	0.66
[TC24]	1.13	1.12	1.22	1.33	1.47	1.58
[TC25]	2.05	2.23	2.36	2.40	2.65	2.83
[TC26]	3.15	3.24	3.36	3.61	3.81	4.08
[TC27]	0.58	0.58	0.63	0.71	0.77	0.86
[TC28]	0.77	0.82	0.88	1.00	0.98	1.10
[TC29]	0.10	0.11	0.12	0.12	0.14	0.17
[TC30]	2.89	2.99	3.14	3.32	3.59	3.85
[TC31]	0.33	0.36	0.37	0.35	0.44	0.48
[TC32]	0.19	0.16	0.20	0.18	0.15	0.16
[TC33]	1.79	1.77	1.79	1.87	1.76	1.82
[TC34]	0.19	0.18	0.19	0.20	0.14	0.15
[TC35]	2.36	2.43	2.60	2.56	2.47	2.58
[TC36]	3.70	4.03	4.02	4.08	3.97	4.03
[TC37]	1.42	1.55	1.54	1.46	1.39	1.46
[TC38]	0.04	0.04	0.04	0.03	0.03	0.03
[TC39]	0.50	0.55	0.58	0.51	0.56	0.60
[TC40]	0.16	0.18	0.16	0.15	0.14	0.16
[TC41]	0.17	0.19	0.21	0.16	0.16	0.18
[TC42]	3.62	3.51	3.74	3.70	3.95	4.23
[TC43]	2.99	3.21	3.28	3.24	3.33	3.65
[TC44]	1.98	2.03	2.09	2.04	2.26	2.31
[TC45]	2.85	2.83	3.07	3.02	3.22	3.45
[TC46]	3.30	3.29	3.54	3.25	3.65	3.82
[TC47]	1.80	1.83	1.90	1.86	2.05	2.06
[TC48]	0.09	0.08	0.08	0.06	0.07	0.07
[TC49]	3.44	3.66	3.76	3.75	3.94	4.12
Mean	1.50	1.55	1.63	1.68	1.79	1.90
Median	1.58	1.57	1.70	1.77	1.76	1.82
Max	3.70	4.03	4.02	4.08	3.97	4.23
Min	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.09	0.09	0.09	0.10	0.10	0.13
Percentile (%25)	0.45	0.48	0.51	0.51	0.56	0.60
Percentile (%50)	1.58	1.57	1.70	1.77	1.76	1.82
Percentile (%75)	2.54	2.53	2.76	2.84	3.22	3.36
Percentile (%90)	3.02	3.22	3.30	3.34	3.61	3.82

Table E.38. Single TC Performances of Policies Derived From Policy 3.32. -
Mismatch Rates

TC	3.32.	3.32.1	3.32.2	3.32.3	3.32.4	3.32.5
[TC1]	0.26	0.28	0.27	0.23	0.22	0.22
[TC2]	0.60	0.61	0.58	0.60	0.49	0.56
[TC3]	0.91	0.97	0.94	0.85	0.81	0.78
[TC4]	1.05	1.04	1.01	0.90	0.91	0.87
[TC5]	1.03	1.08	0.94	0.99	0.88	0.92
[TC6]	0.74	0.87	0.80	0.79	0.71	0.66
[TC7]	0.88	0.90	0.85	0.86	0.79	0.76
[TC8]	1.11	1.08	1.03	1.01	0.98	0.99
[TC9]	1.00	1.21	1.07	1.05	0.98	0.97
[TC10]	1.03	1.14	1.03	1.11	0.95	0.98
[TC11]	0.86	0.84	0.90	0.86	0.82	0.73
[TC12]	1.05	1.19	1.09	1.12	1.10	1.05
[TC13]	1.05	1.16	1.04	1.20	0.97	1.05
[TC14]	0.63	0.82	0.66	0.62	0.60	0.64
[TC15]	0.97	1.09	0.95	0.96	0.87	0.81
[TC16]	1.03	1.13	1.01	0.99	0.86	0.93
[TC17]	1.11	1.25	1.11	1.11	1.12	1.02
[TC18]	0.16	0.17	0.17	0.15	0.15	0.14
[TC19]	0.40	0.39	0.40	0.36	0.31	0.33
[TC20]	0.49	0.51	0.48	0.41	0.41	0.39
[TC21]	0.99	1.25	1.19	1.10	1.10	1.01
[TC22]	0.87	0.89	0.97	0.85	0.83	0.84
[TC23]	0.64	0.67	0.65	0.55	0.50	0.48
[TC24]	0.93	0.97	0.96	0.91	0.80	0.85
[TC25]	1.04	1.00	1.03	0.91	0.83	0.83
[TC26]	0.99	1.15	1.17	0.98	0.97	0.99
[TC27]	0.73	0.79	0.80	0.67	0.62	0.62
[TC28]	0.79	0.85	0.80	0.76	0.73	0.69
[TC29]	0.49	0.48	0.50	0.41	0.37	0.40
[TC30]	1.07	1.14	1.12	1.03	1.06	0.94
[TC31]	0.63	0.68	0.62	0.60	0.52	0.54
[TC32]	1.33	1.25	1.23	1.15	1.05	1.00
[TC33]	2.41	2.13	2.06	1.91	1.74	1.62
[TC34]	1.34	1.15	1.11	1.07	1.02	0.87
[TC35]	2.75	2.42	2.19	2.10	1.96	1.71
[TC36]	2.83	2.30	2.41	1.98	2.03	1.62
[TC37]	2.45	2.10	1.90	2.02	1.90	1.64
[TC38]	0.24	0.25	0.20	0.26	0.23	0.24
[TC39]	0.55	0.46	0.42	0.45	0.46	0.39
[TC40]	0.42	0.39	0.36	0.43	0.37	0.35
[TC41]	0.33	0.31	0.30	0.31	0.31	0.27
[TC42]	0.91	0.82	0.76	1.03	0.79	0.86
[TC43]	0.97	0.88	0.82	0.89	0.89	0.89
[TC44]	0.89	0.94	0.81	0.82	0.78	0.75
[TC45]	0.88	1.01	0.88	0.88	0.82	0.80
[TC46]	0.97	1.05	0.80	0.89	0.83	0.90
[TC47]	0.75	0.76	0.67	0.71	0.61	0.63
[TC48]	0.30	0.29	0.27	0.29	0.28	0.26
[TC49]	1.05	0.88	0.82	0.89	0.85	0.78
Mean	0.96	0.96	0.90	0.88	0.82	0.79
Median	0.91	0.94	0.88	0.89	0.82	0.81
Max	2.83	2.42	2.41	2.10	2.03	1.71
Min	0.16	0.17	0.17	0.15	0.15	0.14
Percentile (%10)	0.39	0.37	0.34	0.35	0.31	0.32
Percentile (%25)	0.63	0.68	0.65	0.60	0.52	0.56
Percentile (%50)	0.91	0.94	0.88	0.89	0.82	0.81
Percentile (%75)	1.05	1.14	1.04	1.03	0.97	0.97
Percentile (%90)	1.33	1.25	1.20	1.16	1.10	1.05

Table E.39. Single TC Performances of Policies Derived From Policy 3.32. -
Shortage Rates

TC	3.32.	3.32.1	3.32.2	3.32.3	3.32.4	3.32.5
[TC1]	0.00	0.00	0.00	0.00	0.00	0.00
[TC2]	0.01	0.00	0.01	0.00	0.01	0.00
[TC3]	0.04	0.01	0.03	0.02	0.05	0.03
[TC4]	0.03	0.02	0.03	0.03	0.03	0.02
[TC5]	0.02	0.03	0.03	0.03	0.05	0.04
[TC6]	0.01	0.01	0.02	0.01	0.01	0.01
[TC7]	0.02	0.02	0.04	0.03	0.04	0.02
[TC8]	0.02	0.02	0.04	0.02	0.04	0.03
[TC9]	0.05	0.05	0.07	0.05	0.08	0.02
[TC10]	0.01	0.03	0.05	0.02	0.03	0.01
[TC11]	0.03	0.03	0.04	0.04	0.04	0.02
[TC12]	0.04	0.07	0.08	0.07	0.08	0.05
[TC13]	0.03	0.04	0.07	0.05	0.11	0.04
[TC14]	0.01	0.01	0.03	0.02	0.04	0.01
[TC15]	0.02	0.03	0.02	0.03	0.03	0.02
[TC16]	0.04	0.03	0.04	0.01	0.04	0.02
[TC17]	0.04	0.05	0.06	0.06	0.08	0.04
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.00	0.00	0.00	0.00	0.00	0.00
[TC20]	0.00	0.00	0.00	0.00	0.00	0.00
[TC21]	0.05	0.06	0.06	0.05	0.07	0.04
[TC22]	0.03	0.02	0.03	0.04	0.04	0.03
[TC23]	0.01	0.00	0.01	0.00	0.01	0.00
[TC24]	0.04	0.03	0.04	0.03	0.06	0.03
[TC25]	0.02	0.02	0.05	0.02	0.03	0.02
[TC26]	0.05	0.07	0.08	0.07	0.09	0.06
[TC27]	0.02	0.02	0.03	0.01	0.02	0.01
[TC28]	0.02	0.02	0.02	0.02	0.03	0.01
[TC29]	0.00	0.00	0.00	0.00	0.00	0.00
[TC30]	0.05	0.06	0.07	0.07	0.07	0.06
[TC31]	0.00	0.00	0.00	0.00	0.00	0.00
[TC32]	0.08	0.04	0.04	0.02	0.01	0.00
[TC33]	0.30	0.17	0.15	0.12	0.07	0.06
[TC34]	0.06	0.04	0.03	0.01	0.01	0.00
[TC35]	0.39	0.22	0.20	0.09	0.10	0.05
[TC36]	0.50	0.37	0.29	0.14	0.15	0.12
[TC37]	0.34	0.18	0.24	0.13	0.08	0.07
[TC38]	0.00	0.00	0.00	0.00	0.00	0.00
[TC39]	0.00	0.00	0.00	0.00	0.00	0.00
[TC40]	0.00	0.00	0.00	0.00	0.00	0.00
[TC41]	0.00	0.00	0.00	0.00	0.00	0.00
[TC42]	0.05	0.05	0.04	0.04	0.02	0.06
[TC43]	0.06	0.04	0.06	0.05	0.03	0.04
[TC44]	0.03	0.02	0.02	0.02	0.01	0.01
[TC45]	0.05	0.06	0.06	0.04	0.04	0.04
[TC46]	0.06	0.05	0.04	0.04	0.04	0.05
[TC47]	0.02	0.02	0.03	0.02	0.02	0.03
[TC48]	0.00	0.00	0.00	0.00	0.00	0.00
[TC49]	0.04	0.05	0.03	0.04	0.05	0.04
Mean	0.05	0.04	0.05	0.03	0.04	0.02
Median	0.03	0.02	0.03	0.02	0.03	0.02
Max	0.50	0.37	0.29	0.14	0.15	0.12
Min	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%25)	0.01	0.00	0.01	0.00	0.01	0.00
Percentile (%50)	0.03	0.02	0.03	0.02	0.03	0.02
Percentile (%75)	0.05	0.05	0.06	0.04	0.05	0.04
Percentile (%90)	0.07	0.07	0.08	0.07	0.08	0.06

Table E.40. Cities Performances and Performance of Region Including DCs and RBC of Group 4 Policies

Performance Measure	Inventory Level				Outdate Rate				Mismatch Rate				Shortage Rate			
	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall
3.32.3	3946.53	599.22	1580.48	6126.23	0.75	1.02	0.75	0.78	0.50	1.13	0.40	0.54	0.01	0.02	0.01	0.01
1	2562.81	408.65	1044.06	4015.52	0.58	0.98	0.67	0.65	0.68	1.68	0.55	0.76	0.02	0.22	0.01	0.04
2	2569.79	397.98	1049.51	4017.27	0.59	0.93	0.69	0.65	0.64	1.89	0.53	0.74	0.01	0.19	0.01	0.03
3	2553.31	403.95	1047.26	4004.52	0.59	0.94	0.69	0.65	0.66	1.85	0.55	0.75	0.02	0.17	0.01	0.03
4	2574.51	408.78	1045.47	4028.75	0.59	0.98	0.69	0.66	0.64	1.64	0.54	0.72	0.01	0.13	0.01	0.03
5	2560.07	406.69	1043.63	4010.38	0.59	0.99	0.67	0.65	0.67	1.75	0.54	0.75	0.01	0.18	0.01	0.03
6	2569.75	411.52	1047.51	4028.78	0.59	1.02	0.68	0.66	0.66	1.60	0.52	0.73	0.02	0.14	0.01	0.03
7	2565.20	403.27	1044.64	4013.11	0.58	0.98	0.67	0.65	0.65	1.80	0.53	0.74	0.02	0.18	0.01	0.03
8	2545.72	403.28	1046.24	3995.25	0.57	0.97	0.68	0.64	0.66	1.78	0.54	0.75	0.02	0.13	0.01	0.03
9	2554.66	407.12	1048.32	4010.10	0.59	1.05	0.67	0.66	0.65	1.70	0.52	0.73	0.02	0.16	0.01	0.03
10	2556.44	406.37	1046.38	4009.19	0.59	0.98	0.68	0.65	0.65	1.77	0.52	0.73	0.02	0.16	0.01	0.03
11	2572.32	409.60	1045.79	4027.72	0.59	0.99	0.67	0.65	0.66	1.62	0.55	0.73	0.01	0.16	0.01	0.03
12	2585.45	407.13	1048.20	4040.78	0.59	0.95	0.69	0.66	0.60	1.72	0.52	0.70	0.01	0.17	0.01	0.03
13	2552.09	403.80	1049.16	4005.05	0.57	0.98	0.68	0.64	0.70	1.66	0.53	0.76	0.02	0.13	0.01	0.03
14	2578.42	406.00	1049.15	4033.57	0.60	0.94	0.70	0.66	0.60	1.74	0.51	0.70	0.01	0.17	0.01	0.03
15	2560.03	407.08	1047.63	4014.73	0.58	0.97	0.68	0.64	0.67	1.66	0.51	0.73	0.02	0.16	0.01	0.03
16	2568.58	394.86	1047.79	4011.23	0.59	0.93	0.69	0.65	0.65	1.91	0.49	0.74	0.02	0.24	0.01	0.04
17	2557.15	403.96	1044.37	4005.49	0.58	0.96	0.68	0.65	0.66	1.81	0.53	0.75	0.02	0.20	0.01	0.04
18	2556.03	399.93	1044.97	4000.93	0.58	0.96	0.70	0.65	0.68	1.76	0.52	0.75	0.02	0.19	0.01	0.04
19	2567.66	408.07	1048.38	4024.11	0.59	1.02	0.67	0.65	0.66	1.66	0.51	0.73	0.02	0.17	0.01	0.03
20	2539.67	397.73	1044.40	3981.80	0.58	0.91	0.69	0.65	0.71	1.83	0.57	0.79	0.02	0.22	0.01	0.04
21	2564.71	402.98	1048.43	4016.12	0.59	1.04	0.70	0.66	0.66	1.77	0.50	0.74	0.01	0.17	0.01	0.03
22	2883.45	431.44	1172.28	4487.17	0.62	0.87	0.71	0.67	0.60	1.81	0.50	0.70	0.01	0.14	0.01	0.03
23	2899.14	435.02	1170.71	4504.86	0.61	0.87	0.70	0.66	0.62	1.71	0.48	0.70	0.01	0.14	0.01	0.03
24	2912.63	434.41	1172.79	4519.83	0.63	0.87	0.70	0.67	0.55	1.76	0.46	0.66	0.02	0.13	0.01	0.03
25	2907.19	424.90	1172.62	4504.72	0.62	0.84	0.71	0.67	0.57	1.84	0.47	0.68	0.01	0.17	0.01	0.03
26	2571.30	405.43	1046.13	4022.87	0.59	0.98	0.66	0.65	0.65	1.69	0.53	0.73	0.01	0.21	0.01	0.03
27	2884.64	435.80	1170.81	4491.26	0.61	0.88	0.69	0.66	0.61	1.65	0.49	0.69	0.01	0.11	0.01	0.02
28	2884.78	424.00	1173.54	4482.33	0.62	0.84	0.70	0.66	0.61	2.00	0.46	0.72	0.01	0.25	0.01	0.04
29	2902.97	429.41	1174.69	4507.07	0.62	0.89	0.72	0.67	0.57	1.76	0.45	0.67	0.01	0.18	0.01	0.03
30	2912.45	428.38	1172.47	4513.30	0.63	0.90	0.70	0.68	0.55	1.75	0.48	0.66	0.01	0.13	0.01	0.02
31	2898.75	432.99	1173.47	4505.21	0.62	0.90	0.72	0.67	0.59	1.71	0.44	0.67	0.02	0.13	0.01	0.03
32	2906.11	431.06	1172.95	4510.12	0.62	0.84	0.72	0.67	0.58	1.79	0.48	0.68	0.01	0.14	0.01	0.02
33	2898.11	432.00	1173.52	4503.63	0.62	0.81	0.71	0.66	0.60	1.69	0.47	0.69	0.01	0.10	0.01	0.02
34	2891.54	435.20	1172.40	4499.14	0.61	0.86	0.71	0.66	0.61	1.81	0.47	0.70	0.01	0.14	0.01	0.03
35	2901.12	440.28	1172.75	4514.15	0.62	0.87	0.69	0.67	0.57	1.66	0.48	0.67	0.02	0.13	0.01	0.03
36	2898.23	435.20	1170.83	4504.27	0.62	0.89	0.71	0.67	0.59	1.74	0.46	0.68	0.01	0.15	0.01	0.03
37	2887.96	435.54	1170.21	4493.71	0.62	0.86	0.70	0.66	0.60	1.65	0.47	0.68	0.01	0.13	0.01	0.02
38	2911.83	433.57	1175.34	4520.74	0.63	0.88	0.71	0.67	0.59	1.70	0.47	0.68	0.01	0.15	0.01	0.03
39	2884.34	433.40	1173.82	4491.56	0.61	0.88	0.71	0.67	0.63	1.74	0.47	0.70	0.01	0.17	0.01	0.03
40	2567.66	408.07	1048.38	4024.11	0.59	1.02	0.67	0.65	0.66	1.66	0.51	0.73	0.02	0.17	0.01	0.03
41	2913.02	432.52	1175.48	4521.02	0.61	0.85	0.72	0.66	0.59	1.76	0.47	0.69	0.01	0.13	0.01	0.03
42	2908.70	435.34	1175.69	4519.73	0.62	0.92	0.72	0.67	0.58	1.72	0.46	0.67	0.02	0.16	0.01	0.03
43	3236.13	488.39	1306.48	5031.00	0.65	0.89	0.74	0.70	0.57	1.48	0.43	0.63	0.01	0.08	0.01	0.02
44	3237.52	482.78	1306.23	5026.52	0.66	0.88	0.75	0.70	0.58	1.59	0.44	0.65	0.01	0.10	0.01	0.02
45	3229.20	486.15	1306.98	5022.33	0.64	0.86	0.73	0.69	0.61	1.51	0.42	0.66	0.01	0.10	0.01	0.02
46	3238.80	486.28	1305.78	5030.87	0.66	0.89	0.74	0.70	0.57	1.52	0.44	0.64	0.01	0.07	0.01	0.02

Table E.40. (Continued)

47	3250.23	494.75	1304.31	5049.28	0.66	0.89	0.73	0.70	0.56	1.44	0.43	0.62	0.01	0.05	0.01	0.02
48	3254.38	493.45	1305.55	5053.38	0.65	0.91	0.73	0.70	0.53	1.47	0.43	0.61	0.01	0.07	0.01	0.02
49	3246.86	483.99	1306.91	5037.77	0.66	0.91	0.74	0.70	0.56	1.54	0.42	0.63	0.01	0.10	0.01	0.02
50	3219.75	479.69	1304.23	5003.67	0.64	0.93	0.74	0.70	0.59	1.57	0.43	0.66	0.01	0.13	0.01	0.02
51	3239.61	489.79	1301.67	5031.07	0.65	0.94	0.72	0.70	0.57	1.41	0.46	0.63	0.01	0.07	0.01	0.02
52	3225.53	480.71	1304.13	5010.38	0.65	0.89	0.73	0.70	0.59	1.64	0.43	0.66	0.01	0.15	0.01	0.03
53	3238.38	488.99	1305.82	5033.19	0.66	0.90	0.73	0.70	0.57	1.44	0.45	0.63	0.01	0.08	0.01	0.02
54	3251.92	487.84	1306.82	5046.58	0.65	0.93	0.74	0.70	0.55	1.45	0.41	0.61	0.01	0.10	0.01	0.02
55	3253.24	481.20	1308.67	5043.10	0.65	0.90	0.74	0.70	0.55	1.63	0.40	0.63	0.01	0.12	0.01	0.02
56	3242.90	488.34	1305.62	5036.86	0.65	0.88	0.74	0.70	0.57	1.49	0.44	0.63	0.01	0.07	0.01	0.02
57	3228.22	479.91	1307.77	5015.90	0.66	0.89	0.75	0.70	0.55	1.63	0.41	0.63	0.01	0.14	0.01	0.02
58	3224.65	491.32	1305.77	5021.75	0.65	0.91	0.75	0.70	0.58	1.51	0.43	0.64	0.01	0.12	0.01	0.02
59	3249.18	492.89	1308.02	5050.08	0.65	0.92	0.74	0.70	0.57	1.42	0.41	0.62	0.01	0.08	0.01	0.02
60	3255.69	486.07	1308.12	5049.88	0.65	0.90	0.73	0.70	0.56	1.43	0.42	0.62	0.01	0.09	0.01	0.02
61	3263.58	497.43	1306.45	5067.45	0.66	0.94	0.74	0.71	0.52	1.34	0.43	0.58	0.01	0.07	0.01	0.02
62	3252.80	483.12	1304.11	5040.03	0.66	0.89	0.72	0.70	0.55	1.57	0.43	0.63	0.01	0.08	0.01	0.02
63	3244.95	482.17	1306.68	5033.80	0.66	0.91	0.75	0.71	0.58	1.58	0.41	0.65	0.01	0.09	0.01	0.02
64	3598.50	545.92	1444.79	5589.22	0.70	0.94	0.77	0.74	0.53	1.35	0.38	0.58	0.01	0.06	0.01	0.02
65	3590.08	534.66	1444.25	5568.98	0.69	0.92	0.78	0.74	0.55	1.38	0.39	0.60	0.01	0.05	0.01	0.01
66	3575.86	536.07	1444.79	5556.72	0.69	0.90	0.77	0.73	0.56	1.43	0.40	0.61	0.01	0.05	0.01	0.01
67	3601.65	538.82	1442.58	5583.06	0.69	0.94	0.77	0.73	0.54	1.33	0.39	0.59	0.02	0.05	0.01	0.02
68	3595.07	545.03	1441.18	5581.28	0.69	0.91	0.74	0.73	0.53	1.26	0.41	0.57	0.01	0.04	0.01	0.01
69	3596.04	537.18	1445.24	5578.46	0.69	0.92	0.77	0.73	0.56	1.48	0.39	0.62	0.01	0.06	0.01	0.02
70	3586.83	532.22	1443.84	5562.89	0.69	0.92	0.77	0.74	0.53	1.52	0.39	0.60	0.01	0.12	0.01	0.02
71	3601.03	539.12	1442.79	5582.94	0.69	0.96	0.77	0.74	0.53	1.32	0.39	0.58	0.01	0.05	0.01	0.01
72	3593.74	539.87	1443.35	5576.95	0.69	0.94	0.78	0.74	0.53	1.28	0.41	0.58	0.01	0.05	0.01	0.02
73	3599.52	542.23	1444.16	5585.91	0.69	0.97	0.77	0.74	0.56	1.31	0.41	0.60	0.01	0.06	0.01	0.01
74	3564.92	534.68	1447.51	5547.11	0.69	0.91	0.78	0.73	0.56	1.39	0.37	0.60	0.01	0.09	0.01	0.02
75	3599.48	536.70	1440.64	5576.83	0.69	0.92	0.77	0.73	0.54	1.31	0.42	0.59	0.01	0.05	0.01	0.01
76	3600.17	537.31	1444.73	5582.21	0.69	0.95	0.78	0.74	0.56	1.39	0.37	0.60	0.02	0.07	0.01	0.02
77	3584.23	544.74	1440.60	5569.57	0.69	0.92	0.76	0.73	0.56	1.33	0.40	0.60	0.01	0.05	0.01	0.01
78	3587.86	533.19	1442.92	5563.97	0.68	0.90	0.77	0.72	0.55	1.44	0.39	0.61	0.01	0.08	0.01	0.02
79	3596.04	531.80	1440.64	5568.48	0.69	0.93	0.74	0.73	0.55	1.41	0.41	0.60	0.01	0.06	0.01	0.01
80	3584.72	533.96	1441.87	5560.55	0.69	0.94	0.76	0.74	0.55	1.40	0.41	0.61	0.01	0.08	0.01	0.02
81	3594.59	534.99	1445.33	5574.91	0.69	0.90	0.79	0.74	0.55	1.47	0.40	0.61	0.01	0.08	0.01	0.02
82	3570.94	539.28	1444.09	5554.30	0.69	0.94	0.78	0.74	0.54	1.35	0.39	0.59	0.01	0.07	0.01	0.02
83	3583.95	540.11	1440.71	5564.77	0.69	0.93	0.77	0.74	0.56	1.31	0.40	0.60	0.02	0.04	0.01	0.02
84	3618.19	529.97	1447.47	5595.63	0.71	0.89	0.79	0.75	0.52	1.47	0.38	0.59	0.01	0.08	0.01	0.02
85	3922.63	593.70	1578.96	6095.29	0.74	0.96	0.74	0.77	0.51	1.25	0.41	0.57	0.01	0.04	0.01	0.01
86	3945.54	587.46	1579.78	6112.78	0.75	0.95	0.73	0.77	0.49	1.39	0.42	0.57	0.01	0.08	0.01	0.02
87	3947.13	589.78	1574.32	6111.24	0.75	0.95	0.74	0.77	0.50	1.28	0.42	0.56	0.01	0.05	0.01	0.02
88	3938.92	602.62	1580.50	6122.04	0.75	0.99	0.75	0.77	0.51	1.18	0.40	0.56	0.01	0.03	0.01	0.01
89	3951.80	589.47	1578.95	6120.22	0.75	0.94	0.74	0.77	0.52	1.27	0.41	0.57	0.01	0.07	0.01	0.02
90	3959.13	577.67	1578.42	6115.21	0.74	0.96	0.73	0.76	0.50	1.26	0.44	0.57	0.01	0.09	0.01	0.02
91	3966.58	594.37	1582.97	6143.93	0.75	0.93	0.73	0.77	0.48	1.29	0.41	0.55	0.01	0.05	0.01	0.01
92	3943.78	589.26	1578.44	6111.48	0.74	1.00	0.73	0.77	0.52	1.27	0.43	0.58	0.01	0.05	0.01	0.01
93	3944.70	592.77	1580.06	6117.54	0.75	0.99	0.75	0.78	0.50	1.20	0.44	0.56	0.01	0.05	0.01	0.01
94	3946.85	594.84	1578.90	6120.59	0.75	1.01	0.74	0.77	0.51	1.21	0.44	0.56	0.01	0.03	0.01	0.01
95	3958.76	597.90	1582.88	6139.53	0.76	0.93	0.75	0.77	0.49	1.25	0.41	0.55	0.02	0.05	0.01	0.02

Table E.40. (Continued)

96	3923.11	593.36	1574.96	6091.44	0.74	0.99	0.74	0.76	0.51	1.20	0.43	0.57	0.01	0.04	0.01	0.01
97	3947.91	592.68	1579.29	6119.87	0.75	0.95	0.74	0.77	0.50	1.29	0.42	0.56	0.01	0.04	0.01	0.01
98	3963.25	586.57	1575.85	6125.68	0.76	0.95	0.73	0.77	0.49	1.29	0.44	0.56	0.01	0.06	0.01	0.02
99	3955.51	590.43	1576.89	6122.83	0.75	0.95	0.74	0.77	0.51	1.22	0.42	0.56	0.01	0.04	0.01	0.01
100	3951.76	587.60	1580.74	6120.10	0.75	0.99	0.75	0.78	0.51	1.25	0.40	0.56	0.01	0.05	0.01	0.01
101	3935.51	594.23	1578.21	6107.95	0.75	0.97	0.75	0.77	0.53	1.20	0.39	0.56	0.01	0.03	0.01	0.01
102	3952.28	588.29	1573.94	6114.52	0.75	0.96	0.74	0.77	0.50	1.26	0.44	0.57	0.01	0.04	0.01	0.01
103	3943.47	579.85	1579.65	6102.96	0.75	0.92	0.74	0.77	0.49	1.38	0.42	0.57	0.01	0.07	0.01	0.02
104	3945.55	590.89	1577.60	6114.04	0.74	0.97	0.74	0.77	0.50	1.26	0.44	0.57	0.01	0.04	0.01	0.01
105	3936.50	602.21	1578.72	6117.44	0.75	1.00	0.76	0.78	0.50	1.10	0.40	0.54	0.01	0.04	0.01	0.01

Table E.41. Delivery Performance Measures of Group 4 Policies

Performance Measure	Inventory Level				Outdate Rate				Mismatch Rate				Shortage Rate			
	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall
3.32.3	3946.53	599.22	1580.48	6126.23	0.75	1.02	0.75	0.78	0.50	1.13	0.40	0.54	0.01	0.02	0.01	0.01
1	2562.81	408.65	1044.06	4015.52	0.58	0.98	0.67	0.65	0.68	1.68	0.55	0.76	0.02	0.22	0.01	0.04
2	2569.79	397.98	1049.51	4017.27	0.59	0.93	0.69	0.65	0.64	1.89	0.53	0.74	0.01	0.19	0.01	0.03
3	2553.31	403.95	1047.26	4004.52	0.59	0.94	0.69	0.65	0.66	1.85	0.55	0.75	0.02	0.17	0.01	0.03
4	2574.51	408.78	1045.47	4028.75	0.59	0.98	0.69	0.66	0.64	1.64	0.54	0.72	0.01	0.13	0.01	0.03
5	2560.07	406.69	1043.63	4010.38	0.59	0.99	0.67	0.65	0.67	1.75	0.54	0.75	0.01	0.18	0.01	0.03
6	2569.75	411.52	1047.51	4028.78	0.59	1.02	0.68	0.66	0.66	1.60	0.52	0.73	0.02	0.14	0.01	0.03
7	2565.20	403.27	1044.64	4013.11	0.58	0.98	0.67	0.65	0.65	1.80	0.53	0.74	0.02	0.18	0.01	0.03
8	2545.72	403.28	1046.24	3995.25	0.57	0.97	0.68	0.64	0.66	1.78	0.54	0.75	0.02	0.13	0.01	0.03
9	2554.66	407.12	1048.32	4010.10	0.59	1.05	0.67	0.66	0.65	1.70	0.52	0.73	0.02	0.16	0.01	0.03
10	2556.44	406.37	1046.38	4009.19	0.59	0.98	0.68	0.65	0.65	1.77	0.52	0.73	0.02	0.16	0.01	0.03
11	2572.32	409.60	1045.79	4027.72	0.59	0.99	0.67	0.65	0.66	1.62	0.55	0.73	0.01	0.16	0.01	0.03
12	2585.45	407.13	1048.20	4040.78	0.59	0.95	0.69	0.66	0.60	1.72	0.52	0.70	0.01	0.17	0.01	0.03
13	2552.09	403.80	1049.16	4005.05	0.57	0.98	0.68	0.64	0.70	1.66	0.53	0.76	0.02	0.13	0.01	0.03
14	2578.42	406.00	1049.15	4033.57	0.60	0.94	0.70	0.66	0.60	1.74	0.51	0.70	0.01	0.17	0.01	0.03
15	2560.03	407.08	1047.63	4014.73	0.58	0.97	0.68	0.64	0.67	1.66	0.51	0.73	0.02	0.16	0.01	0.03
16	2568.58	394.86	1047.79	4011.23	0.59	0.93	0.69	0.65	0.65	1.91	0.49	0.74	0.02	0.24	0.01	0.04
17	2557.15	403.96	1044.37	4005.49	0.58	0.96	0.68	0.65	0.66	1.81	0.53	0.75	0.02	0.20	0.01	0.04
18	2556.03	399.93	1044.97	4000.93	0.58	0.96	0.70	0.65	0.68	1.76	0.52	0.75	0.02	0.19	0.01	0.04
19	2567.66	408.07	1048.38	4024.11	0.59	1.02	0.67	0.65	0.66	1.66	0.51	0.73	0.02	0.17	0.01	0.03
20	2539.67	397.73	1044.40	3981.80	0.58	0.91	0.69	0.65	0.71	1.83	0.57	0.79	0.02	0.22	0.01	0.04
21	2564.71	402.98	1048.43	4016.12	0.59	1.04	0.70	0.66	0.66	1.77	0.50	0.74	0.01	0.17	0.01	0.03
22	2883.45	431.44	1172.28	4487.17	0.62	0.87	0.71	0.67	0.60	1.81	0.50	0.70	0.01	0.14	0.01	0.03
23	2899.14	435.02	1170.71	4504.86	0.61	0.87	0.70	0.66	0.62	1.71	0.48	0.70	0.01	0.14	0.01	0.03
24	2912.63	434.41	1172.79	4519.83	0.63	0.87	0.70	0.67	0.55	1.76	0.46	0.66	0.02	0.13	0.01	0.03
25	2907.19	424.90	1172.62	4504.72	0.62	0.84	0.71	0.67	0.57	1.84	0.47	0.68	0.01	0.17	0.01	0.03
26	2571.30	405.43	1046.13	4022.87	0.59	0.98	0.66	0.65	0.65	1.69	0.53	0.73	0.01	0.21	0.01	0.03
27	2884.64	435.80	1170.81	4491.26	0.61	0.88	0.69	0.66	0.61	1.65	0.49	0.69	0.01	0.11	0.01	0.02
28	2884.78	424.00	1173.54	4482.33	0.62	0.84	0.70	0.66	0.61	2.00	0.46	0.72	0.01	0.25	0.01	0.04
29	2902.97	429.41	1174.69	4507.07	0.62	0.89	0.72	0.67	0.57	1.76	0.45	0.67	0.01	0.18	0.01	0.03
30	2912.45	428.38	1172.47	4513.30	0.63	0.90	0.70	0.68	0.55	1.75	0.48	0.66	0.01	0.13	0.01	0.02
31	2898.75	432.99	1173.47	4505.21	0.62	0.90	0.72	0.67	0.59	1.71	0.44	0.67	0.02	0.13	0.01	0.03
32	2906.11	431.06	1172.95	4510.12	0.62	0.84	0.72	0.67	0.58	1.79	0.48	0.68	0.01	0.14	0.01	0.02
33	2898.11	432.00	1173.52	4503.63	0.62	0.81	0.71	0.66	0.60	1.69	0.47	0.69	0.01	0.10	0.01	0.02
34	2891.54	435.20	1172.40	4499.14	0.61	0.86	0.71	0.66	0.61	1.81	0.47	0.70	0.01	0.14	0.01	0.03
35	2901.12	440.28	1172.75	4514.15	0.62	0.87	0.69	0.67	0.57	1.66	0.48	0.67	0.02	0.13	0.01	0.03
36	2898.23	435.20	1170.83	4504.27	0.62	0.89	0.71	0.67	0.59	1.74	0.46	0.68	0.01	0.15	0.01	0.03
37	2887.96	435.54	1170.21	4493.71	0.62	0.86	0.70	0.66	0.60	1.65	0.47	0.68	0.01	0.13	0.01	0.02
38	2911.83	433.57	1175.34	4520.74	0.63	0.88	0.71	0.67	0.59	1.70	0.47	0.68	0.01	0.15	0.01	0.03
39	2884.34	433.40	1173.82	4491.56	0.61	0.88	0.71	0.67	0.63	1.74	0.47	0.70	0.01	0.17	0.01	0.03
40	2567.66	408.07	1048.38	4024.11	0.59	1.02	0.67	0.65	0.66	1.66	0.51	0.73	0.02	0.17	0.01	0.03
41	2913.02	432.52	1175.48	4521.02	0.61	0.85	0.72	0.66	0.59	1.76	0.47	0.69	0.01	0.13	0.01	0.03
42	2908.70	435.34	1175.69	4519.73	0.62	0.92	0.72	0.67	0.58	1.72	0.46	0.67	0.02	0.16	0.01	0.03
43	3236.13	488.39	1306.48	5031.00	0.65	0.89	0.74	0.70	0.57	1.48	0.43	0.63	0.01	0.08	0.01	0.02
44	3237.52	482.78	1306.23	5026.52	0.66	0.88	0.75	0.70	0.58	1.59	0.44	0.65	0.01	0.10	0.01	0.02
45	3229.20	486.15	1306.98	5022.33	0.64	0.86	0.73	0.69	0.61	1.51	0.42	0.66	0.01	0.10	0.01	0.02
46	3238.80	486.28	1305.78	5030.87	0.66	0.89	0.74	0.70	0.57	1.52	0.44	0.64	0.01	0.07	0.01	0.02

Table E.41. (Continued)

47	3250.23	494.75	1304.31	5049.28	0.66	0.89	0.73	0.70	0.56	1.44	0.43	0.62	0.01	0.05	0.01	0.02
48	3254.38	493.45	1305.55	5053.38	0.65	0.91	0.73	0.70	0.53	1.47	0.43	0.61	0.01	0.07	0.01	0.02
49	3246.86	483.99	1306.91	5037.77	0.66	0.91	0.74	0.70	0.56	1.54	0.42	0.63	0.01	0.10	0.01	0.02
50	3219.75	479.69	1304.23	5003.67	0.64	0.93	0.74	0.70	0.59	1.57	0.43	0.66	0.01	0.13	0.01	0.02
51	3239.61	489.79	1301.67	5031.07	0.65	0.94	0.72	0.70	0.57	1.41	0.46	0.63	0.01	0.07	0.01	0.02
52	3225.53	480.71	1304.13	5010.38	0.65	0.89	0.73	0.70	0.59	1.64	0.43	0.66	0.01	0.15	0.01	0.03
53	3238.38	488.99	1305.82	5033.19	0.66	0.90	0.73	0.70	0.57	1.44	0.45	0.63	0.01	0.08	0.01	0.02
54	3251.92	487.84	1306.82	5046.58	0.65	0.93	0.74	0.70	0.55	1.45	0.41	0.61	0.01	0.10	0.01	0.02
55	3253.24	481.20	1308.67	5043.10	0.65	0.90	0.74	0.70	0.55	1.63	0.40	0.63	0.01	0.12	0.01	0.02
56	3242.90	488.34	1305.62	5036.86	0.65	0.88	0.74	0.70	0.57	1.49	0.44	0.63	0.01	0.07	0.01	0.02
57	3228.22	479.91	1307.77	5015.90	0.66	0.89	0.75	0.70	0.55	1.63	0.41	0.63	0.01	0.14	0.01	0.02
58	3224.65	491.32	1305.77	5021.75	0.65	0.91	0.75	0.70	0.58	1.51	0.43	0.64	0.01	0.12	0.01	0.02
59	3249.18	492.89	1308.02	5050.08	0.65	0.92	0.74	0.70	0.57	1.42	0.41	0.62	0.01	0.08	0.01	0.02
60	3255.69	486.07	1308.12	5049.88	0.65	0.90	0.73	0.70	0.56	1.43	0.42	0.62	0.01	0.09	0.01	0.02
61	3263.58	497.43	1306.45	5067.45	0.66	0.94	0.74	0.71	0.52	1.34	0.43	0.58	0.01	0.07	0.01	0.02
62	3252.80	483.12	1304.11	5040.03	0.66	0.89	0.72	0.70	0.55	1.57	0.43	0.63	0.01	0.08	0.01	0.02
63	3244.95	482.17	1306.68	5033.80	0.66	0.91	0.75	0.71	0.58	1.58	0.41	0.65	0.01	0.09	0.01	0.02
64	3598.50	545.92	1444.79	5589.22	0.70	0.94	0.77	0.74	0.53	1.35	0.38	0.58	0.01	0.06	0.01	0.02
65	3590.08	534.66	1444.25	5568.98	0.69	0.92	0.78	0.74	0.55	1.38	0.39	0.60	0.01	0.05	0.01	0.01
66	3575.86	536.07	1444.79	5556.72	0.69	0.90	0.77	0.73	0.56	1.43	0.40	0.61	0.01	0.05	0.01	0.01
67	3601.65	538.82	1442.58	5583.06	0.69	0.94	0.77	0.73	0.54	1.33	0.39	0.59	0.02	0.05	0.01	0.02
68	3595.07	545.03	1441.18	5581.28	0.69	0.91	0.74	0.73	0.53	1.26	0.41	0.57	0.01	0.04	0.01	0.01
69	3596.04	537.18	1445.24	5578.46	0.69	0.92	0.77	0.73	0.56	1.48	0.39	0.62	0.01	0.06	0.01	0.02
70	3586.83	532.22	1443.84	5562.89	0.69	0.92	0.77	0.74	0.53	1.52	0.39	0.60	0.01	0.12	0.01	0.02
71	3601.03	539.12	1442.79	5582.94	0.69	0.96	0.77	0.74	0.53	1.32	0.39	0.58	0.01	0.05	0.01	0.01
72	3593.74	539.87	1443.35	5576.95	0.69	0.94	0.78	0.74	0.53	1.28	0.41	0.58	0.01	0.05	0.01	0.02
73	3599.52	542.23	1444.16	5585.91	0.69	0.97	0.77	0.74	0.56	1.31	0.41	0.60	0.01	0.06	0.01	0.01
74	3564.92	534.68	1447.51	5547.11	0.69	0.91	0.78	0.73	0.56	1.39	0.37	0.60	0.01	0.09	0.01	0.02
75	3599.48	536.70	1440.64	5576.83	0.69	0.92	0.77	0.73	0.54	1.31	0.42	0.59	0.01	0.05	0.01	0.01
76	3600.17	537.31	1444.73	5582.21	0.69	0.95	0.78	0.74	0.56	1.39	0.37	0.60	0.02	0.07	0.01	0.02
77	3584.23	544.74	1440.60	5569.57	0.69	0.92	0.76	0.73	0.56	1.33	0.40	0.60	0.01	0.05	0.01	0.01
78	3587.86	533.19	1442.92	5563.97	0.68	0.90	0.77	0.72	0.55	1.44	0.39	0.61	0.01	0.08	0.01	0.02
79	3596.04	531.80	1440.64	5568.48	0.69	0.93	0.74	0.73	0.55	1.41	0.41	0.60	0.01	0.06	0.01	0.01
80	3584.72	533.96	1441.87	5560.55	0.69	0.94	0.76	0.74	0.55	1.40	0.41	0.61	0.01	0.08	0.01	0.02
81	3594.59	534.99	1445.33	5574.91	0.69	0.90	0.79	0.74	0.55	1.47	0.40	0.61	0.01	0.08	0.01	0.02
82	3570.94	539.28	1444.09	5554.30	0.69	0.94	0.78	0.74	0.54	1.35	0.39	0.59	0.01	0.07	0.01	0.02
83	3583.95	540.11	1440.71	5564.77	0.69	0.93	0.77	0.74	0.56	1.31	0.40	0.60	0.02	0.04	0.01	0.02
84	3618.19	529.97	1447.47	5595.63	0.71	0.89	0.79	0.75	0.52	1.47	0.38	0.59	0.01	0.08	0.01	0.02
85	3922.63	593.70	1578.96	6095.29	0.74	0.96	0.74	0.77	0.51	1.25	0.41	0.57	0.01	0.04	0.01	0.01
86	3945.54	587.46	1579.78	6112.78	0.75	0.95	0.73	0.77	0.49	1.39	0.42	0.57	0.01	0.08	0.01	0.02
87	3947.13	589.78	1574.32	6111.24	0.75	0.95	0.74	0.77	0.50	1.28	0.42	0.56	0.01	0.05	0.01	0.02
88	3938.92	602.62	1580.50	6122.04	0.75	0.99	0.75	0.77	0.51	1.18	0.40	0.56	0.01	0.03	0.01	0.01
89	3951.80	589.47	1578.95	6120.22	0.75	0.94	0.74	0.77	0.52	1.27	0.41	0.57	0.01	0.07	0.01	0.02
90	3959.13	577.67	1578.42	6115.21	0.74	0.96	0.73	0.76	0.50	1.26	0.44	0.57	0.01	0.09	0.01	0.02
91	3966.58	594.37	1582.97	6143.93	0.75	0.93	0.73	0.77	0.48	1.29	0.41	0.55	0.01	0.05	0.01	0.01
92	3943.78	589.26	1578.44	6111.48	0.74	1.00	0.73	0.77	0.52	1.27	0.43	0.58	0.01	0.05	0.01	0.01
93	3944.70	592.77	1580.06	6117.54	0.75	0.99	0.75	0.78	0.50	1.20	0.44	0.56	0.01	0.05	0.01	0.01
94	3946.85	594.84	1578.90	6120.59	0.75	1.01	0.74	0.77	0.51	1.21	0.44	0.56	0.01	0.03	0.01	0.01
95	3958.76	597.90	1582.88	6139.53	0.76	0.93	0.75	0.77	0.49	1.25	0.41	0.55	0.02	0.05	0.01	0.02

Table E.41. (Continued)

96	3923.11	593.36	1574.96	6091.44	0.74	0.99	0.74	0.76	0.51	1.20	0.43	0.57	0.01	0.04	0.01	0.01
97	3947.91	592.68	1579.29	6119.87	0.75	0.95	0.74	0.77	0.50	1.29	0.42	0.56	0.01	0.04	0.01	0.01
98	3963.25	586.57	1575.85	6125.68	0.76	0.95	0.73	0.77	0.49	1.29	0.44	0.56	0.01	0.06	0.01	0.02
99	3955.51	590.43	1576.89	6122.83	0.75	0.95	0.74	0.77	0.51	1.22	0.42	0.56	0.01	0.04	0.01	0.01
100	3951.76	587.60	1580.74	6120.10	0.75	0.99	0.75	0.78	0.51	1.25	0.40	0.56	0.01	0.05	0.01	0.01
101	3935.51	594.23	1578.21	6107.95	0.75	0.97	0.75	0.77	0.53	1.20	0.39	0.56	0.01	0.03	0.01	0.01
102	3952.28	588.29	1573.94	6114.52	0.75	0.96	0.74	0.77	0.50	1.26	0.44	0.57	0.01	0.04	0.01	0.01
103	3943.47	579.85	1579.65	6102.96	0.75	0.92	0.74	0.77	0.49	1.38	0.42	0.57	0.01	0.07	0.01	0.02
104	3945.55	590.89	1577.60	6114.04	0.74	0.97	0.74	0.77	0.50	1.26	0.44	0.57	0.01	0.04	0.01	0.01
105	3936.50	602.21	1578.72	6117.44	0.75	1.00	0.76	0.78	0.50	1.10	0.40	0.54	0.01	0.04	0.01	0.01

Table E.42. Selection Criterion Performance of Group 4 Policies

Performance Measure	Outdate Rate			Mismatch Rate			Shortage Rate			Selection Criterion Performance
Case	Region Including Dcs and RBC	Region Excluding DCs And RBC	Single TCs' Means	Region Including DCs and RBC	Region Excluding DCs And RBC	Single TCs' Means	Region Including DCs and RBC	Region Excluding DCs And RBC	Single TCs' Means	
3.32.3	0.78	0.78	1.73	0.54	0.54	0.80	0.01	0.01	0.03	1.33
1	0.65	0.64	1.42	0.76	0.76	1.12	0.04	0.04	0.07	1.44
2	0.65	0.65	1.44	0.74	0.74	1.11	0.03	0.03	0.07	1.43
3	0.65	0.64	1.43	0.75	0.75	1.12	0.03	0.03	0.06	1.43
4	0.66	0.65	1.44	0.72	0.72	1.07	0.03	0.03	0.05	1.40
5	0.65	0.64	1.42	0.75	0.75	1.12	0.03	0.03	0.06	1.43
6	0.66	0.64	1.43	0.73	0.73	1.07	0.03	0.03	0.06	1.41
7	0.65	0.63	1.41	0.74	0.74	1.10	0.03	0.03	0.06	1.42
8	0.64	0.63	1.39	0.75	0.75	1.11	0.03	0.03	0.05	1.42
9	0.66	0.64	1.42	0.73	0.73	1.09	0.03	0.03	0.06	1.42
10	0.65	0.63	1.41	0.73	0.73	1.09	0.03	0.03	0.06	1.42
11	0.65	0.65	1.44	0.73	0.73	1.08	0.03	0.03	0.06	1.41
12	0.66	0.65	1.45	0.70	0.70	1.04	0.03	0.03	0.06	1.39
13	0.64	0.64	1.43	0.76	0.76	1.13	0.03	0.03	0.06	1.43
14	0.66	0.65	1.45	0.70	0.70	1.04	0.03	0.03	0.06	1.39
15	0.64	0.64	1.42	0.73	0.73	1.10	0.03	0.03	0.06	1.41
16	0.65	0.64	1.42	0.74	0.74	1.10	0.04	0.04	0.09	1.43
17	0.65	0.64	1.41	0.75	0.75	1.12	0.04	0.04	0.08	1.43
18	0.65	0.64	1.41	0.75	0.75	1.12	0.04	0.04	0.07	1.44
19	0.65	0.64	1.41	0.73	0.73	1.08	0.03	0.03	0.06	1.42
20	0.65	0.63	1.40	0.79	0.79	1.17	0.04	0.04	0.08	1.48
21	0.66	0.64	1.41	0.74	0.74	1.10	0.03	0.03	0.06	1.43
22	0.67	0.67	1.48	0.70	0.70	1.04	0.03	0.03	0.05	1.40
23	0.66	0.66	1.46	0.70	0.70	1.03	0.03	0.03	0.05	1.39
24	0.67	0.67	1.49	0.66	0.66	0.97	0.03	0.03	0.06	1.35
25	0.67	0.66	1.47	0.68	0.68	1.00	0.03	0.03	0.05	1.37
26	0.65	0.64	1.42	0.73	0.73	1.09	0.03	0.03	0.07	1.41
27	0.66	0.66	1.45	0.69	0.69	1.01	0.02	0.02	0.05	1.37
28	0.66	0.66	1.45	0.72	0.72	1.06	0.04	0.04	0.07	1.42
29	0.67	0.66	1.47	0.67	0.67	1.00	0.03	0.03	0.06	1.37
30	0.68	0.67	1.48	0.66	0.66	0.98	0.02	0.02	0.05	1.36
31	0.67	0.66	1.46	0.67	0.67	0.99	0.03	0.03	0.06	1.37
32	0.67	0.67	1.48	0.68	0.68	1.01	0.02	0.02	0.05	1.38
33	0.66	0.66	1.47	0.69	0.69	1.02	0.02	0.02	0.05	1.37
34	0.66	0.66	1.47	0.70	0.70	1.04	0.03	0.03	0.05	1.39
35	0.67	0.66	1.48	0.67	0.67	0.98	0.03	0.03	0.05	1.36
36	0.67	0.67	1.48	0.68	0.68	1.01	0.03	0.03	0.05	1.38
37	0.66	0.66	1.46	0.68	0.68	1.02	0.02	0.02	0.05	1.37
38	0.67	0.67	1.48	0.68	0.68	1.00	0.03	0.03	0.05	1.38
39	0.67	0.66	1.46	0.70	0.70	1.03	0.03	0.03	0.06	1.40
40	0.65	0.64	1.41	0.73	0.73	1.08	0.03	0.03	0.06	1.42
41	0.66	0.65	1.45	0.69	0.69	1.01	0.03	0.03	0.05	1.37
42	0.67	0.66	1.46	0.67	0.67	0.98	0.03	0.03	0.06	1.37
43	0.70	0.70	1.54	0.63	0.63	0.93	0.02	0.02	0.04	1.35
44	0.70	0.70	1.56	0.65	0.65	0.96	0.02	0.02	0.04	1.38

Table E.42. (Continued)

45	0.69	0.68	1.52	0.66	0.66	0.97	0.02	0.02	0.04	1.36
46	0.70	0.70	1.54	0.64	0.64	0.94	0.02	0.02	0.04	1.36
47	0.70	0.69	1.54	0.62	0.62	0.91	0.02	0.02	0.03	1.33
48	0.70	0.69	1.54	0.61	0.61	0.90	0.02	0.02	0.04	1.32
49	0.70	0.70	1.54	0.63	0.63	0.93	0.02	0.02	0.04	1.35
50	0.70	0.68	1.52	0.66	0.66	0.96	0.02	0.02	0.05	1.37
51	0.70	0.69	1.53	0.63	0.63	0.94	0.02	0.02	0.04	1.35
52	0.70	0.68	1.52	0.66	0.66	0.96	0.03	0.03	0.05	1.38
53	0.70	0.70	1.55	0.63	0.63	0.92	0.02	0.02	0.04	1.35
54	0.70	0.70	1.55	0.61	0.61	0.91	0.02	0.02	0.04	1.33
55	0.70	0.70	1.55	0.63	0.63	0.93	0.02	0.02	0.05	1.35
56	0.70	0.70	1.54	0.63	0.63	0.94	0.02	0.02	0.04	1.35
57	0.70	0.70	1.55	0.63	0.63	0.93	0.02	0.02	0.05	1.36
58	0.70	0.70	1.55	0.64	0.64	0.95	0.02	0.02	0.05	1.37
59	0.70	0.70	1.54	0.62	0.62	0.91	0.02	0.02	0.04	1.34
60	0.70	0.69	1.54	0.62	0.62	0.91	0.02	0.02	0.04	1.34
61	0.71	0.70	1.55	0.58	0.58	0.87	0.02	0.02	0.03	1.31
62	0.70	0.69	1.52	0.63	0.63	0.92	0.02	0.02	0.04	1.34
63	0.71	0.69	1.54	0.65	0.65	0.95	0.02	0.02	0.04	1.37
64	0.74	0.74	1.64	0.58	0.58	0.86	0.02	0.02	0.03	1.34
65	0.74	0.73	1.63	0.60	0.60	0.89	0.01	0.01	0.03	1.35
66	0.73	0.73	1.63	0.61	0.61	0.90	0.01	0.01	0.03	1.36
67	0.73	0.73	1.62	0.59	0.59	0.88	0.02	0.02	0.04	1.34
68	0.73	0.72	1.61	0.57	0.57	0.86	0.01	0.01	0.03	1.32
69	0.73	0.73	1.61	0.62	0.62	0.91	0.02	0.02	0.03	1.36
70	0.74	0.73	1.62	0.60	0.60	0.88	0.02	0.02	0.05	1.36
71	0.74	0.73	1.62	0.58	0.58	0.86	0.01	0.01	0.03	1.33
72	0.74	0.73	1.62	0.58	0.58	0.87	0.02	0.02	0.04	1.34
73	0.74	0.73	1.61	0.60	0.60	0.89	0.01	0.01	0.03	1.36
74	0.73	0.73	1.62	0.60	0.60	0.89	0.02	0.02	0.04	1.36
75	0.73	0.73	1.62	0.59	0.59	0.87	0.01	0.01	0.03	1.34
76	0.74	0.74	1.63	0.60	0.60	0.89	0.02	0.02	0.04	1.36
77	0.73	0.73	1.61	0.60	0.60	0.90	0.01	0.01	0.03	1.35
78	0.72	0.72	1.59	0.61	0.61	0.91	0.02	0.02	0.04	1.35
79	0.73	0.72	1.60	0.60	0.60	0.89	0.01	0.01	0.03	1.34
80	0.74	0.73	1.61	0.61	0.61	0.90	0.02	0.02	0.04	1.36
81	0.74	0.73	1.62	0.61	0.61	0.91	0.02	0.02	0.04	1.37
82	0.74	0.73	1.62	0.59	0.59	0.87	0.02	0.02	0.04	1.35
83	0.74	0.72	1.61	0.60	0.60	0.89	0.02	0.02	0.05	1.36
84	0.75	0.74	1.63	0.59	0.59	0.87	0.02	0.02	0.04	1.35
85	0.77	0.76	1.69	0.57	0.57	0.85	0.01	0.01	0.03	1.35
86	0.77	0.76	1.69	0.57	0.57	0.84	0.02	0.02	0.03	1.35
87	0.77	0.76	1.70	0.56	0.56	0.84	0.02	0.02	0.04	1.34
88	0.77	0.77	1.71	0.56	0.56	0.83	0.01	0.01	0.03	1.35
89	0.77	0.77	1.70	0.57	0.57	0.85	0.02	0.02	0.03	1.36
90	0.76	0.76	1.69	0.57	0.57	0.83	0.02	0.02	0.04	1.35
91	0.77	0.76	1.69	0.55	0.55	0.82	0.01	0.01	0.03	1.33
92	0.77	0.76	1.68	0.58	0.58	0.86	0.01	0.01	0.03	1.36
93	0.78	0.77	1.70	0.56	0.56	0.84	0.01	0.01	0.03	1.35

Table E.42. (Continued)

94	0.77	0.76	1.69	0.56	0.56	0.83	0.01	0.01	0.03	1.35
95	0.77	0.77	1.72	0.55	0.55	0.81	0.02	0.02	0.04	1.34
96	0.76	0.76	1.70	0.57	0.57	0.83	0.01	0.01	0.03	1.34
97	0.77	0.76	1.70	0.56	0.56	0.83	0.01	0.01	0.03	1.35
98	0.77	0.77	1.70	0.56	0.56	0.83	0.02	0.02	0.03	1.35
99	0.77	0.77	1.70	0.56	0.56	0.84	0.01	0.01	0.03	1.35
100	0.78	0.77	1.71	0.56	0.56	0.83	0.01	0.01	0.03	1.35
101	0.77	0.76	1.69	0.56	0.56	0.84	0.01	0.01	0.03	1.35
102	0.77	0.76	1.70	0.57	0.57	0.84	0.01	0.01	0.03	1.35
103	0.77	0.76	1.69	0.57	0.57	0.84	0.02	0.02	0.03	1.35
104	0.77	0.76	1.68	0.57	0.57	0.84	0.01	0.01	0.03	1.35
105	0.78	0.77	1.70	0.54	0.54	0.80	0.01	0.01	0.03	1.33

Table E.43. Regression Model Summary of Policy Group 4 - Outdate Rate of Region Including DCs And RBC

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.983750733	0.967765505	0.966808044	0.008070438
Predictors: (Constant), AgeDifference, Ada, Dadc **Variable MASD is excluded from the model				

Table E.44. Regression Model Anova Table of Policy Group 4 - Outdate Rate of Region Including DCs and RBC

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.19749898	3	0.065832993	1010.763107	3.71993E-75
	Residual	0.006578329	101	6.5132E-05		
	Total	0.204077309	104			
Predictors: (Constant), AgeDifference, Ada, Dadc **Variable MASD is excluded from the model						
Dependent Variable: OutdateRate						

Table E.45. Regression Model Coefficient Table of Policy Group 4 - Outdate Rate of Region Including DCs and RBC

Coefficients						
Model		Unstandardized Coefficients		Standardized Coef.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.53310301	0.008629622		61.77594118	4.75E-82
	Ada	0.030650927	0.000556913	0.983231776	55.03717766	3.97E-77
	Dadc	-0.000454214	0.000260134	-0.031299376	-1.746078405	0.083837927
	AgeDifference	0.000167414	0.000316466	0.009482773	0.529009448	0.597959605
Dependent Variable: OutdateRate						

Table E.46. Regression Model Summary of Policy Group 4 - Mismatch Rate of Region Including DCs and RBC

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.960987433	0.923496846	0.921224475	0.018500592
Predictors: (Constant), AgeDifference, Ada, Dadc **Variable MASD is excluded from the model				

Table E.47. Regression Model Summary of Policy Group 4 - Mismatch Rate of Region Including DCs and RBC

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.417300299	3	0.1391001	406.4023357	3.2823E-56
	Residual	0.034569462	101	0.000342272		
	Total	0.45186976	104			
Predictors: (Constant), AgeDifference, Ada, Dadc **Variable MASD is excluded from the model						
Dependent Variable: MismatchRate						

Table E.48. Regression Model Coefficient Table of Policy Group 4 - Mismatch Rate of Region Including DCs and RBC

Coefficients						
Model		Unstandardized Coefficients		Standardized Coef.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.917344406	0.019782459		46.37160627	6.73854E-70
	Ada	-0.044571129	0.001276662	-0.96085233	-34.91223597	3.52488E-58
	Dadc	-0.000114088	0.000596328	-0.005283312	-0.191317677	0.848660791
	AgeDifference	-0.000388661	0.000725464	-0.014794684	-0.535740549	0.593315696
Dependent Variable: Mismatch Rate **Variable MASD is excluded from the model						

Table E.49. Regression Model Summary of Policy Group 4 - Shortage Rate of Region Including DCs and RBC

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.879265964	0.773108635	0.766369288	0.003507714
Predictors: (Constant), AgeDifference, Ada, Dadc **Variable MASD is excluded from the model				

Table E.50. Regression Model Anova Table of Policy Group 4 - Shortage Rate of Region Including DCs and RBC

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.004234403	3	0.001411468	114.7156516	2.09635E-32
	Residual	0.00124271	101	1.23041E-05		
	Total	0.005477113	104			
Predictors: (Constant), AgeDifference, Ada, Dadc **Variable MASD is excluded from the model						
Dependent Variable: ShortageRate						

Table E.51. Regression Model Coefficient Table of Policy Group 4 - Shortage Rate of Region Including DCs and RBC

Coefficients(a)						
Model		Unstandardized Coefficients		Standardized Coef.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.052238154	0.003750756		13.92736716	3.03311E-25
	Ada	-0.004478247	0.000242055	-0.87688331	-18.50092776	3.26878E-34
	Dadc	-0.000140483	0.000113064	-0.059090919	-1.24251105	0.216925153
	AgeDifference	9.14476E-05	0.000137548	0.031618259	0.664840508	0.507667722
Dependent Variable: ShortageRate						

Table E.52. Regression Model Summary of Policy Group 4 - Sum of Main Performance Measures

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.790841824	0.62543079	0.614304972	0.020604337
Predictors: (Constant), AgeDifference, Ada, Dadc **Variable MASD is excluded from the model				

Table E.53. Regression Model Anova Table of Policy Group 4 - Sum of Main Performance Measures

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.071595518	3	0.023865173	56.21436415	1.86753E-21
	Residual	0.042878408	101	0.000424539		
	Total	0.114473926	104			
Predictors: (Constant), AgeDifference, Ada, Dadc **Variable MASD is excluded from the model						
Dependent Variable: SelectionCriterion						

Table E.54. Regression Model Coefficient Table of Policy Group 4 - Sum of Main Performance Measures

Coefficients						
Model		Unstandardized Coefficients		Standardized Coef.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.50268557	0.022031968		68.20478165	2.72351E-86
	Ada	-0.018398449	0.001421834	-0.788020591	-12.9399386	3.63053E-23
	Dadc	-0.000708785	0.000664138	-0.065212955	-1.067225862	0.288414196
	AgeDifference	-0.000129799	0.000807959	-0.009816601	-0.160651061	0.872689122
Dependent Variable: SelectionCriterion						

Table E.55. Regression Model Summary of Policy Group 4 - Total Number of Deliveries

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.96068396	0.922913672	0.920623979	109.5627939
Predictors: (Constant), AgeDifference, Ada, Dadc **Variable MASD is excluded from the model				

Table E.56. Regression Model Anova Table of Policy Group 4 -Total Number of Deliveries

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14515476.27	3	4838492.09	403.0731218	4.81497E-56
	Residual	1212404.585	101	12004.0058		
	Total	15727880.86	104			
Predictors: (Constant), AgeDifference, Ada, Dadc **Variable MASD is excluded from the model						
Dependent Variable: TotalNumDel						

Table E.57. Regression Model Coefficient Table of Policy Group 4 - Total Number of Deliveries

Coefficients					
Model		Unstandardized Coefficients		Standardized Coef.	Sig.
		B	Std. Error	Beta	
1	(Constant)	129913.7157	117.1541703		1108.91243
	Ada	-262.6695238	7.560551062	-0.959807698	-34.74211359
	Dadc	2.953818182	3.531528612	0.023185753	0.836413493
	AgeDifference	4.957963636	4.296289983	0.031989683	1.154010473
Dependent Variable: TotalNumDel					

Table E.58. Cities Performances and Performance of Region Including DCs and RBC of Group 5 Policies

Performance Measure	Inventory Level				Outdate Rate				Mismatch Rate				Shortage Rate			
	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall	Antalya	Burdur	Isparta	Overall
4.61.	3263.58	497.43	1306.45	5067.45	0.66	0.94	0.74	0.71	0.52	1.34	0.43	0.58	0.01	0.07	0.01	0.02
1	2579.12	384.45	1051.41	4014.98	0.58	0.81	0.67	0.62	1.25	2.47	1.06	1.33	0.07	0.32	0.06	0.02
2	2905.46	435.27	1176.96	4517.69	0.62	0.84	0.70	0.66	0.75	1.74	0.62	0.83	0.03	0.11	0.02	0.10
3	3263.58	497.43	1306.45	5067.45	0.66	0.94	0.74	0.71	0.52	1.34	0.43	0.58	0.01	0.07	0.01	0.03
4	3577.60	535.66	1445.05	5558.30	0.71	0.92	0.80	0.76	0.47	1.45	0.34	0.54	0.01	0.09	0.00	0.02
5	3904.05	583.31	1573.87	6061.23	0.77	0.99	0.86	0.83	0.41	1.28	0.28	0.47	0.01	0.04	0.00	0.01
6	2599.04	391.81	1053.94	4044.80	0.58	0.84	0.67	0.63	1.23	2.26	1.03	1.32	0.07	0.26	0.06	0.01
7	2902.55	434.23	1180.24	4517.01	0.62	0.87	0.70	0.67	0.78	1.85	0.59	0.85	0.03	0.17	0.02	0.09
8	3262.25	487.95	1310.03	5060.24	0.67	0.92	0.76	0.72	0.55	1.48	0.39	0.61	0.01	0.11	0.01	0.04
9	3598.57	541.09	1444.65	5584.31	0.73	0.93	0.79	0.76	0.45	1.31	0.34	0.51	0.01	0.05	0.00	0.02
10	3910.18	600.07	1569.73	6079.98	0.79	0.99	0.82	0.82	0.47	1.15	0.31	0.50	0.02	0.05	0.00	0.01
11	2591.52	388.37	1050.21	4030.09	0.58	0.82	0.68	0.63	1.22	2.34	1.05	1.30	0.07	0.31	0.05	0.02
12	2916.72	435.72	1177.41	4529.84	0.62	0.84	0.70	0.66	0.72	1.90	0.60	0.82	0.03	0.14	0.02	0.09
13	3244.90	485.08	1305.75	5035.72	0.65	0.90	0.74	0.68	0.56	1.54	0.43	0.61	0.01	0.09	0.01	0.04
14	3594.95	538.37	1442.96	5576.29	0.70	0.97	0.77	0.75	0.47	1.33	0.36	0.54	0.00	0.05	0.00	0.02
15	3912.13	598.33	1573.10	6083.57	0.77	1.01	0.85	0.81	0.43	1.23	0.30	0.48	0.00	0.02	0.00	0.01
16	2572.34	388.05	1049.69	4010.07	0.58	0.87	0.68	0.64	1.24	2.35	1.05	1.31	0.09	0.30	0.06	0.01
17	2918.72	445.86	1177.95	4542.53	0.62	0.88	0.69	0.67	0.78	1.68	0.65	0.84	0.02	0.13	0.02	0.10
18	3241.88	482.60	1306.49	5030.98	0.66	0.88	0.74	0.70	0.57	1.63	0.44	0.65	0.01	0.12	0.01	0.03
19	3581.12	536.86	1441.11	5559.09	0.72	0.94	0.77	0.75	0.47	1.39	0.36	0.54	0.00	0.05	0.00	0.02
20	3872.92	570.90	1571.82	6015.64	0.77	0.91	0.85	0.80	0.47	1.43	0.30	0.53	0.01	0.06	0.00	0.01
21	2501.13	375.34	1020.93	3897.41	0.57	0.84	0.69	0.63	1.34	2.41	1.09	1.39	0.09	0.32	0.07	0.01
22	2815.22	419.54	1131.72	4366.48	0.61	0.84	0.70	0.66	0.81	1.90	0.65	0.89	0.03	0.19	0.02	0.11
23	3094.72	458.72	1252.28	4805.73	0.66	0.89	0.73	0.70	0.61	1.68	0.46	0.69	0.01	0.18	0.01	0.05
24	3432.83	517.11	1387.01	5336.94	0.69	0.93	0.77	0.74	0.53	1.39	0.38	0.58	0.01	0.09	0.01	0.03
25	3754.09	568.11	1511.91	5834.11	0.77	0.94	0.84	0.80	0.44	1.28	0.33	0.50	0.00	0.07	0.00	0.02
26	2507.95	379.97	1020.47	3908.38	0.58	0.83	0.67	0.63	1.30	2.36	1.11	1.37	0.10	0.28	0.07	0.01
27	2796.54	422.75	1134.43	4353.72	0.61	0.88	0.72	0.67	0.83	1.78	0.63	0.88	0.04	0.14	0.02	0.11
28	3107.30	474.70	1250.58	4832.58	0.66	0.91	0.73	0.70	0.62	1.45	0.46	0.68	0.01	0.08	0.01	0.04
29	3445.37	517.05	1385.80	5348.23	0.71	0.95	0.77	0.75	0.50	1.35	0.37	0.56	0.01	0.05	0.00	0.02
30	3770.72	559.36	1510.77	5840.85	0.78	0.94	0.83	0.81	0.43	1.38	0.33	0.51	0.01	0.05	0.00	0.01
31	2491.68	377.66	1013.98	3883.31	0.57	0.83	0.67	0.62	1.33	2.37	1.08	1.38	0.09	0.35	0.07	0.01
32	2791.86	418.95	1130.18	4340.99	0.61	0.85	0.69	0.66	0.85	1.85	0.67	0.88	0.03	0.17	0.02	0.11
33	3099.69	462.70	1252.46	4814.85	0.64	0.91	0.74	0.69	0.61	1.55	0.46	0.67	0.02	0.13	0.01	0.05
34	3428.34	520.72	1385.03	5334.08	0.70	0.93	0.77	0.74	0.50	1.38	0.38	0.56	0.01	0.05	0.01	0.03
35	3754.76	565.33	1510.76	5830.85	0.77	0.99	0.82	0.81	0.43	1.32	0.33	0.50	0.00	0.03	0.00	0.01
36	2508.81	374.79	1016.86	3900.46	0.57	0.83	0.66	0.62	1.39	2.49	1.13	1.44	0.10	0.33	0.07	0.01
37	2778.39	416.85	1133.50	4328.74	0.62	0.85	0.70	0.66	0.87	1.91	0.66	0.93	0.03	0.17	0.03	0.11
38	3114.52	464.53	1253.08	4832.13	0.65	0.89	0.75	0.70	0.61	1.69	0.46	0.69	0.01	0.11	0.01	0.05
39	3448.70	511.69	1386.13	5346.52	0.72	0.90	0.77	0.75	0.48	1.55	0.38	0.57	0.01	0.08	0.01	0.02
40	3782.13	568.25	1511.95	5862.33	0.78	0.98	0.85	0.82	0.44	1.29	0.33	0.50	0.00	0.05	0.00	0.01
41	2466.33	373.62	1008.55	3848.51	0.57	0.85	0.67	0.62	1.35	2.36	1.10	1.40	0.10	0.35	0.07	0.01
42	2711.47	404.74	1102.06	4218.27	0.62	0.83	0.71	0.67	0.84	2.00	0.65	0.91	0.04	0.18	0.03	0.12
43	2998.59	453.44	1203.78	4655.80	0.64	0.90	0.72	0.69	0.63	1.60	0.50	0.70	0.02	0.12	0.01	0.05
44	3302.80	501.51	1327.23	5131.55	0.70	0.93	0.77	0.74	0.52	1.35	0.41	0.59	0.01	0.08	0.01	0.03

Table E.58. (Continued)

45	3601.07	537.85	1455.61	5594.54	0.75	0.91	0.84	0.79	0.48	1.47	0.33	0.54	0.01	0.05	0.00	0.02
46	2480.56	377.24	1004.50	3862.30	0.57	0.87	0.67	0.63	1.39	2.33	1.12	1.40	0.09	0.32	0.08	0.01
47	2721.64	407.62	1105.59	4234.86	0.62	0.86	0.71	0.66	0.85	1.90	0.62	0.90	0.03	0.18	0.02	0.11
48	3000.93	456.68	1206.17	4663.79	0.66	0.91	0.74	0.70	0.59	1.66	0.47	0.68	0.02	0.10	0.01	0.05
49	3287.17	488.56	1332.41	5108.14	0.70	0.88	0.78	0.73	0.52	1.60	0.39	0.60	0.01	0.09	0.01	0.02
50	3601.38	548.15	1452.81	5602.34	0.77	0.98	0.84	0.81	0.47	1.32	0.32	0.52	0.00	0.06	0.00	0.02
51	2468.31	370.65	1005.75	3844.71	0.57	0.81	0.66	0.62	1.36	2.44	1.14	1.38	0.09	0.36	0.08	0.01
52	2690.51	403.70	1102.44	4196.65	0.60	0.83	0.70	0.65	0.87	2.04	0.63	0.92	0.04	0.18	0.02	0.12
53	3001.36	452.11	1209.37	4662.84	0.64	0.90	0.72	0.69	0.64	1.58	0.46	0.68	0.02	0.12	0.01	0.05
54	3293.18	495.15	1331.59	5119.91	0.69	0.90	0.77	0.73	0.54	1.44	0.37	0.59	0.02	0.06	0.01	0.03
55	3601.85	543.44	1453.15	5598.45	0.75	0.97	0.82	0.79	0.47	1.36	0.33	0.53	0.00	0.06	0.00	0.02
56	2462.96	374.32	1006.03	3843.31	0.57	0.83	0.67	0.62	1.41	2.40	1.10	1.43	0.11	0.32	0.07	0.01
57	2733.67	404.54	1103.66	4241.87	0.62	0.83	0.71	0.66	0.81	2.08	0.65	0.91	0.03	0.22	0.02	0.12
58	2979.19	449.56	1206.46	4635.21	0.64	0.86	0.72	0.68	0.67	1.69	0.48	0.73	0.01	0.17	0.01	0.05
59	3299.15	496.40	1329.54	5125.09	0.70	0.95	0.75	0.74	0.54	1.38	0.41	0.60	0.01	0.08	0.01	0.03
60	3607.45	549.71	1452.71	5609.88	0.76	0.97	0.81	0.80	0.49	1.28	0.33	0.53	0.00	0.04	0.00	0.02

Table E.59. Delivery Performance Measures of Group 5 Policies

Delivery Performances	Quantity					Percentage			
Delivery Type	Routine Deliveries To TCs	Ad-Hoc Deliveries to TCs	Emergency Deliveries To TCs	Ad-hoc Deliveries Between DCs and RBC	Total	Routine Deliveries To TCs	Ad-Hoc Deliveries to TCs	Emergency Deliveries To TCs	Ad-hoc Deliveries Between DCs and RBC
4.61.	69386	56346	0	2528	128260	54.10	43.93	0.00	1.97
1	52733	109569	0	2423	164725	32.01	66.52	0.00	1.47
2	64286	74547	0	2463	141296	45.50	52.76	0.00	1.74
3	69386	56346	0	2528	128260	54.10	43.93	0.00	1.97
4	72424	44331	0	2427	119182	60.77	37.20	0.00	2.04
5	73896	38235	0	2410	114540	64.52	33.38	0.00	2.10
6	52606	109096	0	2459	164160	32.05	66.46	0.00	1.50
7	64323	74469	0	2484	141275	45.53	52.71	0.00	1.76
8	69458	56135	0	2502	128095	54.22	43.82	0.00	1.95
9	72539	43950	0	2458	118946	60.98	36.95	0.00	2.07
10	73829	37661	0	2457	113948	64.79	33.05	0.00	2.16
11	52694	109421	0	2419	164533	32.03	66.50	0.00	1.47
12	64343	74565	0	2448	141356	45.52	52.75	0.00	1.73
13	69427	56400	0	2450	128278	54.12	43.97	0.00	1.91
14	72528	44190	0	2395	119113	60.89	37.10	0.00	2.01
15	73917	38037	0	2427	114382	64.62	33.25	0.00	2.12
16	52702	109373	0	2422	164497	32.04	66.49	0.00	1.47
17	64334	74562	0	2483	141379	45.50	52.74	0.00	1.76
18	69470	56179	0	2431	128080	54.24	43.86	0.00	1.90
19	72515	43990	0	2424	118929	60.97	36.99	0.00	2.04
20	73899	37779	0	2327	114006	64.82	33.14	0.00	2.04
21	29276	124979	0	2394	156649	18.69	79.78	0.00	1.53
22	36462	87078	0	2392	125932	28.95	69.15	0.00	1.90
23	39411	65441	0	2309	107161	36.78	61.07	0.00	2.15
24	41109	50957	0	2371	94437	43.53	53.96	0.00	2.51
25	41828	42827	0	2329	86984	48.09	49.24	0.00	2.68
26	29285	124925	0	2422	156632	18.70	79.76	0.00	1.55
27	36420	86816	0	2429	125665	28.98	69.09	0.00	1.93
28	39433	65046	0	2375	106854	36.90	60.87	0.00	2.22
29	41097	50404	0	2358	93859	43.79	53.70	0.00	2.51
30	41853	42622	0	2279	86753	48.24	49.13	0.00	2.63
31	29244	125007	0	2409	156659	18.67	79.80	0.00	1.54
32	36441	87128	0	2405	125973	28.93	69.16	0.00	1.91
33	39449	65346	0	2371	107167	36.81	60.98	0.00	2.21
34	41071	50702	0	2384	94156	43.62	53.85	0.00	2.53
35	41837	42894	0	2317	87048	48.06	49.28	0.00	2.66
36	29252	125097	0	2385	156733	18.66	79.81	0.00	1.52
37	36486	86887	0	2400	125774	29.01	69.08	0.00	1.91
38	39440	65038	0	2374	106852	36.91	60.87	0.00	2.22
39	41123	50428	0	2361	93912	43.79	53.70	0.00	2.51
40	41847	42471	0	2297	86614	48.31	49.03	0.00	2.65
41	20052	132726	0	2428	155207	12.92	85.52	0.00	1.56
42	25065	96828	0	2379	124272	20.17	77.92	0.00	1.91
43	27139	73610	0	2365	103114	26.32	71.39	0.00	2.29
44	28251	57023	0	2323	87596	32.25	65.10	0.00	2.65

Table E.59. (Continued)

45	28726	47789	0	2233	78749	36.48	60.69	0.00	2.84
46	20072	132567	0	2408	155048	12.95	85.50	0.00	1.55
47	25098	96757	0	2415	124269	20.20	77.86	0.00	1.94
48	27125	73374	0	2381	102880	26.37	71.32	0.00	2.31
49	28274	56853	0	2319	87446	32.33	65.01	0.00	2.65
50	28746	47219	0	2289	78254	36.73	60.34	0.00	2.93
51	20083	132379	0	2397	154859	12.97	85.48	0.00	1.55
52	25095	96951	0	2383	124429	20.17	77.92	0.00	1.91
53	27130	73556	0	2354	103040	26.33	71.39	0.00	2.28
54	28225	57125	0	2314	87664	32.20	65.16	0.00	2.64
55	28742	47553	0	2255	78550	36.59	60.54	0.00	2.87
56	20053	132611	0	2411	155075	12.93	85.51	0.00	1.55
57	25058	96767	0	2393	124218	20.17	77.90	0.00	1.93
58	27147	73422	0	2329	102898	26.38	71.35	0.00	2.26
59	28257	56717	0	2326	87300	32.37	64.97	0.00	2.66
60	28746	47065	0	2275	78086	36.81	60.27	0.00	2.91

Table E.60. Selection Criterion Performance of Group 5 Policies

Performance Measure	Outdate Rate			Mismatch Rate			Shortage Rate			Selection Criterion Performance
Case	Region Including Dcs and RBC	Region Excluding DCs And RBC	Single TCs' Means	Region Including Dcs and RBC	Region Excluding DCs And RBC	Single TCs' Means	Region Including Dcs and RBC	Region Excluding DCs And RBC	Single TCs' Means	
4.61.	0.71	0.70	1.55	0.58	0.58	0.87	0.02	0.02	0.03	1.31
1	0.62	0.62	1.39	1.33	1.33	1.78	0.10	0.10	0.16	2.05
2	0.66	0.65	1.47	0.83	0.83	1.17	0.03	0.03	0.07	1.52
3	0.71	0.70	1.55	0.58	0.58	0.87	0.02	0.02	0.03	1.31
4	0.76	0.75	1.63	0.54	0.54	0.83	0.01	0.01	0.03	1.31
5	0.83	0.82	1.76	0.47	0.47	0.73	0.01	0.01	0.02	1.31
6	0.63	0.62	1.40	1.32	1.32	1.73	0.09	0.09	0.15	2.04
7	0.67	0.66	1.48	0.85	0.85	1.19	0.04	0.04	0.08	1.56
8	0.72	0.71	1.56	0.61	0.61	0.89	0.02	0.02	0.04	1.35
9	0.76	0.76	1.65	0.51	0.51	0.77	0.01	0.01	0.02	1.29
10	0.82	0.81	1.77	0.50	0.50	0.76	0.02	0.02	0.03	1.33
11	0.63	0.62	1.40	1.30	1.30	1.74	0.09	0.09	0.15	2.02
12	0.66	0.65	1.47	0.82	0.82	1.16	0.04	0.04	0.07	1.52
13	0.68	0.68	1.53	0.61	0.61	0.93	0.02	0.02	0.04	1.31
14	0.75	0.74	1.62	0.54	0.54	0.82	0.01	0.01	0.02	1.29
15	0.81	0.80	1.75	0.48	0.48	0.73	0.01	0.01	0.01	1.30
16	0.64	0.62	1.41	1.31	1.31	1.74	0.10	0.10	0.16	2.05
17	0.67	0.66	1.47	0.84	0.84	1.17	0.03	0.03	0.07	1.54
18	0.70	0.69	1.54	0.65	0.65	0.95	0.02	0.02	0.05	1.37
19	0.75	0.74	1.63	0.54	0.54	0.81	0.01	0.01	0.02	1.30
20	0.80	0.80	1.74	0.53	0.53	0.81	0.01	0.01	0.02	1.35
21	0.63	0.62	1.40	1.39	1.39	1.86	0.11	0.11	0.18	2.12
22	0.66	0.65	1.46	0.89	0.89	1.26	0.05	0.05	0.09	1.59
23	0.70	0.69	1.53	0.69	0.69	1.03	0.03	0.03	0.06	1.42
24	0.74	0.73	1.60	0.58	0.58	0.89	0.02	0.02	0.03	1.33
25	0.80	0.80	1.75	0.50	0.50	0.77	0.01	0.01	0.02	1.31
26	0.63	0.62	1.40	1.37	1.37	1.83	0.11	0.11	0.18	2.12
27	0.67	0.65	1.47	0.88	0.88	1.23	0.04	0.04	0.08	1.59
28	0.70	0.69	1.54	0.68	0.68	0.98	0.02	0.02	0.04	1.40
29	0.75	0.74	1.63	0.56	0.56	0.84	0.01	0.01	0.02	1.32
30	0.81	0.80	1.74	0.51	0.51	0.77	0.01	0.01	0.02	1.33
31	0.62	0.61	1.39	1.38	1.38	1.85	0.11	0.11	0.18	2.11
32	0.66	0.65	1.46	0.88	0.88	1.28	0.05	0.05	0.09	1.58
33	0.69	0.68	1.52	0.67	0.67	1.00	0.03	0.03	0.06	1.39
34	0.74	0.73	1.60	0.56	0.56	0.86	0.01	0.01	0.03	1.31
35	0.81	0.80	1.74	0.50	0.50	0.75	0.01	0.01	0.01	1.31
36	0.62	0.61	1.38	1.44	1.44	1.91	0.11	0.11	0.19	2.17
37	0.66	0.65	1.47	0.93	0.93	1.30	0.05	0.05	0.09	1.63
38	0.70	0.69	1.54	0.69	0.69	1.01	0.02	0.02	0.05	1.41
39	0.75	0.74	1.63	0.57	0.57	0.86	0.01	0.01	0.03	1.34
40	0.82	0.81	1.77	0.50	0.50	0.74	0.01	0.01	0.02	1.32
41	0.62	0.61	1.39	1.40	1.40	1.87	0.12	0.12	0.19	2.14
42	0.67	0.66	1.48	0.91	0.91	1.30	0.05	0.05	0.10	1.63
43	0.69	0.68	1.51	0.70	0.70	1.03	0.03	0.03	0.06	1.41
44	0.74	0.73	1.61	0.59	0.59	0.89	0.02	0.02	0.03	1.34

Table E.60. (Continued)

45	0.79	0.78	1.70	0.54	0.54	0.83	0.01	0.01	0.02	1.34
46	0.63	0.62	1.39	1.40	1.40	1.88	0.11	0.11	0.18	2.14
47	0.66	0.65	1.47	0.90	0.89	1.27	0.05	0.05	0.09	1.62
48	0.70	0.69	1.53	0.68	0.68	0.99	0.02	0.02	0.05	1.40
49	0.73	0.72	1.61	0.60	0.60	0.90	0.02	0.02	0.03	1.35
50	0.81	0.80	1.75	0.52	0.52	0.80	0.01	0.01	0.02	1.34
51	0.62	0.61	1.38	1.38	1.42	1.89	0.12	0.12	0.20	2.12
52	0.65	0.64	1.45	0.92	0.92	1.32	0.05	0.05	0.09	1.62
53	0.69	0.68	1.51	0.68	0.68	1.03	0.03	0.03	0.06	1.39
54	0.73	0.72	1.59	0.59	0.59	0.90	0.02	0.02	0.04	1.34
55	0.79	0.78	1.72	0.53	0.53	0.81	0.01	0.01	0.02	1.33
56	0.62	0.61	1.38	1.43	1.43	1.90	0.12	0.12	0.20	2.18
57	0.66	0.65	1.47	0.91	0.91	1.27	0.05	0.05	0.09	1.62
58	0.68	0.68	1.50	0.73	0.73	1.06	0.03	0.03	0.06	1.45
59	0.74	0.73	1.60	0.60	0.60	0.89	0.02	0.02	0.03	1.35
60	0.80	0.79	1.73	0.53	0.53	0.80	0.01	0.01	0.02	1.34

Table E.61. Sum of Outdate, Shortage, and Mismatch Rates of TCs (Policy Group 5)

Policy No	11	12	13	14	15	31	32	33	34	51	52	53	54	55	56	Selected DPTb Values
Routine Delivery Check Period	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Atb Values	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	
[TC1]	0.74	0.38	0.26	0.24	0.18	0.78	0.44	0.29	0.23	0.18	0.84	0.46	0.33	0.26	0.19	2
[TC2]	2.12	1.35	1.14	1.09	1.21	2.26	1.40	1.11	1.14	1.08	2.30	1.44	1.14	1.24	1.12	2
[TC3]	2.76	2.32	2.13	1.96	2.20	2.76	2.30	2.06	1.92	2.06	2.73	2.35	2.03	2.06	2.10	2
[TC4]	3.87	3.09	2.86	2.90	2.89	3.80	3.11	2.89	2.87	2.96	3.86	3.12	2.91	2.99	2.83	2
[TC5]	3.94	3.45	3.33	3.27	3.27	4.18	3.32	3.20	3.15	3.15	4.05	3.43	3.23	3.35	3.29	2
[TC6]	2.68	1.88	1.77	1.75	1.74	2.70	2.00	1.82	1.64	1.66	2.70	2.00	1.92	1.74	1.72	2
[TC7]	3.51	2.82	2.47	2.51	2.48	3.59	3.04	2.41	2.50	2.61	3.42	2.97	2.48	2.63	2.60	2
[TC8]	3.76	3.05	2.72	2.72	2.77	3.82	3.02	2.71	2.73	2.78	3.71	2.93	2.87	2.82	2.85	1
[TC9]	4.75	3.96	3.92	3.73	3.87	4.82	4.19	3.96	3.72	3.80	4.81	4.07	3.95	3.72	3.90	2
[TC10]	3.90	2.98	2.78	2.96	2.92	3.87	3.13	2.78	2.82	2.75	3.79	3.03	2.96	2.84	2.73	2
[TC11]	2.94	2.16	2.09	2.03	2.06	3.13	2.44	2.06	2.08	2.08	3.11	2.29	2.12	2.10	2.14	1
[TC12]	4.88	4.45	4.17	4.10	4.19	4.74	4.43	4.34	4.15	4.22	5.00	4.42	4.22	4.08	4.35	2
[TC13]	4.61	4.16	3.98	3.80	4.03	4.91	4.04	3.97	3.79	3.91	4.80	4.26	4.05	3.98	3.88	2
[TC14]	2.29	1.61	1.27	1.25	1.34	2.27	1.80	1.38	1.29	1.28	2.24	1.68	1.38	1.34	1.39	2
[TC15]	3.39	2.88	2.82	2.64	2.83	3.71	3.22	3.04	2.84	2.81	3.86	3.23	3.10	2.93	2.88	1
[TC16]	4.37	3.44	3.30	3.42	3.42	4.28	3.53	3.39	3.49	3.32	4.38	3.61	3.33	3.58	3.47	1
[TC17]	4.66	4.01	3.66	3.89	3.86	4.93	4.26	4.17	3.78	3.87	4.89	4.37	3.93	3.75	3.90	1
[TC18]	0.48	0.25	0.17	0.11	0.08	0.59	0.30	0.18	0.12	0.10	0.61	0.32	0.21	0.14	0.12	1
[TC19]	0.93	0.52	0.40	0.29	0.29	0.92	0.58	0.42	0.32	0.29	1.01	0.58	0.41	0.32	0.28	1
[TC20]	1.07	0.74	0.60	0.54	0.57	1.24	0.88	0.65	0.57	0.57	1.38	0.95	0.69	0.61	0.58	1
[TC21]	4.72	4.09	4.10	3.90	4.06	5.00	4.50	4.00	4.15	4.05	5.04	4.29	4.19	4.19	4.18	2
[TC22]	3.22	2.42	2.15	2.05	2.11	3.19	2.39	2.19	2.15	2.22	3.31	2.49	2.23	2.13	2.25	1
[TC23]	2.22	1.29	1.06	1.11	1.18	2.53	1.53	1.12	1.13	1.16	2.54	1.55	1.27	1.17	1.21	1
[TC24]	3.17	2.25	2.09	2.07	2.12	3.63	2.69	2.30	2.30	2.18	3.95	2.88	2.41	2.34	2.28	1
[TC25]	3.98	3.28	3.19	3.21	3.26	4.52	3.59	3.59	3.42	3.56	4.62	3.90	3.48	3.56	3.48	1
[TC26]	5.15	4.45	4.43	4.52	4.54	5.75	5.04	4.86	4.60	4.97	5.65	5.37	4.83	4.69	4.96	1
[TC27]	2.23	1.61	1.33	1.32	1.41	2.46	1.92	1.45	1.27	1.36	2.57	1.95	1.66	1.39	1.48	2
[TC28]	2.60	1.72	1.63	1.58	1.58	2.83	1.98	1.78	1.60	1.55	2.88	2.04	1.72	1.66	1.55	1
[TC29]	1.26	0.76	0.63	0.55	0.56	1.44	0.93	0.63	0.60	0.55	1.42	0.92	0.61	0.61	0.61	1
[TC30]	4.77	4.39	3.87	4.06	4.22	5.04	4.48	4.18	4.20	4.41	4.93	4.54	4.15	4.21	4.08	1
[TC31]	1.80	1.19	1.01	1.02	1.04	1.98	1.43	0.99	0.97	0.91	1.95	1.38	1.07	0.97	0.98	2
[TC32]	2.56	1.75	1.45	1.15	1.12	2.69	1.74	1.48	1.23	1.21	2.82	1.88	1.51	1.26	1.22	1
[TC33]	5.11	4.55	4.07	4.05	3.80	4.85	4.53	3.81	3.92	3.87	4.90	4.75	3.96	3.86	3.91	1
[TC34]	2.14	1.74	1.31	1.17	1.03	2.23	1.76	1.45	1.16	1.11	2.29	1.89	1.39	1.26	1.14	1
[TC35]	5.81	4.97	4.95	4.80	4.79	6.14	5.23	5.10	4.95	4.99	6.17	5.42	5.23	4.87	5.03	1
[TC36]	6.92	6.86	6.33	6.32	6.36	7.07	6.71	6.43	6.32	6.31	7.01	7.10	6.43	6.40	6.80	2
[TC37]	4.73	3.98	3.63	3.56	3.43	4.71	3.83	3.84	3.51	3.53	4.70	4.20	3.79	3.67	3.58	1
[TC38]	0.76	0.37	0.27	0.23	0.22	0.75	0.40	0.29	0.24	0.22	0.79	0.39	0.26	0.25	0.21	2
[TC39]	1.88	1.22	1.02	0.95	0.98	1.87	1.25	1.02	0.99	1.07	1.83	1.20	0.95	0.99	0.97	3
[TC40]	1.18	0.68	0.55	0.48	0.46	1.22	0.73	0.57	0.52	0.48	1.29	0.73	0.56	0.48	0.46	1
[TC41]	1.05	0.68	0.51	0.48	0.47	1.10	0.70	0.51	0.47	0.46	1.14	0.67	0.51	0.49	0.49	2
[TC42]	5.11	4.73	4.52	4.50	4.66	5.02	5.01	4.57	4.61	4.69	5.34	4.75	4.60	4.68	4.72	1
[TC43]	4.85	4.32	4.00	4.03	4.14	4.90	4.35	4.14	4.04	4.10	4.83	4.38	4.10	3.93	4.10	3
[TC44]	3.70	3.14	2.90	2.87	2.84	3.96	3.29	3.04	2.92	2.90	4.19	3.25	3.13	3.06	3.02	1
[TC45]	4.54	4.03	3.94	3.79	3.83	4.88	4.33	4.14	4.00	3.80	5.08	4.41	4.07	3.89	3.97	1
[TC46]	4.90	4.49	4.19	4.24	4.39	5.20	4.63	4.51	4.37	4.49	5.38	4.73	4.40	4.25	4.40	1
[TC47]	3.38	2.84	2.58	2.54	2.56	3.57	3.06	2.57	2.60	2.69	3.71	2.99	2.72	2.65	2.56	1
[TC48]	0.89	0.45	0.37	0.30	0.34	0.89	0.48	0.38	0.32	0.33	0.94	0.46	0.36	0.29	0.33	3
[TC49]	5.16	4.74	4.47	4.42	4.60	5.12	4.62	4.36	4.41	4.47	5.14	4.62	4.37	4.43	4.54	2
Mean	3.30	2.70	2.50	2.46	2.50	3.42	2.83	2.57	2.49	2.51	3.47	2.87	2.60	2.53	2.55	
Median	3.33	2.69	2.47	2.43	2.37	3.53	2.84	2.50	2.42	2.52	3.56	2.74	2.62	2.47	2.54	
Max	7.13	6.86	6.33	6.32	6.42	7.67	6.76	6.43	6.47	6.42	7.52	7.10	6.60	6.56	6.80	
Min	0.48	0.25	0.17	0.11	0.08	0.59	0.30	0.18	0.12	0.10	0.61	0.32	0.21	0.14	0.12	
Percentile (%10)	0.99	0.60	0.47	0.40	0.38	1.03	0.64	0.47	0.38	0.38	1.09	0.64	0.47	0.38	0.39	
Percentile (%25)	2.06	1.30	1.17	1.11	1.13	2.09	1.53	1.12	1.10	1.08	2.09	1.52	1.23	1.16	1.11	
Percentile (%50)	3.33	2.69	2.47	2.43	2.37	3.53	2.84	2.50	2.42	2.52	3.56	2.74	2.62	2.47	2.54	
Percentile (%75)	4.58	3.95	3.59	3.67	3.81	4.60	4.10	3.80	3.64	3.74	4.79	4.15	3.80	3.71	3.87	
Percentile (%90)	5.35	4.73	4.40	4.42	4.49	5.72	4.84	4.77	4.37	4.65	5.70	5.04	4.59	4.50	4.56	

Table E.62. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group 0 + (Policy Group 5)

Policy No	11	12	13	14	15	31	32	33	34	51	52	53	54	55	56	Selected Atb Values
Routine Delivery Check Period	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Atb Values	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	
[TC1]	0.08	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.11	0.01	0.00	0.00	0.00	6
[TC2]	0.74	0.25	0.05	0.02	0.01	0.79	0.20	0.10	0.08	0.02	0.90	0.25	0.07	0.12	0.02	6
[TC3]	1.36	0.42	0.32	0.11	0.07	1.36	0.34	0.35	0.15	0.11	1.23	0.42	0.37	0.22	0.08	6
[TC4]	1.20	0.91	0.38	0.27	0.13	1.05	1.12	0.23	0.38	0.12	1.17	1.04	0.28	0.34	0.15	6
[TC5]	1.00	0.93	0.22	0.26	0.23	1.04	0.78	0.29	0.27	0.17	1.16	0.88	0.29	0.37	0.29	6
[TC6]	1.77	0.47	0.15	0.11	0.04	1.63	0.41	0.23	0.14	0.03	1.50	0.51	0.14	0.18	0.06	6
[TC7]	1.26	0.90	0.35	0.33	0.11	1.46	1.04	0.38	0.27	0.15	1.53	1.07	0.32	0.45	0.13	6
[TC8]	1.24	0.91	0.27	0.32	0.10	1.37	0.99	0.28	0.34	0.07	1.23	0.85	0.32	0.39	0.12	6
[TC9]	1.36	0.92	0.76	0.32	0.21	1.65	0.89	0.77	0.27	0.43	1.74	0.80	0.80	0.36	0.28	5
[TC10]	1.37	1.09	0.33	0.29	0.05	1.19	1.03	0.21	0.33	0.10	1.28	1.03	0.26	0.44	0.09	6
[TC11]	1.30	0.41	0.31	0.11	0.09	1.27	0.38	0.41	0.18	0.08	1.32	0.33	0.34	0.23	0.08	6
[TC12]	1.48	0.75	0.76	0.34	0.39	1.58	1.08	0.85	0.48	0.36	1.59	0.80	0.79	0.33	0.30	6
[TC13]	1.38	0.93	0.71	0.41	0.36	1.69	0.86	0.86	0.30	0.30	1.41	0.80	0.88	0.50	0.17	5
[TC14]	0.80	0.47	0.10	0.03	0.04	0.78	0.56	0.19	0.08	0.01	0.76	0.55	0.14	0.07	0.03	6
[TC15]	1.27	0.99	0.27	0.28	0.12	1.23	1.08	0.38	0.30	0.09	1.58	1.17	0.46	0.46	0.11	6
[TC16]	0.95	0.78	0.38	0.26	0.30	0.96	0.86	0.36	0.28	0.26	1.21	0.81	0.40	0.42	0.32	5
[TC17]	1.44	0.72	0.63	0.32	0.35	1.90	1.05	1.04	0.33	0.35	1.70	0.97	0.77	0.48	0.39	5
[TC18]	0.02	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	6
[TC19]	0.15	0.01	0.00	0.00	0.00	0.16	0.02	0.00	0.01	0.00	0.23	0.02	0.00	0.00	0.00	6
[TC20]	0.35	0.05	0.00	0.00	0.01	0.43	0.14	0.03	0.01	0.00	0.40	0.11	0.03	0.01	0.00	5
[TC21]	1.52	1.00	0.81	0.23	0.35	1.54	1.18	0.88	0.44	0.31	1.84	0.91	0.78	0.44	0.37	6
[TC22]	1.34	0.45	0.40	0.07	0.09	1.16	0.41	0.54	0.17	0.15	1.49	0.50	0.47	0.13	0.16	5
[TC23]	0.83	0.24	0.10	0.03	0.01	0.97	0.36	0.10	0.05	0.01	1.04	0.34	0.09	0.08	0.02	6
[TC24]	1.32	0.40	0.29	0.16	0.13	1.60	0.46	0.41	0.22	0.08	1.86	0.70	0.46	0.32	0.14	6
[TC25]	1.10	0.88	0.28	0.34	0.29	1.39	1.03	0.49	0.29	0.27	1.52	1.26	0.54	0.60	0.30	4
[TC26]	1.31	0.90	0.92	0.20	0.36	2.12	1.33	1.25	0.40	0.45	1.71	1.46	1.07	0.58	0.46	5
[TC27]	0.82	0.52	0.16	0.05	0.02	0.94	0.56	0.25	0.09	0.02	1.01	0.67	0.20	0.10	0.02	6
[TC28]	1.39	0.38	0.14	0.11	0.01	1.61	0.53	0.16	0.14	0.05	1.74	0.56	0.20	0.25	0.04	6
[TC29]	0.69	0.09	0.00	0.00	0.00	0.75	0.12	0.01	0.00	0.00	0.77	0.09	0.02	0.02	0.00	6
[TC30]	1.42	0.99	0.68	0.27	0.32	1.47	1.09	0.79	0.36	0.35	1.54	1.03	0.99	0.26	0.32	5
[TC31]	0.85	0.24	0.08	0.01	0.00	0.97	0.35	0.07	0.07	0.02	0.85	0.31	0.09	0.07	0.01	6
[TC32]	1.18	0.27	0.13	0.04	0.03	1.24	0.32	0.31	0.07	0.06	1.22	0.36	0.28	0.10	0.12	6
[TC33]	2.51	1.63	0.79	0.87	0.13	2.61	1.92	0.85	0.72	0.27	2.49	1.72	0.85	0.64	0.47	6
[TC34]	0.72	0.26	0.12	0.04	0.02	0.78	0.43	0.29	0.10	0.03	0.96	0.39	0.21	0.07	0.08	6
[TC35]	2.01	1.40	0.82	0.74	0.36	2.26	1.94	1.20	0.70	0.64	2.37	1.84	1.04	0.85	0.87	6
[TC36]	2.19	1.75	1.41	1.13	0.65	2.49	1.65	1.84	1.29	0.62	2.34	1.98	1.68	1.35	0.83	6
[TC37]	2.06	1.05	0.73	0.28	0.18	2.28	1.07	0.95	0.27	0.37	2.17	1.19	1.03	0.54	0.52	6
[TC38]	0.15	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.19	0.03	0.00	0.00	0.00	6
[TC39]	0.82	0.26	0.04	0.00	0.00	0.85	0.25	0.08	0.01	0.01	0.83	0.24	0.07	0.03	0.00	6
[TC40]	0.53	0.06	0.02	0.00	0.00	0.65	0.08	0.03	0.00	0.00	0.60	0.11	0.02	0.01	0.00	6
[TC41]	0.62	0.07	0.02	0.00	0.00	0.63	0.10	0.03	0.01	0.00	0.76	0.09	0.01	0.00	0.00	6
[TC42]	1.23	0.80	0.69	0.30	0.25	1.56	1.02	0.70	0.32	0.42	1.46	0.94	0.78	0.43	0.38	6
[TC43]	1.53	0.89	0.79	0.28	0.24	1.62	0.98	0.74	0.29	0.24	1.44	0.99	0.73	0.25	0.35	5
[TC44]	1.10	1.14	0.27	0.18	0.13	1.29	1.13	0.32	0.34	0.13	1.49	1.16	0.48	0.40	0.12	6
[TC45]	1.30	0.82	0.84	0.26	0.34	1.61	1.05	0.84	0.40	0.25	2.14	0.89	0.91	0.30	0.32	5
[TC46]	1.49	0.78	0.71	0.30	0.31	1.67	1.03	0.95	0.31	0.42	1.71	1.05	0.83	0.26	0.37	5
[TC47]	1.44	0.95	0.37	0.24	0.06	1.64	1.19	0.39	0.28	0.10	1.82	0.88	0.38	0.34	0.10	6
[TC48]	0.36	0.03	0.00	0.00	0.00	0.42	0.04	0.00	0.00	0.00	0.41	0.03	0.00	0.00	0.00	6
[TC49]	1.29	0.86	0.75	0.23	0.36	1.32	0.82	0.70	0.26	0.35	1.38	0.79	0.68	0.30	0.30	5
Mean	1.14	0.63	0.37	0.21	0.15	1.25	0.72	0.45	0.24	0.17	1.29	0.71	0.44	0.29	0.19	
Median	1.23	0.72	0.28	0.17	0.08	1.30	0.78	0.35	0.20	0.09	1.37	0.74	0.37	0.25	0.10	
Max	2.53	1.84	1.43	1.15	0.75	2.83	2.01	1.91	1.35	0.88	2.83	2.11	1.72	1.35	0.98	
Min	0.02	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	
Percentile (%10)	0.35	0.05	0.00	0.00	0.00	0.42	0.07	0.01	0.00	0.00	0.42	0.07	0.01	0.00	0.00	
Percentile (%25)	0.77	0.24	0.07	0.02	0.01	0.83	0.27	0.10	0.05	0.01	0.87	0.27	0.11	0.07	0.02	
Percentile (%50)	1.23	0.72	0.28	0.17	0.08	1.30	0.78	0.35	0.20	0.09	1.37	0.74	0.37	0.25	0.10	
Percentile (%75)	1.41	0.91	0.64	0.29	0.28	1.59	1.08	0.73	0.33	0.26	1.59	1.01	0.71	0.40	0.28	
Percentile (%90)	1.71	1.08	0.80	0.39	0.36	1.89	1.26	0.98	0.45	0.42	1.98	1.28	0.96	0.58	0.44	

Table E.63. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group 0 - (Policy Group 5)

Policy No	11	12	13	14	15	31	32	33	34	51	52	53	54	55	56	Selected Atb Values
Routine Delivery Check Period	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Atb Values	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	
[TC1]	5.16	1.21	0.87	0.28	0.30	5.48	1.63	0.91	0.30	0.19	6.31	1.81	1.25	0.53	0.42	6
[TC2]	7.85	5.75	3.77	3.22	4.10	9.53	6.67	3.41	3.28	3.53	9.58	7.04	3.33	4.07	3.52	5
[TC3]	8.89	8.01	7.85	7.70	9.85	10.53	8.19	7.82	6.44	8.08	11.31	7.38	7.80	8.00	8.38	5
[TC4]	10.58	9.62	9.41	10.70	12.23	10.71	9.42	9.64	9.82	11.65	11.62	10.65	9.23	10.63	10.99	3
[TC5]	13.13	11.64	12.21	12.71	13.49	13.08	11.42	11.70	11.01	10.93	12.86	11.25	12.07	12.66	11.51	6
[TC6]	9.21	6.32	6.12	6.32	6.91	8.35	8.75	6.88	5.90	6.46	9.39	8.19	7.45	7.27	6.12	5
[TC7]	11.19	9.52	7.90	8.46	9.08	11.78	9.28	9.12	8.26	8.94	11.16	9.32	9.58	8.50	9.64	5
[TC8]	11.17	8.71	10.33	9.58	9.97	11.30	10.73	9.62	9.16	10.06	10.06	9.76	9.93	10.86	9.38	3
[TC9]	15.04	11.03	13.42	13.30	14.18	14.83	14.46	14.59	12.28	11.47	15.99	13.53	13.91	13.20	14.40	5
[TC10]	9.61	9.60	9.84	11.69	11.20	12.24	10.36	9.60	9.75	10.34	11.55	11.07	10.68	9.95	9.23	4
[TC11]	9.11	6.96	7.64	6.89	8.82	10.76	8.14	6.74	7.92	7.89	10.22	7.57	7.00	8.60	8.26	5
[TC12]	14.62	15.01	12.95	14.70	16.81	16.13	12.92	14.59	16.04	14.25	14.90	13.56	15.73	15.63	16.49	4
[TC13]	14.32	13.46	14.37	13.39	13.86	17.25	13.61	14.31	13.59	15.03	17.31	15.33	14.04	15.23	13.88	5
[TC14]	9.95	5.91	5.58	3.86	4.00	9.71	7.44	5.69	4.50	4.04	9.98	7.39	5.84	5.16	4.56	6
[TC15]	10.64	8.25	9.98	9.11	10.49	12.00	10.46	9.49	10.54	10.08	13.42	11.00	10.63	10.84	12.49	3
[TC16]	13.68	12.94	11.67	11.96	13.22	12.72	11.80	11.25	12.54	11.88	13.74	12.40	11.72	15.01	12.73	4
[TC17]	14.57	11.07	12.71	15.33	15.47	15.00	12.61	13.73	13.73	13.47	15.72	14.43	13.11	13.81	13.19	3
[TC18]	2.92	0.74	0.31	0.12	0.06	3.77	1.04	0.43	0.10	0.05	4.00	1.31	0.56	0.33	0.05	6
[TC19]	4.50	2.07	1.06	0.68	0.59	4.62	2.49	1.18	0.68	0.48	5.04	3.13	1.00	0.85	0.65	6
[TC20]	5.02	3.63	1.95	1.78	1.45	5.98	3.86	2.31	1.55	1.88	6.95	4.89	2.77	2.44	1.85	6
[TC21]	13.43	11.55	13.14	13.74	15.25	18.01	15.24	13.74	13.84	14.15	17.29	14.11	13.80	14.56	15.21	4
[TC22]	9.99	7.50	6.29	7.95	8.13	10.61	8.61	8.09	8.27	7.33	11.16	9.11	8.31	8.07	8.89	4
[TC23]	9.20	5.24	3.47	3.77	3.98	10.33	7.39	3.42	3.18	3.59	10.82	8.07	4.51	4.13	4.23	4
[TC24]	9.90	7.00	7.10	7.90	9.12	11.62	9.24	7.71	8.64	8.56	13.14	10.25	8.79	8.34	8.12	3
[TC25]	10.88	9.94	11.20	10.21	12.11	14.09	11.21	12.02	11.90	12.64	13.74	13.11	12.02	13.68	14.60	3
[TC26]	16.54	13.52	15.79	18.64	14.70	18.51	14.38	15.73	13.78	16.79	19.73	20.31	15.99	16.13	17.28	3
[TC27]	8.61	5.66	5.78	4.60	4.48	11.05	7.57	5.90	4.69	4.03	10.84	8.04	7.46	5.03	4.63	6
[TC28]	8.57	6.16	6.60	5.81	6.19	11.43	7.13	6.65	6.07	5.00	11.29	8.87	6.16	5.62	5.64	5
[TC29]	4.93	2.92	2.05	1.32	1.54	6.18	4.42	2.26	2.24	1.27	6.08	4.03	2.20	1.93	1.92	5
[TC30]	13.18	13.11	12.00	13.84	14.94	17.25	12.98	13.55	14.92	14.91	14.72	14.56	14.27	15.45	14.45	4
[TC31]	7.74	4.91	3.78	2.90	3.15	9.87	7.61	2.51	2.34	2.49	10.16	7.31	3.23	3.36	2.97	5
[TC32]	19.08	11.93	8.32	6.05	7.01	19.91	11.89	8.93	6.92	6.42	19.98	12.03	8.92	6.92	7.09	5
[TC33]	19.05	19.26	19.56	21.10	20.99	15.53	18.44	18.72	20.11	20.57	18.65	21.25	19.55	17.61	17.48	2
[TC34]	13.03	11.29	8.86	6.99	5.65	12.34	12.52	9.66	6.75	6.31	12.47	13.00	8.81	7.46	6.03	6
[TC35]	20.92	19.22	23.55	21.72	22.65	21.09	19.73	21.08	21.68	19.24	20.52	21.31	21.76	18.81	20.67	2
[TC36]	24.27	23.92	23.82	23.83	26.26	25.01	23.63	24.22	22.68	24.65	21.67	26.67	22.73	24.20	29.23	5
[TC37]	20.28	18.79	17.31	19.33	19.17	17.43	18.40	17.95	18.41	20.12	19.66	19.80	18.69	16.85	19.06	4
[TC38]	2.90	1.61	0.88	0.54	0.41	2.49	1.71	1.00	0.47	0.50	2.77	1.72	0.88	0.70	0.46	5
[TC39]	4.98	4.99	3.47	3.49	3.00	5.05	4.60	2.74	2.62	3.58	4.92	4.27	2.71	2.55	2.90	5
[TC40]	6.34	1.94	1.69	1.67	1.11	5.89	2.29	1.34	1.35	1.24	6.98	2.30	1.70	0.99	1.27	6
[TC41]	2.84	2.00	2.19	1.60	1.05	3.23	2.46	1.10	1.43	1.21	2.74	1.71	1.34	1.59	1.36	4
[TC42]	13.92	14.34	15.25	15.40	15.67	12.95	15.31	14.61	16.31	15.43	14.87	13.16	14.14	13.84	16.37	6
[TC43]	10.66	12.70	12.40	13.91	12.52	11.28	12.52	13.18	13.53	15.31	13.22	10.75	12.67	14.68	13.75	3
[TC44]	8.37	8.40	9.61	9.96	10.39	9.15	8.35	9.32	9.77	9.77	7.82	7.25	10.01	11.28	11.00	2
[TC45]	12.25	11.76	11.73	13.15	12.80	11.44	12.13	13.20	14.16	12.36	10.15	12.26	12.53	14.74	13.06	4
[TC46]	13.93	13.14	13.92	14.45	14.18	11.59	12.79	16.56	13.99	15.94	13.33	13.44	12.87	14.98	13.41	3
[TC47]	7.78	7.42	10.10	9.64	7.81	8.48	8.79	9.28	9.00	9.45	8.83	7.91	8.45	8.71	8.37	3
[TC48]	3.38	1.77	1.67	0.78	0.59	3.06	2.17	1.19	0.80	0.65	3.21	1.70	1.36	0.56	0.79	5
[TC49]	12.57	12.94	12.28	16.80	16.17	13.03	14.44	15.32	15.30	17.29	13.16	13.78	13.78	15.41	15.02	2
Mean	10.83	9.11	9.06	9.24	9.53	11.50	9.86	9.27	9.03	9.21	11.74	10.27	9.33	9.42	9.45	
Median	9.17	7.33	7.62	7.86	8.82	10.43	8.08	7.88	7.66	8.77	10.49	8.38	8.45	8.41	8.64	
Max	32.40	29.18	28.92	32.72	30.65	32.55	27.73	28.32	29.89	31.69	32.77	33.62	28.31	27.20	29.78	
Min	2.76	0.74	0.31	0.12	0.06	2.48	1.04	0.43	0.10	0.05	2.51	1.31	0.56	0.33	0.05	
Percentile (%10)	3.32	1.97	1.66	1.21	0.75	3.22	2.39	1.19	1.09	0.86	3.54	1.98	1.36	0.90	1.01	
Percentile (%25)	5.23	3.43	3.24	3.25	3.34	5.57	4.47	3.42	3.07	3.01	6.00	4.35	3.76	3.44	3.24	
Percentile (%50)	9.17	7.33	7.62	7.86	8.82	10.43	8.08	7.88	7.66	8.77	10.49	8.38	8.45	8.41	8.64	
Percentile (%75)	14.84	12.54	12.59	13.52	14.45	15.43	14.11	13.31	13.23	12.04	15.88	14.15	13.40	13.90	13.49	
Percentile (%90)	21.17	21.87	18.55	17.53	17.13	21.16	21.74	19.47	17.81	18.43	21.22	21.74	18.91	18.22	17.73	

Table E.64. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group A + (Policy Group 5)

Policy No	11	12	13	14	15	31	32	33	34	51	52	53	54	55	56	Selected Atb Values
Routine Delivery Check Period	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Atb Values	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	
[TC1]	0.03	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	6
[TC2]	0.94	0.13	0.03	0.01	0.01	0.93	0.16	0.06	0.01	0.00	0.92	0.17	0.02	0.01	0.01	6
[TC3]	0.74	0.51	0.18	0.04	0.00	0.65	0.49	0.16	0.03	0.02	0.66	0.52	0.19	0.08	0.01	6
[TC4]	1.29	0.39	0.27	0.11	0.11	1.43	0.39	0.33	0.09	0.11	1.28	0.42	0.31	0.10	0.19	5
[TC5]	1.28	0.49	0.36	0.08	0.07	1.27	0.45	0.31	0.13	0.08	1.14	0.42	0.35	0.12	0.14	6
[TC6]	0.75	0.20	0.17	0.07	0.02	0.75	0.31	0.16	0.08	0.00	0.70	0.23	0.23	0.07	0.03	6
[TC7]	1.80	0.43	0.12	0.07	0.04	1.63	0.52	0.16	0.19	0.02	1.47	0.53	0.15	0.17	0.05	6
[TC8]	1.39	0.56	0.32	0.11	0.02	1.52	0.46	0.36	0.09	0.03	1.42	0.46	0.42	0.15	0.06	6
[TC9]	1.46	0.82	0.31	0.28	0.12	1.35	1.05	0.28	0.37	0.16	1.55	0.80	0.26	0.31	0.13	6
[TC10]	1.51	0.37	0.30	0.09	0.03	1.33	0.44	0.37	0.07	0.02	1.31	0.32	0.36	0.18	0.04	6
[TC11]	1.41	0.39	0.15	0.05	0.04	1.65	0.65	0.12	0.08	0.02	1.56	0.48	0.16	0.07	0.04	6
[TC12]	1.12	1.00	0.36	0.31	0.14	1.15	0.95	0.38	0.26	0.09	1.36	1.28	0.35	0.44	0.11	6
[TC13]	1.31	0.88	0.39	0.25	0.18	1.33	1.00	0.40	0.33	0.10	1.31	1.00	0.37	0.34	0.08	6
[TC14]	0.89	0.27	0.07	0.02	0.00	0.94	0.25	0.06	0.04	0.00	0.78	0.28	0.07	0.04	0.01	6
[TC15]	1.44	0.40	0.36	0.09	0.02	1.76	0.59	0.44	0.13	0.05	1.63	0.56	0.49	0.16	0.08	6
[TC16]	1.60	0.37	0.41	0.15	0.13	1.55	0.53	0.31	0.13	0.11	1.43	0.48	0.29	0.12	0.08	6
[TC17]	1.29	0.99	0.28	0.23	0.10	1.53	0.96	0.48	0.25	0.11	1.41	1.19	0.42	0.30	0.17	6
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	6
[TC19]	0.06	0.00	0.00	0.00	0.00	0.06	0.01	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	6
[TC20]	0.20	0.04	0.00	0.00	0.00	0.30	0.04	0.00	0.00	0.00	0.29	0.06	0.01	0.01	0.00	6
[TC21]	1.20	0.93	0.28	0.22	0.16	1.19	0.96	0.39	0.16	0.11	1.30	0.93	0.38	0.42	0.15	6
[TC22]	1.79	0.62	0.14	0.06	0.03	1.68	0.53	0.15	0.05	0.02	1.63	0.52	0.16	0.06	0.06	6
[TC23]	0.88	0.10	0.03	0.00	0.00	1.20	0.18	0.04	0.02	0.00	1.12	0.22	0.08	0.03	0.01	5
[TC24]	1.72	0.50	0.19	0.06	0.02	1.82	0.73	0.23	0.08	0.04	2.13	0.83	0.19	0.12	0.08	6
[TC25]	1.28	0.41	0.34	0.11	0.06	1.53	0.60	0.51	0.14	0.11	1.41	0.54	0.39	0.19	0.14	6
[TC26]	1.09	0.94	0.30	0.26	0.12	1.39	1.22	0.45	0.28	0.15	1.51	1.36	0.37	0.37	0.17	6
[TC27]	0.92	0.26	0.07	0.02	0.01	0.92	0.38	0.10	0.04	0.01	1.08	0.39	0.10	0.06	0.01	6
[TC28]	0.79	0.19	0.08	0.04	0.00	0.83	0.27	0.11	0.08	0.01	0.93	0.33	0.07	0.09	0.03	6
[TC29]	0.38	0.03	0.00	0.00	0.00	0.48	0.03	0.00	0.00	0.00	0.49	0.04	0.01	0.00	0.00	6
[TC30]	1.24	0.96	0.39	0.31	0.16	1.36	1.09	0.34	0.31	0.15	1.20	1.09	0.32	0.30	0.08	6
[TC31]	0.45	0.16	0.05	0.01	0.00	0.52	0.19	0.09	0.00	0.00	0.53	0.16	0.08	0.00	0.00	6
[TC32]	0.43	0.10	0.05	0.00	0.00	0.50	0.07	0.03	0.00	0.00	0.54	0.18	0.01	0.00	0.01	6
[TC33]	1.68	0.61	0.27	0.09	0.04	1.61	0.61	0.21	0.07	0.05	1.79	0.84	0.16	0.16	0.07	6
[TC34]	0.29	0.08	0.02	0.00	0.01	0.32	0.06	0.01	0.00	0.00	0.38	0.09	0.01	0.02	0.01	5
[TC35]	1.64	0.58	0.42	0.16	0.08	1.68	0.70	0.40	0.16	0.17	2.13	0.67	0.39	0.26	0.11	6
[TC36]	1.10	1.09	0.35	0.33	0.34	1.11	0.92	0.38	0.25	0.33	1.30	1.27	0.28	0.46	0.43	5
[TC37]	1.51	0.44	0.25	0.11	0.03	1.52	0.61	0.28	0.12	0.10	1.57	0.74	0.28	0.30	0.15	6
[TC38]	0.08	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	6
[TC39]	1.08	0.17	0.02	0.01	0.00	1.00	0.17	0.05	0.01	0.00	0.99	0.15	0.04	0.00	0.00	6
[TC40]	0.41	0.05	0.00	0.00	0.00	0.41	0.09	0.00	0.00	0.00	0.49	0.05	0.00	0.00	0.00	6
[TC41]	0.34	0.02	0.00	0.00	0.00	0.54	0.03	0.01	0.00	0.00	0.50	0.03	0.01	0.00	0.00	6
[TC42]	1.12	0.99	0.24	0.35	0.25	1.11	0.89	0.22	0.24	0.22	1.34	0.94	0.33	0.23	0.40	6
[TC43]	1.42	0.90	0.30	0.16	0.13	1.23	0.88	0.26	0.30	0.09	1.35	1.05	0.32	0.22	0.10	6
[TC44]	1.31	0.42	0.37	0.06	0.04	1.29	0.58	0.31	0.10	0.10	1.87	0.54	0.51	0.14	0.11	6
[TC45]	1.22	0.97	0.30	0.28	0.06	1.50	0.82	0.38	0.28	0.13	1.50	1.08	0.45	0.31	0.20	6
[TC46]	1.18	1.19	0.27	0.24	0.10	1.37	1.04	0.31	0.31	0.11	1.42	1.14	0.34	0.27	0.12	6
[TC47]	1.47	0.49	0.14	0.07	0.01	1.72	0.41	0.15	0.15	0.04	1.68	0.51	0.20	0.09	0.04	6
[TC48]	0.15	0.00	0.00	0.00	0.00	0.18	0.01	0.00	0.00	0.00	0.20	0.01	0.00	0.00	0.00	6
[TC49]	1.01	0.89	0.28	0.26	0.10	1.24	1.01	0.31	0.30	0.09	1.27	0.83	0.33	0.27	0.13	6
Mean	1.01	0.46	0.19	0.11	0.06	1.07	0.50	0.21	0.12	0.06	1.10	0.53	0.21	0.14	0.08	
Median	1.12	0.41	0.19	0.07	0.03	1.23	0.49	0.21	0.08	0.02	1.28	0.48	0.20	0.11	0.05	
Max	1.86	1.26	0.47	0.35	0.34	1.87	1.28	0.54	0.40	0.36	2.20	1.38	0.53	0.49	0.43	
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	
Percentile (%10)	0.19	0.01	0.00	0.00	0.00	0.28	0.02	0.00	0.00	0.00	0.27	0.03	0.00	0.00	0.00	
Percentile (%25)	0.74	0.13	0.03	0.01	0.00	0.65	0.17	0.05	0.01	0.00	0.66	0.17	0.04	0.01	0.01	
Percentile (%50)	1.12	0.41	0.19	0.07	0.03	1.23	0.49	0.21	0.08	0.02	1.28	0.48	0.20	0.11	0.05	
Percentile (%75)	1.41	0.82	0.30	0.16	0.09	1.50	0.81	0.33	0.19	0.11	1.47	0.83	0.35	0.26	0.12	
Percentile (%90)	1.62	0.98	0.37	0.28	0.15	1.68	1.01	0.40	0.29	0.13	1.67	1.11	0.41	0.33	0.18	

**Table E.65. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group A - (Policy Group 5)**

Policy No	11	12	13	14	15	31	32	33	34	51	52	53	54	55	56	Selected Atb Values
Routine Delivery Check Period	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Atb Values	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	
[TC1]	1.64	0.40	0.22	0.11	0.07	1.86	0.60	0.19	0.15	0.09	1.66	0.73	0.21	0.21	0.05	6
[TC2]	3.40	1.69	1.57	2.28	2.58	3.32	1.96	1.73	1.91	2.31	3.35	1.53	1.82	2.69	2.20	4
[TC3]	4.30	4.90	4.74	5.05	5.48	4.47	5.01	4.45	5.00	5.65	4.47	4.92	5.12	4.80	5.04	4
[TC4]	7.12	7.26	7.82	6.97	6.76	6.84	5.86	7.56	7.28	7.66	6.65	7.22	6.82	8.28	7.44	3
[TC5]	7.73	8.42	8.49	8.65	8.47	7.97	8.14	7.72	8.75	9.02	8.70	8.48	7.94	9.37	8.04	4
[TC6]	3.35	3.92	4.33	3.82	4.01	5.10	4.22	4.29	3.64	4.05	4.27	4.49	4.02	4.17	4.12	5
[TC7]	6.06	5.67	6.62	6.30	6.66	5.49	6.44	6.16	6.35	8.15	6.72	6.15	6.22	6.43	8.12	2
[TC8]	5.80	7.75	6.43	7.15	9.07	6.42	6.49	6.90	8.01	9.37	5.77	6.25	6.80	7.35	9.32	2
[TC9]	9.70	11.19	11.08	9.66	10.04	10.22	9.38	9.53	10.37	10.60	10.32	11.01	10.56	11.15	9.94	3
[TC10]	6.14	6.34	6.26	7.42	8.90	6.61	6.96	6.06	7.20	8.59	6.35	6.54	7.25	7.55	8.17	4
[TC11]	4.56	4.97	4.75	5.54	4.83	4.03	5.09	4.98	5.37	5.33	4.51	5.39	5.13	4.96	5.54	2
[TC12]	10.02	11.29	11.75	11.39	10.67	10.24	11.48	11.67	12.55	12.05	11.66	10.35	11.51	10.95	11.28	2
[TC13]	8.89	9.98	11.37	10.13	10.77	9.75	9.38	8.86	10.85	11.45	9.10	10.26	11.06	10.22	9.07	4
[TC14]	3.37	3.72	2.39	2.49	3.15	3.76	3.77	2.25	2.91	3.46	3.34	3.34	2.17	2.81	3.48	4
[TC15]	5.37	5.95	6.61	7.09	8.51	5.90	6.69	7.61	7.43	9.54	6.27	6.52	7.51	8.39	8.22	2
[TC16]	8.84	8.70	7.95	9.64	8.91	8.01	8.71	8.42	10.41	8.86	8.21	8.40	8.81	11.08	9.66	4
[TC17]	10.46	10.19	9.91	11.40	10.15	9.24	9.67	10.63	10.26	12.87	9.40	9.97	10.56	10.23	11.90	4
[TC18]	0.94	0.30	0.04	0.00	0.00	1.34	0.36	0.09	0.02	0.03	1.33	0.50	0.09	0.05	0.03	6
[TC19]	1.44	1.11	0.37	0.29	0.14	1.90	1.24	0.42	0.31	0.16	1.64	0.96	0.48	0.39	0.15	6
[TC20]	1.40	0.74	0.95	0.40	0.35	2.04	1.20	1.17	0.53	0.66	2.06	1.59	1.06	0.69	0.51	6
[TC21]	9.85	9.87	10.93	10.70	10.20	9.59	11.50	10.49	13.09	11.93	10.74	10.25	11.76	11.10	11.18	2
[TC22]	4.73	4.51	4.70	5.97	5.70	4.67	4.81	5.52	5.47	6.57	4.68	5.20	5.69	5.36	5.65	3
[TC23]	3.35	1.62	1.62	2.23	1.93	3.79	1.59	2.02	2.68	2.93	4.06	1.98	2.02	2.09	2.32	4
[TC24]	4.13	3.97	5.30	5.39	5.24	6.18	5.78	5.21	6.90	6.04	5.96	6.52	6.37	6.05	5.99	3
[TC25]	7.47	7.78	8.41	7.79	8.33	9.23	8.11	8.99	8.58	10.57	8.63	9.23	8.78	9.06	10.21	2
[TC26]	12.71	10.44	12.40	12.22	10.53	13.05	13.23	12.96	14.53	12.88	12.26	11.81	13.48	11.71	13.04	3
[TC27]	2.71	3.42	2.26	2.42	3.28	3.82	4.26	2.64	2.46	3.55	4.02	4.64	2.96	3.06	3.68	5
[TC28]	3.44	4.17	3.17	3.17	3.39	4.23	4.42	4.04	3.13	4.13	4.08	3.75	2.98	3.90	3.41	5
[TC29]	1.20	1.04	0.94	1.01	0.43	1.90	1.09	0.96	0.85	0.60	1.53	1.02	0.93	1.08	0.47	6
[TC30]	10.80	9.68	9.17	11.18	10.55	10.48	10.00	12.27	11.69	12.80	11.00	11.34	11.63	12.98	11.50	4
[TC31]	2.67	1.25	1.26	1.55	2.01	3.86	1.89	1.54	1.54	1.59	3.36	1.49	1.47	1.50	2.02	4
[TC32]	5.31	4.80	3.06	2.97	2.61	5.45	4.69	3.49	3.76	3.80	6.55	4.49	3.40	4.22	2.73	6
[TC33]	10.41	11.85	11.89	12.43	10.72	10.47	10.88	10.24	13.95	12.36	10.34	12.29	11.79	13.47	11.70	2
[TC34]	5.17	5.89	3.11	2.67	2.42	6.33	4.94	3.57	3.05	3.38	6.84	5.58	3.68	2.93	2.85	6
[TC35]	11.89	15.28	14.22	16.02	14.06	13.25	13.02	14.68	16.83	17.48	13.34	13.78	14.32	15.91	17.72	2
[TC36]	15.83	20.37	18.51	18.09	18.63	17.21	17.47	17.32	20.35	19.17	16.62	16.16	18.92	19.48	21.09	2
[TC37]	9.41	10.79	10.68	10.06	9.76	9.85	10.21	11.68	9.94	11.86	9.70	10.76	10.59	10.59	10.67	2
[TC38]	1.76	0.41	0.33	0.18	0.11	1.91	0.64	0.41	0.18	0.18	1.67	0.55	0.44	0.15	0.23	6
[TC39]	2.96	1.34	1.73	1.74	1.44	3.16	1.77	1.61	1.99	1.90	3.13	1.30	1.73	1.84	2.00	3
[TC40]	1.45	1.08	0.80	0.71	0.49	1.69	0.96	1.00	0.95	0.43	1.18	0.94	0.78	0.79	0.55	6
[TC41]	1.21	1.04	0.94	0.82	0.51	1.55	1.06	1.01	0.76	0.57	1.35	1.05	0.96	0.77	0.67	6
[TC42]	10.62	11.00	13.20	12.14	12.48	11.25	12.80	12.53	13.06	10.99	11.43	10.81	12.33	13.84	12.75	2
[TC43]	9.22	9.59	9.99	12.24	11.78	10.53	11.79	10.82	11.12	10.85	10.08	10.43	9.85	11.17	11.24	4
[TC44]	5.56	6.94	6.63	7.26	8.71	6.84	6.92	7.25	6.87	8.34	6.59	6.26	7.23	7.51	8.40	2
[TC45]	10.14	7.67	10.74	9.84	10.21	9.33	11.15	10.59	9.78	9.64	9.74	11.07	10.83	9.65	9.66	3
[TC46]	10.05	11.55	11.67	12.36	12.30	11.65	10.11	12.94	10.82	11.39	12.47	10.92	11.62	12.05	12.58	2
[TC47]	5.35	5.15	5.94	5.84	7.15	5.79	6.53	6.40	6.98	7.38	5.47	7.07	7.68	6.66	7.26	3
[TC48]	1.26	0.79	0.48	0.37	0.30	1.21	1.19	0.44	0.29	0.39	1.25	1.10	0.43	0.30	0.28	6
[TC49]	13.42	12.17	12.78	12.14	11.34	11.60	10.08	10.44	12.75	12.33	11.28	11.21	11.34	11.00	12.04	3
Mean	6.22	6.33	6.34	6.48	6.45	6.62	6.44	6.40	6.81	7.06	6.64	6.48	6.55	6.78	6.86	
Median	4.70	4.67	5.35	6.62	5.81	5.16	5.31	5.40	6.40	6.86	4.94	5.38	5.35	6.49	6.37	
Max	19.30	20.95	20.03	19.96	18.79	18.44	18.60	19.11	22.05	22.36	18.23	19.24	19.98	21.12	22.44	
Min	0.94	0.30	0.04	0.00	0.00	1.21	0.36	0.09	0.02	0.03	1.16	0.50	0.09	0.05	0.03	
Percentile (%10)	1.34	0.73	0.63	0.39	0.36	1.60	0.98	0.77	0.48	0.40	1.62	0.90	0.69	0.54	0.39	
Percentile (%25)	1.97	1.73	1.56	1.82	2.07	2.11	1.86	1.70	2.07	1.67	2.15	1.73	1.73	1.99	2.05	
Percentile (%50)	4.70	4.67	5.35	6.62	5.81	5.16	5.31	5.40	6.40	6.86	4.94	5.38	5.35	6.49	6.37	
Percentile (%75)	9.71	9.38	9.80	9.97	10.37	9.90	10.13	9.94	10.18	10.75	10.04	10.11	10.36	10.72	9.77	
Percentile (%90)	13.93	14.36	12.61	12.76	11.52	14.64	13.82	12.87	13.70	13.16	15.87	13.68	13.23	13.09	12.86	

Table E.66. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group B + (Policy Group 5)

Policy No	11	12	13	14	15	31	32	33	34	51	52	53	54	55	56	Selected Atb Values
Routine Delivery Check Period	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Atb Values	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	
[TC1]	0.31	0.06	0.01	0.00	0.00	0.35	0.11	0.02	0.00	0.00	0.38	0.12	0.01	0.01	0.00	6
[TC2]	1.22	1.09	0.23	0.27	0.17	1.02	1.00	0.25	0.31	0.08	1.23	1.01	0.27	0.35	0.10	6
[TC3]	1.05	0.75	0.83	0.79	0.64	0.99	0.90	0.85	0.83	0.45	1.28	0.73	0.53	0.76	0.48	6
[TC4]	3.24	1.07	1.00	0.93	1.08	3.46	1.18	1.06	0.89	1.31	3.21	0.85	1.10	1.13	0.93	5
[TC5]	3.10	1.18	1.03	1.20	1.41	3.20	0.92	1.02	1.28	1.45	3.13	1.10	1.12	1.06	1.44	3
[TC6]	1.32	1.13	0.73	0.25	0.59	1.20	1.02	0.72	0.38	0.31	1.34	0.79	1.03	0.36	0.42	6
[TC7]	1.28	0.92	0.89	0.82	1.01	1.30	1.25	0.66	0.91	0.88	0.80	1.31	0.75	0.77	0.96	4
[TC8]	3.25	1.07	0.79	0.91	1.09	3.33	1.13	0.91	1.13	0.91	3.45	1.05	0.98	1.16	1.08	4
[TC9]	2.79	1.58	1.20	1.61	1.81	3.41	1.59	1.52	1.63	1.69	2.95	1.74	1.45	1.50	1.79	4
[TC10]	3.39	1.07	0.78	1.23	1.39	3.32	1.02	0.68	1.18	1.04	3.79	0.87	0.89	1.24	0.94	4
[TC11]	1.21	0.67	0.89	0.75	0.43	1.11	0.97	0.74	0.94	0.61	1.02	0.84	0.77	0.90	0.46	6
[TC12]	3.17	1.36	1.50	1.91	2.07	3.08	1.47	1.53	1.97	2.08	3.18	1.40	1.55	1.71	2.21	3
[TC13]	3.35	1.17	1.23	1.74	2.05	3.25	1.35	1.39	1.78	1.82	3.10	1.53	1.68	1.91	1.38	3
[TC14]	1.26	0.76	0.32	0.37	0.28	0.97	0.99	0.30	0.37	0.27	0.94	0.74	0.35	0.20	0.31	6
[TC15]	0.82	1.04	1.13	0.84	1.45	1.26	1.58	0.88	1.31	1.26	1.33	1.59	1.17	1.22	1.25	2
[TC16]	3.15	1.16	1.30	1.26	1.58	3.06	1.20	1.38	1.42	1.53	3.52	1.21	1.01	1.48	1.68	3
[TC17]	3.64	1.30	1.13	1.60	1.51	3.57	1.44	1.84	1.66	1.78	3.44	1.90	1.75	1.48	1.56	4
[TC18]	0.19	0.01	0.00	0.00	0.00	0.29	0.02	0.00	0.00	0.00	0.32	0.03	0.00	0.00	0.00	6
[TC19]	0.55	0.13	0.02	0.00	0.00	0.55	0.15	0.02	0.00	0.00	0.64	0.19	0.02	0.00	0.00	6
[TC20]	0.75	0.26	0.16	0.06	0.02	0.90	0.31	0.24	0.07	0.01	0.95	0.26	0.29	0.08	0.03	6
[TC21]	3.17	1.32	1.87	1.63	1.85	3.33	1.73	1.30	2.25	1.80	3.15	1.22	1.61	2.19	1.92	4
[TC22]	1.10	0.78	0.86	0.79	0.31	1.13	0.88	0.59	0.89	0.36	1.28	0.91	0.72	0.90	0.52	6
[TC23]	1.28	1.13	0.22	0.22	0.12	1.38	1.19	0.41	0.36	0.16	1.52	1.11	0.36	0.34	0.12	6
[TC24]	1.03	0.68	0.74	0.86	0.46	1.50	1.36	0.97	1.08	0.55	1.92	1.54	1.05	1.14	0.67	6
[TC25]	3.27	1.06	1.07	1.15	1.58	3.95	1.59	1.60	1.26	1.65	4.59	1.48	1.56	1.32	1.71	3
[TC26]	3.10	1.73	1.39	2.13	2.52	3.96	1.93	2.10	2.94	2.76	4.17	2.42	2.57	2.30	2.72	4
[TC27]	0.87	0.77	0.30	0.32	0.25	1.39	1.18	0.37	0.26	0.28	1.46	1.32	0.42	0.31	0.32	5
[TC28]	1.49	0.88	0.98	0.29	0.39	1.51	1.07	0.93	0.30	0.37	1.33	0.88	0.95	0.35	0.35	5
[TC29]	0.92	0.52	0.18	0.06	0.01	0.93	0.62	0.22	0.07	0.01	0.92	0.60	0.18	0.06	0.01	6
[TC30]	3.15	1.59	1.26	2.13	1.96	3.52	1.63	1.92	2.31	3.42	1.50	1.51	2.15	1.90	1.4	4
[TC31]	1.52	0.98	0.33	0.27	0.12	1.62	1.01	0.32	0.32	0.11	1.50	1.20	0.37	0.36	0.08	6
[TC32]	1.41	0.84	0.52	0.29	0.23	1.47	0.99	0.67	0.32	0.22	1.62	1.15	0.70	0.39	0.36	6
[TC33]	1.90	2.30	2.05	1.71	1.65	1.77	2.73	1.93	1.09	1.84	1.72	2.44	2.01	1.36	1.85	6
[TC34]	1.25	0.62	0.56	0.29	0.15	1.67	0.82	0.74	0.28	0.32	1.24	0.96	0.82	0.39	0.37	6
[TC35]	4.18	2.08	1.83	2.45	2.63	5.30	2.41	1.92	1.81	3.43	4.87	2.47	2.19	1.96	2.66	4
[TC36]	4.91	4.71	3.28	3.29	3.55	4.48	4.61	3.01	2.39	3.32	4.30	5.12	3.47	2.91	4.37	5
[TC37]	2.29	1.50	1.73	1.59	1.23	2.48	1.40	2.29	1.29	0.90	1.95	1.80	2.02	1.55	1.20	6
[TC38]	0.51	0.12	0.01	0.00	0.00	0.52	0.20	0.03	0.00	0.00	0.56	0.19	0.04	0.01	0.00	6
[TC39]	1.38	0.95	0.26	0.27	0.14	1.19	0.95	0.33	0.19	0.11	1.19	0.98	0.27	0.26	0.09	6
[TC40]	0.82	0.53	0.16	0.04	0.00	0.78	0.51	0.15	0.05	0.01	0.78	0.53	0.14	0.04	0.01	6
[TC41]	0.80	0.40	0.13	0.04	0.01	0.80	0.55	0.16	0.05	0.01	0.65	0.57	0.17	0.08	0.02	6
[TC42]	3.42	1.57	1.68	1.89	2.14	3.28	1.58	1.81	2.35	2.12	3.31	1.86	1.80	2.35	1.82	3
[TC43]	3.24	1.31	1.20	1.51	2.42	3.13	1.63	1.52	1.62	1.65	3.06	1.33	1.26	1.55	1.59	4
[TC44]	3.43	0.88	0.89	1.17	0.97	3.87	1.15	1.22	1.09	0.96	3.68	1.31	1.15	1.05	0.97	3
[TC45]	2.90	1.42	1.33	1.22	1.62	4.21	1.55	1.59	1.67	1.25	3.56	1.48	1.43	1.49	1.69	5
[TC46]	3.50	1.41	1.56	1.56	2.18	3.97	1.62	1.16	1.95	2.07	3.77	1.48	1.67	2.20	1.76	3
[TC47]	1.13	0.80	0.81	0.89	1.00	1.14	1.36	0.88	0.89	1.45	1.39	1.40	1.10	0.91	1.07	3
[TC48]	0.97	0.22	0.06	0.01	0.00	0.94	0.33	0.09	0.00	0.00	0.85	0.24	0.12	0.04	0.01	6
[TC49]	3.76	1.52	1.54	2.13	2.44	3.05	1.43	1.66	2.17	2.02	2.75	1.49	1.72	2.52	2.05	3
Mean	2.08	1.07	0.90	0.95	1.03	2.20	1.22	0.97	1.00	1.01	2.17	1.23	1.02	1.02	1.01	
Median	1.54	0.81	0.74	0.66	0.86	1.67	0.94	0.79	0.80	0.81	1.61	0.94	0.79	0.80	0.80	
Max	5.27	5.16	3.28	4.01	3.82	5.83	5.08	3.34	3.58	4.33	5.47	5.49	3.91	3.73	4.40	
Min	0.19	0.01	0.00	0.00	0.00	0.29	0.02	0.00	0.00	0.00	0.32	0.03	0.00	0.00	0.00	
Percentile (%10)	0.74	0.25	0.11	0.03	0.00	0.79	0.33	0.14	0.04	0.01	0.66	0.26	0.13	0.04	0.01	
Percentile (%25)	1.00	0.60	0.30	0.25	0.14	0.99	0.74	0.33	0.26	0.15	1.18	0.64	0.34	0.29	0.11	
Percentile (%50)	1.54	0.81	0.74	0.66	0.86	1.67	0.94	0.79	0.80	0.81	1.61	0.94	0.79	0.80	0.80	
Percentile (%75)	3.15	1.42	1.25	1.33	1.62	3.26	1.57	1.41	1.56	1.64	3.37	1.55	1.51	1.50	1.54	
Percentile (%90)	3.72	1.95	1.72	1.96	2.39	3.95	2.14	1.96	2.28	2.38	3.97	2.31	1.95	2.41	2.14	

**Table E.67. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group B - (Policy Group 5)**

Policy No	11	12	13	14	15	31	32	33	34	51	52	53	54	55	56	Selected Atb Values
Routine Delivery Check Period	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Atb Values	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	
[TC1]	5.41	3.14	3.22	3.14	2.21	5.35	4.62	4.32	2.89	2.10	6.28	4.50	5.19	3.03	2.06	6
[TC2]	14.92	14.48	16.22	15.15	16.57	15.56	15.04	16.43	15.11	15.17	13.54	14.23	15.95	15.36	15.52	3
[TC3]	21.71	23.38	23.47	22.94	23.10	21.31	22.22	23.69	21.00	23.28	21.12	21.63	22.03	25.88	25.96	5
[TC4]	28.31	26.84	26.47	30.23	32.51	30.14	31.78	31.39	30.26	31.96	29.05	28.32	29.00	31.40	29.97	2
[TC5]	28.71	31.00	35.43	34.35	32.35	29.65	30.37	32.89	31.11	30.26	26.68	30.19	35.05	33.37	33.33	2
[TC6]	18.94	19.04	19.10	24.57	22.51	18.80	19.42	19.07	18.95	20.75	20.52	20.87	21.46	19.92	21.38	2
[TC7]	25.76	26.40	27.58	27.80	29.69	25.96	30.53	27.20	26.47	27.60	24.54	29.60	27.48	29.13	29.18	2
[TC8]	24.74	28.79	27.68	27.59	29.65	25.16	27.83	25.66	26.82	28.99	24.38	27.52	30.69	28.08	31.17	2
[TC9]	34.50	34.30	36.10	36.93	36.60	34.21	31.70	34.49	33.48	35.96	31.19	32.82	36.38	35.54	38.34	3
[TC10]	27.22	29.93	28.84	28.46	30.60	29.80	27.41	30.53	30.54	26.76	24.16	27.63	30.65	30.10	30.59	6
[TC11]	22.16	21.98	21.30	23.13	25.30	21.90	24.56	22.36	22.53	26.01	23.63	23.83	25.84	22.54	26.77	4
[TC12]	36.61	38.32	37.97	39.51	34.96	33.35	40.14	43.86	36.09	38.38	36.04	37.03	34.10	35.39	36.52	2
[TC13]	32.11	39.83	35.58	38.84	37.44	36.96	35.72	39.26	34.32	35.01	33.88	37.45	31.20	36.49	36.86	5
[TC14]	15.82	16.14	15.45	16.15	17.51	16.25	16.45	16.65	15.87	16.22	15.06	14.10	17.62	17.02	18.02	5
[TC15]	26.26	25.75	30.56	28.93	31.41	28.00	29.32	34.99	29.92	30.18	26.19	25.76	30.20	28.85	29.06	3
[TC16]	29.53	32.54	33.63	33.43	33.95	33.35	30.89	33.19	32.93	32.34	33.04	33.99	31.94	33.95	33.13	2
[TC17]	32.50	34.51	34.44	37.46	36.14	35.15	32.91	34.95	35.77	35.66	34.52	36.01	34.20	34.95	34.09	2
[TC18]	4.58	2.47	2.22	1.21	0.73	5.85	3.88	2.20	1.36	1.19	6.17	3.92	2.50	1.57	1.44	6
[TC19]	9.52	5.01	3.77	4.30	4.01	9.52	6.56	4.35	4.14	3.89	10.26	5.38	4.33	4.38	3.69	4
[TC20]	8.72	8.61	6.28	6.54	7.52	9.38	11.01	6.88	6.92	7.13	11.23	10.43	7.57	5.80	7.18	4
[TC21]	32.04	34.80	37.53	41.10	40.25	36.72	36.85	33.41	37.95	37.04	35.54	38.33	36.36	38.11	36.51	4
[TC22]	24.80	23.41	27.41	23.47	21.68	22.48	22.80	23.06	24.73	25.74	23.73	24.46	26.33	24.57	24.74	6
[TC23]	15.20	13.54	14.79	16.56	18.09	15.19	14.98	15.57	13.78	14.94	13.90	14.12	17.54	14.39	17.52	3
[TC24]	20.70	20.47	22.20	24.35	25.12	25.15	22.72	26.11	25.17	23.53	23.54	22.51	23.55	23.38	24.27	3
[TC25]	28.16	30.61	34.05	32.79	30.41	30.90	30.82	31.26	35.55	36.74	28.90	32.16	31.53	36.12	32.44	2
[TC26]	39.49	36.62	40.60	43.32	41.83	37.15	38.70	39.57	36.52	42.43	40.51	40.28	40.95	43.29	44.14	3
[TC27]	16.91	15.11	15.37	18.88	20.24	13.95	16.58	17.30	16.23	17.16	15.16	15.73	20.44	16.91	19.98	2
[TC28]	18.34	18.14	19.52	19.06	19.74	18.00	21.34	19.99	18.79	20.68	20.00	20.16	19.72	18.03	20.79	3
[TC29]	9.95	8.47	7.02	6.97	7.19	10.80	9.87	7.15	6.12	7.21	9.25	11.24	6.75	6.29	7.86	5
[TC30]	35.77	35.16	39.97	40.64	37.36	36.01	37.36	37.77	37.09	41.56	35.25	37.07	34.22	37.02	34.58	3
[TC31]	12.40	11.01	12.30	14.88	14.57	12.53	12.54	13.31	12.56	12.76	14.34	11.76	13.80	12.45	13.53	2
[TC32]	14.32	14.44	15.55	13.86	12.43	15.17	12.03	15.06	12.18	13.35	14.07	14.02	15.70	13.27	13.74	6
[TC33]	36.37	30.75	33.71	35.17	33.93	32.89	32.21	32.41	32.41	37.09	34.59	31.84	32.01	34.86	38.59	3
[TC34]	14.14	13.86	12.80	13.06	12.09	13.99	12.00	12.05	12.14	12.68	14.71	12.25	12.02	12.52	14.04	6
[TC35]	42.44	41.32	41.03	41.62	41.83	39.57	37.75	42.37	39.97	46.84	38.04	39.92	43.67	38.68	45.12	4
[TC36]	43.39	48.36	50.52	53.07	50.69	47.16	45.08	50.10	48.84	54.83	52.70	45.15	49.26	45.08	46.85	3
[TC37]	35.32	32.64	32.13	35.42	33.72	29.41	31.13	32.72	35.42	32.97	29.65	30.71	29.88	32.69	32.95	4
[TC38]	8.54	4.59	3.25	3.41	3.13	6.93	4.63	3.60	4.08	3.10	8.86	4.42	2.99	4.35	2.89	6
[TC39]	11.40	11.64	13.66	11.65	13.34	14.26	12.87	13.30	14.06	16.81	11.92	10.38	10.68	14.56	13.10	3
[TC40]	7.88	7.98	7.97	6.39	5.67	7.63	8.66	8.57	8.05	6.78	8.95	8.57	8.20	6.93	6.67	6
[TC41]	8.77	8.48	5.67	6.78	7.05	5.82	7.97	5.94	6.70	6.59	7.95	7.99	6.32	6.35	6.61	2
[TC42]	37.71	38.97	37.09	39.20	35.85	33.86	42.28	37.09	39.52	40.11	38.11	35.32	37.57	39.39	39.89	6
[TC43]	35.58	35.99	35.21	33.64	39.07	36.36	35.78	34.25	30.82	37.75	34.62	34.96	39.63	35.24	36.08	2
[TC44]	26.66	27.73	29.39	30.29	28.87	22.96	26.83	29.62	32.95	31.26	27.66	29.11	28.40	30.99	33.06	2
[TC45]	31.21	37.38	32.70	36.04	35.51	32.41	36.10	37.32	38.17	37.60	32.22	35.51	33.39	37.10	35.99	2
[TC46]	31.87	33.02	35.31	38.25	36.26	35.41	35.54	40.79	41.42	37.87	37.19	34.05	41.54	34.86	39.56	2
[TC47]	23.61	26.33	25.23	26.92	26.91	26.04	25.26	26.31	26.89	26.58	24.78	27.30	26.52	30.36	27.96	2
[TC48]	8.11	5.00	4.11	4.25	4.45	6.90	4.11	5.50	4.91	4.51	8.89	4.62	4.13	3.88	4.53	5
[TC49]	36.54	40.54	37.18	37.14	38.14	36.82	40.27	36.63	38.10	33.75	36.31	39.10	34.12	34.46	39.89	6
Mean	23.58	23.85	24.26	25.08	24.90	23.84	24.23	24.75	24.24	25.08	23.94	24.05	24.50	24.47	25.27	
Median	24.87	26.44	26.68	26.28	28.62	25.50	27.36	27.06	27.11	27.15	24.99	27.06	28.50	27.52	29.40	
Max	47.77	50.67	52.87	53.08	52.20	50.23	47.78	52.60	50.01	56.56	52.70	49.10	53.20	49.34	50.85	
Min	3.92	2.47	2.22	1.21	0.73	4.06	3.48	2.20	1.36	1.19	4.88	3.92	2.50	1.57	1.44	
Percentile (%10)	6.00	5.78	4.82	5.79	5.14	5.99	6.32	5.98	5.87	5.48	6.41	6.01	6.15	5.58	5.40	
Percentile (%25)	12.19	12.36	12.35	12.86	13.36	12.52	12.32	12.81	12.10	13.37	12.01	11.56	11.59	11.92	13.42	
Percentile (%50)	24.87	26.44	26.68	26.28	28.62	25.50	27.36	27.06	27.11	27.15	24.99	27.06	28.50	27.52	29.40	
Percentile (%75)	34.74	35.07	35.84	37.38	36.76	34.66	33.86	35.90	34.93	35.17	34.08	36.07	35.48	37.13	36.91	
Percentile (%90)	39.97	40.04	40.51	41.48	40.59	39.78	39.87	40.62	39.06	41.74	39.79	39.79	40.82	39.27	42.15	

Table E.68. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group AB + (Policy Group 5)

Policy No	11	12	13	14	15	31	32	33	34	51	52	53	54	55	56	Selected Atb Values
Routine Delivery Check Period	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Atb Values	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	
[TC1]	0.78	0.25	0.05	0.01	0.01	0.92	0.24	0.10	0.01	0.02	0.83	0.33	0.11	0.07	0.01	5
[TC2]	3.13	1.09	1.08	1.00	1.07	3.74	0.80	0.72	1.10	1.16	3.83	1.09	0.79	1.11	1.11	4
[TC3]	3.48	3.50	2.45	2.48	2.88	3.76	3.21	2.00	2.51	3.75	3.02	4.08	2.08	2.07	3.12	4
[TC4]	4.86	4.78	4.10	5.29	4.65	4.52	4.53	4.13	4.49	4.50	4.09	4.19	4.96	4.39	4.91	4
[TC5]	4.12	5.11	5.37	6.03	5.29	6.13	5.33	5.10	5.20	5.12	4.95	5.27	4.88	5.69	6.05	4
[TC6]	3.34	1.92	1.36	2.24	2.00	3.48	1.42	2.03	2.06	2.09	3.94	1.82	1.92	1.75	1.92	3
[TC7]	3.88	4.14	2.95	3.05	3.17	4.41	3.86	3.05	3.62	3.82	4.11	3.99	3.23	3.38	3.20	4
[TC8]	4.43	4.10	4.05	4.18	4.50	4.29	4.03	4.36	4.20	3.97	4.40	3.85	3.97	4.06	4.04	4
[TC9]	6.34	5.96	7.21	5.92	7.99	6.30	7.14	6.95	6.61	7.43	5.61	6.17	6.51	5.86	8.00	2
[TC10]	5.12	3.97	4.25	4.76	4.07	4.05	4.45	4.34	4.28	4.06	3.92	4.74	4.73	3.83	3.98	2
[TC11]	3.10	3.07	3.01	2.15	2.96	3.68	3.59	2.13	2.24	2.81	3.75	3.28	2.39	2.18	2.86	5
[TC12]	6.95	6.93	6.78	7.86	8.97	5.50	6.27	7.27	6.83	8.25	6.65	6.85	7.56	6.80	9.30	2
[TC13]	5.62	7.07	5.74	6.92	7.82	6.92	4.89	6.58	6.47	7.82	7.24	5.65	6.83	6.51	8.81	3
[TC14]	3.07	1.06	0.95	1.09	1.75	3.38	1.23	1.15	0.96	1.58	3.11	1.42	1.26	1.19	1.52	5
[TC15]	4.12	4.11	3.88	3.51	3.95	5.12	4.06	4.38	4.64	4.22	5.56	4.69	4.06	3.79	4.61	5
[TC16]	6.22	5.46	4.28	5.82	5.70	5.30	5.46	5.70	6.10	6.12	4.81	6.29	5.63	5.88	6.78	4
[TC17]	5.68	6.12	5.84	6.37	6.84	6.72	7.15	6.73	7.09	6.63	6.68	6.91	6.18	6.65	8.32	2
[TC18]	0.60	0.09	0.01	0.00	0.00	0.75	0.10	0.03	0.00	0.00	0.77	0.13	0.04	0.01	0.00	6
[TC19]	1.58	0.49	0.20	0.09	0.02	1.43	0.45	0.18	0.13	0.05	1.40	0.51	0.12	0.17	0.07	6
[TC20]	1.08	0.86	0.36	0.31	0.13	1.28	1.16	0.43	0.28	0.16	1.57	1.41	0.43	0.41	0.18	6
[TC21]	6.62	6.31	6.05	6.82	7.88	6.68	6.78	6.42	7.03	8.43	6.24	7.41	6.60	7.93	9.24	4
[TC22]	3.70	3.70	2.37	2.28	3.37	4.20	3.41	2.53	2.57	3.88	3.71	3.99	2.05	2.82	3.87	5
[TC23]	3.27	0.79	0.86	0.89	1.16	4.18	1.25	0.83	1.04	1.26	3.63	1.37	1.05	1.27	1.56	3
[TC24]	3.65	3.78	2.15	2.31	3.13	4.32	4.10	2.75	2.90	3.69	4.92	4.16	3.01	3.14	4.10	4
[TC25]	4.68	4.64	4.47	6.15	5.82	5.40	5.91	5.91	6.78	6.38	6.18	7.03	5.61	6.23	6.46	4
[TC26]	7.69	7.06	8.46	8.45	10.22	8.68	8.91	9.61	8.46	11.95	8.68	8.93	9.04	8.65	11.20	3
[TC27]	3.07	1.18	1.41	1.31	1.76	3.66	1.47	1.32	1.07	1.83	3.88	1.71	1.67	1.41	1.81	5
[TC28]	3.32	1.17	1.25	1.77	1.87	3.23	1.53	1.46	1.69	1.71	3.43	1.47	1.99	2.08	1.61	3
[TC29]	1.08	0.85	0.28	0.31	0.38	1.23	0.98	0.28	0.27	0.41	1.16	1.06	0.40	0.39	0.46	4
[TC30]	6.95	7.04	5.84	6.80	9.14	6.99	7.59	5.94	6.71	9.10	6.57	7.67	7.51	6.68	8.30	4
[TC31]	1.19	0.88	0.89	0.84	1.17	1.19	1.40	0.81	1.07	0.93	1.07	1.09	1.23	0.74	1.23	4
[TC32]	3.44	2.79	2.21	1.49	1.41	3.66	2.77	2.12	1.58	1.21	3.48	3.37	2.37	1.53	1.67	6
[TC33]	7.22	8.46	6.56	5.97	7.06	6.68	6.77	6.29	6.09	6.56	6.33	8.43	6.21	6.64	7.26	5
[TC34]	3.70	3.07	1.89	1.71	1.32	3.39	2.93	1.94	1.56	1.38	3.36	3.82	2.08	2.00	1.04	6
[TC35]	8.47	7.42	9.71	7.66	9.04	8.31	8.75	10.15	9.35	8.78	8.81	10.08	11.68	10.06	9.31	3
[TC36]	11.17	10.58	11.89	11.67	13.08	11.31	12.49	12.72	13.91	13.60	12.77	11.93	11.88	14.22	14.28	2
[TC37]	6.68	8.01	5.44	5.99	7.15	6.75	6.06	5.94	5.62	5.79	7.11	7.52	5.64	6.01	5.65	4
[TC38]	1.57	0.49	0.15	0.04	0.03	1.59	0.52	0.22	0.06	0.06	1.35	0.42	0.15	0.06	0.05	6
[TC39]	1.12	0.97	0.85	0.65	1.08	1.04	0.94	1.14	0.81	1.37	0.97	1.22	0.75	1.05	1.02	4
[TC40]	0.93	0.94	0.38	0.27	0.29	1.22	0.91	0.41	0.25	0.36	1.05	1.02	0.32	0.36	0.28	5
[TC41]	0.91	0.94	0.47	0.29	0.29	1.06	1.03	0.29	0.36	0.27	1.13	0.89	0.28	0.28	0.28	2
[TC42]	6.73	7.16	7.77	7.33	8.99	5.67	7.46	7.72	7.86	9.75	7.34	8.45	8.48	7.38	8.72	2
[TC43]	6.11	6.42	6.15	6.89	7.48	6.68	6.40	6.52	6.09	7.75	6.14	6.70	6.73	6.25	8.40	2
[TC44]	4.38	4.96	4.34	4.23	3.46	5.21	5.15	5.46	5.04	4.06	4.56	4.66	4.80	4.37	4.57	6
[TC45]	5.36	6.12	6.04	5.84	6.36	6.32	6.60	6.39	5.98	7.83	7.16	7.22	6.30	5.81	7.75	1
[TC46]	6.14	6.54	6.11	5.92	8.22	6.66	7.78	7.23	7.12	9.17	7.12	7.62	6.92	6.68	8.56	5
[TC47]	3.50	3.98	3.37	3.99	3.27	4.00	4.40	3.13	3.54	3.89	4.34	3.77	3.51	3.13	3.83	6
[TC48]	1.37	0.47	0.34	0.08	0.09	1.40	0.37	0.33	0.12	0.14	1.18	0.45	0.35	0.13	0.21	5
[TC49]	7.32	6.91	7.95	7.79	9.21	7.78	6.48	6.88	6.50	8.77	6.74	6.97	7.55	7.88	9.07	3
Mean	4.26	3.95	3.66	3.77	4.23	4.49	4.09	3.88	3.88	4.36	4.50	4.35	3.96	3.90	4.50	
Median	3.31	3.02	3.56	2.88	3.33	3.54	3.67	3.69	2.73	3.80	3.62	3.49	3.97	3.00	3.52	
Max	11.75	12.79	13.28	12.69	16.94	12.06	13.98	13.43	13.91	18.09	12.97	13.49	14.63	14.52	18.44	
Min	0.60	0.09	0.01	0.00	0.00	0.75	0.10	0.03	0.00	0.00	0.77	0.13	0.04	0.01	0.00	
Percentile (%10)	1.06	0.52	0.33	0.21	0.11	1.19	0.61	0.29	0.21	0.15	1.11	0.64	0.30	0.25	0.16	
Percentile (%25)	1.61	0.98	0.67	0.69	0.88	1.67	1.14	0.75	0.74	0.82	1.65	1.14	0.89	0.92	0.88	
Percentile (%50)	3.31	3.02	3.56	2.88	3.33	3.54	3.67	3.69	2.73	3.80	3.62	3.49	3.97	3.00	3.52	
Percentile (%75)	6.61	6.16	5.54	6.28	6.34	6.92	6.23	6.04	6.48	6.98	7.25	6.57	5.94	6.25	6.91	
Percentile (%90)	8.89	8.10	7.25	7.86	9.19	8.67	8.13	8.34	8.04	9.19	8.67	8.68	7.97	8.04	9.69	

Table E.69. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group AB - (Policy Group 5)

Policy No	11	12	13	14	15	31	32	33	34	51	52	53	54	55	56	Selected Atb Values
Routine Delivery Check Period	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Atb Values	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	
[TC1]	22.16	21.65	14.99	16.08	11.97	21.13	22.54	14.96	15.49	12.59	21.65	21.74	14.92	15.80	12.30	6
[TC2]	41.18	40.52	47.24	40.71	48.93	39.28	43.18	44.00	43.89	47.75	40.72	44.06	46.23	47.80	45.19	2
[TC3]	60.70	56.89	56.29	51.72	61.67	53.00	53.20	52.74	55.69	53.64	53.71	56.21	51.65	53.93	58.48	4
[TC4]	61.38	63.93	60.23	67.58	71.44	54.33	62.16	64.52	68.28	72.25	64.76	61.30	65.20	64.82	66.16	2
[TC5]	66.52	67.24	69.17	64.19	69.60	70.27	66.54	66.16	66.77	70.76	64.61	63.92	68.45	63.70	72.34	4
[TC6]	50.98	47.68	57.13	56.86	53.71	54.91	48.72	51.31	54.14	52.91	47.41	49.31	51.91	55.25	53.43	3
[TC7]	56.25	55.09	59.04	68.28	63.34	60.53	63.40	61.03	61.44	68.54	58.23	61.69	55.99	63.30	65.44	2
[TC8]	56.14	58.07	62.92	64.22	69.87	62.39	59.39	59.95	60.76	71.31	63.09	62.19	71.19	67.96	64.28	2
[TC9]	74.65	65.78	62.97	79.43	76.39	72.58	75.59	72.77	73.67	73.51	70.60	67.06	64.86	71.53	68.31	2
[TC10]	61.60	59.72	63.16	64.21	70.23	58.73	60.15	65.11	70.00	67.19	58.34	64.21	70.39	61.97	64.42	2
[TC11]	49.46	50.18	52.87	61.27	57.06	53.54	53.81	56.52	56.47	58.92	53.23	54.12	53.99	59.60	56.37	2
[TC12]	73.41	65.95	74.11	71.91	74.81	70.82	70.66	73.52	71.71	78.58	73.99	69.92	67.41	78.92	77.06	3
[TC13]	71.83	64.19	75.41	67.47	75.47	62.75	68.27	68.22	73.31	71.21	64.46	69.51	71.44	82.87	78.13	2
[TC14]	41.57	40.51	44.75	46.92	51.18	41.01	46.37	51.76	49.54	45.97	48.62	45.29	49.95	49.21	51.47	2
[TC15]	63.78	61.38	63.00	64.47	63.52	60.70	68.45	66.31	68.24	67.49	61.07	60.43	62.69	70.44	61.30	3
[TC16]	67.69	58.50	64.53	73.29	70.50	64.22	66.44	68.73	73.14	68.17	71.90	72.08	66.92	71.93	63.08	3
[TC17]	67.66	69.95	72.69	72.29	75.66	66.25	72.33	72.13	68.51	74.81	68.23	68.33	73.62	75.83	75.38	2
[TC18]	14.30	14.79	10.73	7.80	5.98	14.94	15.57	11.28	9.05	7.64	14.92	15.42	12.35	9.05	8.28	6
[TC19]	24.05	23.28	24.61	15.83	17.72	21.96	22.19	25.75	17.21	17.59	24.84	23.06	25.46	16.19	17.84	5
[TC20]	26.62	26.41	31.63	31.40	33.29	26.60	27.99	28.99	31.78	32.73	30.31	29.32	30.38	33.17	32.50	3
[TC21]	72.02	66.76	74.52	69.28	76.47	75.29	63.08	73.65	78.11	68.93	62.64	69.85	74.15	68.87	73.37	3
[TC22]	54.27	57.03	56.63	56.12	58.78	51.23	55.09	59.30	57.78	61.21	60.17	54.61	57.44	54.67	59.61	2
[TC23]	41.59	40.97	43.57	42.05	45.54	41.58	44.35	42.27	49.34	46.54	42.68	41.31	45.67	47.43	48.73	3
[TC24]	55.07	55.82	55.88	60.30	68.39	57.11	58.12	56.65	64.22	59.18	56.48	58.71	62.51	60.40	61.80	2
[TC25]	69.05	63.31	66.92	69.23	76.76	66.28	63.98	79.55	72.77	70.37	65.23	66.97	72.92	71.65	72.32	3
[TC26]	70.01	70.32	77.10	79.49	85.24	72.54	64.19	75.51	81.49	81.17	70.06	73.59	70.48	80.20	76.31	2
[TC27]	44.69	46.11	43.59	45.21	47.46	43.60	43.92	44.57	48.00	51.44	44.09	44.33	52.24	48.85	48.92	2
[TC28]	52.85	46.34	48.55	54.85	55.59	49.83	49.73	54.58	56.98	52.36	47.67	51.93	51.53	56.42	52.84	3
[TC29]	27.68	27.30	31.78	30.57	33.60	28.56	29.05	31.90	32.77	31.34	30.18	29.00	28.21	31.39	32.50	3
[TC30]	68.56	70.07	72.90	73.34	74.40	65.44	68.59	73.96	72.01	76.66	73.10	71.90	65.18	74.32	74.50	2
[TC31]	40.51	39.47	40.93	43.05	42.60	38.51	38.15	39.49	40.19	39.12	38.99	39.68	39.97	40.12	40.92	3
[TC32]	32.44	33.50	36.89	35.03	32.72	33.95	35.30	31.93	35.01	35.44	37.20	34.64	33.39	33.92	33.15	2
[TC33]	64.92	67.14	66.61	66.13	68.19	65.67	66.93	63.38	72.17	66.32	62.66	66.51	62.92	60.51	66.34	2
[TC34]	32.11	31.21	31.02	33.09	31.83	34.72	32.77	33.88	33.99	32.78	33.15	32.80	30.05	34.91	33.42	4
[TC35]	71.19	65.18	72.16	73.31	74.59	72.22	79.42	76.69	77.73	71.74	71.21	74.01	70.72	72.50	68.39	3
[TC36]	78.67	77.46	80.24	79.51	85.15	76.05	83.74	76.35	78.98	76.85	73.61	73.91	74.47	75.08	79.98	2
[TC37]	65.57	58.32	62.25	68.47	64.27	62.18	61.49	63.76	65.31	65.08	68.83	64.79	64.83	64.39	60.00	3
[TC38]	13.52	14.32	14.12	11.98	13.81	13.95	13.67	14.76	11.55	12.38	15.48	14.58	13.13	12.56	12.29	5
[TC39]	33.31	31.30	38.56	35.57	38.83	31.67	31.97	31.87	37.62	35.13	31.69	34.10	33.26	32.32	34.89	2
[TC40]	19.72	21.80	21.37	21.56	24.31	21.98	24.11	22.69	23.34	24.22	21.84	22.45	21.77	22.45	22.30	2
[TC41]	20.73	22.27	20.75	20.73	24.98	20.26	19.51	23.63	22.15	23.23	22.18	21.80	22.74	22.96	24.90	3
[TC42]	66.79	69.92	60.73	65.42	74.26	67.28	66.83	70.80	66.66	68.09	64.23	67.82	64.20	72.98	66.52	4
[TC43]	63.97	63.59	63.47	64.23	63.65	66.22	62.41	65.10	76.40	65.86	68.47	63.69	63.84	63.29	65.30	5
[TC44]	57.17	52.90	53.67	57.11	57.34	55.92	57.58	56.62	53.14	59.75	58.83	57.23	53.42	56.59	60.46	3
[TC45]	61.55	56.91	65.06	67.65	60.50	56.50	59.78	61.20	64.56	66.01	64.18	64.56	66.37	63.64	59.69	3
[TC46]	66.04	60.55	61.10	66.20	71.39	62.46	65.14	61.51	68.07	71.62	63.86	68.18	62.56	61.49	73.01	3
[TC47]	59.83	52.81	49.88	51.24	53.62	52.25	55.27	54.42	53.40	54.03	57.03	54.70	56.38	55.24	56.84	4
[TC48]	14.58	17.00	17.52	16.80	20.05	15.51	17.04	16.65	16.65	17.84	18.13	16.41	17.49	16.49	16.25	6
[TC49]	62.93	65.58	63.20	64.45	70.39	61.58	71.32	59.42	63.33	65.52	69.62	61.57	63.81	62.51	64.88	4
Mean	51.70	50.14	52.21	53.22	55.45	50.82	52.03	52.90	54.34	54.36	52.00	52.14	52.46	53.70	53.72	
Median	58.77	57.43	60.96	62.86	64.98	59.67	60.53	60.60	60.76	64.23	59.25	61.21	60.69	61.71	61.15	
Max	83.66	82.65	84.56	85.85	88.13	83.15	88.69	89.71	88.23	86.89	83.93	82.74	85.25	91.71	87.22	
Min	7.28	5.92	6.51	6.78	5.98	6.87	6.73	6.87	6.64	7.39	9.56	8.34	6.34	6.35	6.53	
Percentile (%10)	14.38	16.51	16.02	17.40	17.45	15.53	17.48	16.05	16.01	18.99	18.30	16.48	16.30	15.22	17.58	
Percentile (%25)	34.46	35.38	32.57	33.38	34.48	34.34	37.98	32.74	33.74	37.21	34.83	36.23	33.99	33.87	34.00	
Percentile (%50)	58.77	57.43	60.96	62.86	64.98	59.67	60.53	60.60	60.76	64.23	59.25	61.21	60.69	61.71	61.15	
Percentile (%75)	70.96	67.24	70.97	73.04	74.84	68.12	69.22	72.68	73.54	72.83	68.91	68.93	70.01	73.21	74.21	
Percentile (%90)	75.84	73.78	78.07	80.16	81.93	75.21	76.08	77.00	80.64	78.44	75.99	76.15	78.16	80.21	77.34	

Table E.70. Cities Performances and Performance of Region Including DCs and RBC of Group 6 Policies

Performance Measure		5.9.	1	2	3	4	5	6	7
Inventory Level	Antalya	3599	3753	3716	3718	3779	3776	3672	3731
	Burdur	541	575	562	568	573	575	559	574
	Isparta	1445	1488	1471	1458	1484	1485	1454	1470
	Overall	5584	5815	5749	5744	5836	5836	5685	5774
Outdate Rate	Antalya	0.73	0.66	0.61	0.63	0.58	0.55	0.63	0.35
	Burdur	0.93	0.94	0.86	0.86	0.85	0.83	0.87	0.74
	Isparta	0.79	0.75	0.71	0.71	0.66	0.69	0.71	0.50
	Overall	0.76	0.72	0.66	0.67	0.63	0.62	0.68	0.43
Mismatch Rate	Antalya	0.45	0.50	0.51	0.52	0.43	0.38	0.57	0.34
	Burdur	1.31	1.33	1.43	1.38	1.24	1.20	1.52	1.06
	Isparta	0.34	0.37	0.38	0.40	0.33	0.29	0.42	0.28
	Overall	0.51	0.55	0.58	0.58	0.49	0.44	0.63	0.40
Shortage Rate	Antalya	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
	Burdur	0.05	0.04	0.06	0.04	0.04	0.02	0.06	0.04
	Isparta	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
	Overall	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table E.71. Delivery Performance Measures of Group 6 Policies

Delivery Performances	Delivery Type	5.9.	1	2	3	4	5	6	7
Quantity	Routine Deliveries To TCs	72539	57098	57030	57018	57032	56983	57026	56898
	Ad-Hoc Deliveries to TCs	43950	49680	42239	41924	43624	45439	40080	24504
	Emergency Deliveries To TCs	0	0	13431	16634	6821	3418	23036	21905
	Ad-hoc Deliveries Between DCs and RBC	2458	2372	2446	2444	2489	2381	2442	2541
	Total	118946	109151	115146	118019	109966	108221	122584	105848
Percentage	Routine Deliveries To TCs	60.98	52.31	49.53	48.31	51.86	52.65	46.52	53.75
	Ad-Hoc Deliveries to TCs	36.95	45.52	36.68	35.52	39.67	41.99	32.70	23.15
	Emergency Deliveries To TCs	0.00	0.00	11.66	14.09	6.20	3.16	18.79	20.69
	Ad-hoc Deliveries Between DCs and RBC	2.07	2.17	2.12	2.07	2.26	2.20	1.99	2.40

Table E.72. Selection Criterion Performance of Group 6 Policies

Performance Measure	Case	5.9.	1	2	3	4	5	6	7
Outdate Rate	Region Including Dcs and RBC	0.76	0.72	0.66	0.67	0.63	0.62	0.68	0.43
	Region Excluding DCs And RBC	0.76	0.71	0.65	0.66	0.61	0.58	0.67	0.36
	Single TCs' Means	1.65	1.55	1.43	1.45	1.34	1.27	1.47	0.77
Mismatch Rate	Region Including Dcs and RBC	0.51	0.55	0.58	0.58	0.49	0.44	0.63	0.40
	Region Excluding DCs And RBC	0.51	0.55	0.58	0.58	0.49	0.44	0.63	0.40
	Single TCs' Means	0.77	0.87	0.84	0.84	0.75	0.71	0.92	0.65
Shortage Rate	Region Including Dcs and RBC	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Region Excluding DCs And RBC	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Single TCs' Means	0.02	0.02	0.03	0.02	0.02	0.01	0.03	0.03
Selection Criterion Performance		1.29	1.28	1.25	1.26	1.13	1.07	1.32	0.84

Table E.73. Single TC Performances of Group 6 Policies - Mean Inventory Levels

TC	5.9.	1	2	3	4	5	6	7
[TC1]	187.54	212.54	205.03	202.65	209.14	210.91	200.99	211.15
[TC2]	46.61	51.02	49.76	49.95	50.51	50.67	49.03	48.67
[TC3]	32.47	33.99	33.48	33.45	33.40	33.42	32.66	31.65
[TC4]	23.84	23.99	23.40	23.50	23.53	23.42	23.52	20.86
[TC5]	23.99	24.34	23.69	23.74	23.74	23.71	23.77	21.19
[TC6]	35.74	38.90	37.54	37.55	38.29	38.35	37.54	34.89
[TC7]	27.22	29.09	28.54	28.60	28.43	28.45	27.69	25.28
[TC8]	26.51	27.77	27.19	27.20	27.10	27.05	27.22	24.64
[TC9]	21.47	20.95	20.41	20.39	20.27	20.37	20.42	17.81
[TC10]	25.60	26.71	26.15	26.25	26.14	26.15	26.17	23.68
[TC11]	30.48	35.42	34.86	34.92	34.77	34.85	34.12	32.94
[TC12]	20.65	21.93	21.30	21.40	21.20	21.29	21.35	18.59
[TC13]	21.48	20.97	20.36	20.43	20.23	20.28	20.33	17.83
[TC14]	40.58	46.93	45.56	45.62	46.46	46.26	44.87	44.53
[TC15]	26.41	27.59	26.92	27.08	27.06	26.93	26.29	23.71
[TC16]	24.06	23.35	22.68	22.76	22.75	22.71	22.80	20.13
[TC17]	21.40	21.56	20.96	20.94	20.94	20.75	20.97	18.34
[TC18]	331.67	408.37	392.93	389.42	401.99	405.33	380.99	409.38
[TC19]	144.56	175.24	169.03	167.27	173.35	174.32	163.61	174.32
[TC20]	89.07	103.52	99.84	99.14	102.47	103.26	96.32	101.98
[TC21]	21.59	21.92	21.34	21.30	21.31	21.14	21.30	18.65
[TC22]	29.68	32.82	32.24	32.23	32.29	32.17	31.55	29.01
[TC23]	47.64	49.99	48.61	48.65	49.35	49.36	48.67	48.83
[TC24]	30.55	34.51	34.05	34.08	33.91	33.92	33.25	32.12
[TC25]	23.91	22.36	21.90	21.80	21.71	21.69	21.80	19.26
[TC26]	19.73	19.79	19.07	19.20	19.09	19.03	19.26	16.44
[TC27]	40.70	45.33	44.04	44.07	44.80	44.85	43.21	42.81
[TC28]	37.46	42.47	41.11	41.18	41.94	41.91	41.09	38.65
[TC29]	86.06	101.05	98.22	96.45	99.77	100.70	97.40	99.38
[TC30]	20.63	21.69	20.97	21.03	21.00	20.93	21.06	18.40
[TC31]	51.70	56.82	55.52	55.59	56.27	56.39	54.73	54.52
[TC32]	81.56	97.83	94.77	93.35	96.63	97.56	91.38	96.36
[TC33]	26.90	31.45	30.83	30.99	30.82	30.84	30.14	28.93
[TC34]	86.45	97.67	93.81	93.23	96.47	97.33	91.13	96.37
[TC35]	21.80	24.63	23.88	24.16	23.77	23.84	24.06	21.31
[TC36]	17.69	18.13	17.36	17.57	17.29	17.34	17.51	14.64
[TC37]	29.33	33.20	32.64	32.75	32.61	32.56	31.85	30.84
[TC38]	148.14	168.63	163.68	160.98	165.94	167.36	157.97	167.54
[TC39]	50.44	51.35	50.00	49.99	50.69	50.51	49.37	49.94
[TC40]	82.67	99.58	96.79	94.99	98.27	99.13	94.29	97.73
[TC41]	84.51	89.55	87.70	85.19	89.15	89.01	87.84	88.44
[TC42]	19.79	20.78	20.21	20.20	20.10	19.99	20.24	17.43
[TC43]	21.55	20.72	19.97	20.03	20.09	19.90	20.16	17.22
[TC44]	25.71	27.94	27.29	27.35	27.25	27.03	26.52	23.92
[TC45]	21.52	22.45	21.88	21.82	21.72	21.61	21.89	19.04
[TC46]	19.74	20.92	20.18	20.28	20.20	20.00	20.28	17.47
[TC47]	27.44	29.68	29.16	29.19	28.99	28.88	28.32	25.79
[TC48]	111.31	118.18	114.77	112.52	116.31	116.84	111.90	116.92
[TC49]	19.80	19.48	18.81	18.91	18.81	18.61	18.94	16.08
Mean	51.17	57.45	55.72	55.33	56.50	56.71	54.65	54.81
Median	27.44	31.45	30.83	30.99	30.82	30.84	30.14	28.93
Max	331.67	408.37	392.93	389.42	401.99	405.33	380.99	409.38
Min	17.69	18.13	17.36	17.57	17.29	17.34	17.51	14.64
Percentile (%10)	20.47	20.89	20.20	20.26	20.18	20.00	20.27	17.46
Percentile (%25)	21.59	22.36	21.88	21.80	21.71	21.61	21.80	19.04
Percentile (%50)	27.44	31.45	30.83	30.99	30.82	30.84	30.14	28.93
Percentile (%75)	50.44	51.35	50.00	49.99	50.69	50.67	49.37	49.94
Percentile (%90)	93.52	106.45	102.83	101.81	105.24	105.97	100.30	104.97

Table E.74. Single TC Performances of Group 6 Policies - Outdate Rates

TC	5.9.	1	2	3	4	5	6	7
[TC1]	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01
[TC2]	0.57	0.50	0.41	0.48	0.47	0.40	0.45	0.29
[TC3]	1.26	1.13	1.15	1.15	1.03	0.93	1.07	0.69
[TC4]	1.99	1.78	1.67	1.74	1.61	1.55	1.83	0.89
[TC5]	2.49	2.08	1.98	2.07	1.84	1.78	2.06	1.06
[TC6]	1.13	1.09	0.87	0.93	0.93	0.85	0.93	0.49
[TC7]	1.66	1.65	1.50	1.45	1.38	1.28	1.44	0.74
[TC8]	1.85	1.69	1.52	1.61	1.42	1.32	1.63	0.86
[TC9]	2.83	2.52	2.54	2.40	2.25	2.21	2.59	1.37
[TC10]	2.03	1.75	1.62	1.68	1.48	1.47	1.69	0.90
[TC11]	1.39	1.21	1.19	1.12	0.98	0.97	1.07	0.68
[TC12]	3.16	2.92	2.71	2.69	2.63	2.59	2.73	1.40
[TC13]	2.83	2.70	2.44	2.54	2.34	2.33	2.56	1.39
[TC14]	0.69	0.67	0.56	0.61	0.62	0.57	0.61	0.44
[TC15]	1.95	1.76	1.60	1.64	1.56	1.55	1.64	0.85
[TC16]	2.64	2.18	2.07	2.05	1.98	1.95	2.23	1.16
[TC17]	2.78	2.66	2.43	2.48	2.34	2.09	2.49	1.27
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.04	0.04	0.03	0.04	0.03	0.02	0.03	0.02
[TC20]	0.11	0.11	0.10	0.11	0.09	0.11	0.10	0.07
[TC21]	2.99	2.89	2.59	2.58	2.51	2.37	2.63	1.41
[TC22]	1.36	1.24	1.13	1.15	1.07	1.03	1.19	0.60
[TC23]	0.58	0.42	0.42	0.45	0.42	0.37	0.45	0.34
[TC24]	1.29	1.18	1.12	1.19	0.99	0.94	1.12	0.72
[TC25]	2.40	2.11	1.98	2.08	1.92	1.79	2.06	1.14
[TC26]	3.41	3.33	2.82	3.09	2.82	2.83	3.16	1.54
[TC27]	0.67	0.63	0.59	0.59	0.58	0.54	0.61	0.40
[TC28]	1.01	0.94	0.81	0.86	0.87	0.80	0.87	0.48
[TC29]	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.09
[TC30]	3.11	3.15	2.76	2.74	2.72	2.53	2.92	1.50
[TC31]	0.39	0.32	0.32	0.33	0.29	0.29	0.31	0.22
[TC32]	0.21	0.22	0.22	0.21	0.18	0.19	0.20	0.15
[TC33]	1.66	1.74	1.56	1.64	1.38	1.37	1.62	0.83
[TC34]	0.17	0.19	0.16	0.16	0.13	0.15	0.17	0.13
[TC35]	2.58	2.41	2.15	2.30	1.86	1.77	2.35	1.00
[TC36]	3.73	3.71	3.51	3.55	3.06	2.97	3.54	1.49
[TC37]	1.48	1.43	1.36	1.33	1.16	1.10	1.31	0.77
[TC38]	0.07	0.06	0.07	0.07	0.05	0.05	0.06	0.06
[TC39]	0.57	0.51	0.51	0.46	0.50	0.40	0.51	0.37
[TC40]	0.20	0.19	0.19	0.20	0.15	0.19	0.18	0.14
[TC41]	0.19	0.15	0.16	0.14	0.15	0.11	0.16	0.13
[TC42]	3.74	3.56	3.31	3.27	3.04	2.90	3.43	1.64
[TC43]	3.25	3.10	2.82	2.79	2.57	2.40	2.86	1.34
[TC44]	2.20	2.07	1.98	2.00	1.86	1.64	1.95	0.96
[TC45]	2.99	3.04	2.78	2.78	2.59	2.36	2.93	1.41
[TC46]	3.46	3.34	3.03	3.09	2.93	2.66	3.15	1.54
[TC47]	1.87	1.80	1.77	1.75	1.57	1.39	1.65	0.88
[TC48]	0.10	0.14	0.14	0.14	0.13	0.10	0.13	0.10
[TC49]	3.66	3.58	3.23	3.29	3.13	2.72	3.15	1.59
Mean	1.65	1.55	1.43	1.45	1.34	1.27	1.47	0.77
Median	1.66	1.65	1.50	1.45	1.38	1.28	1.44	0.77
Max	3.74	3.71	3.51	3.55	3.13	2.97	3.54	1.64
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.11	0.11	0.10	0.11	0.10	0.10	0.10	0.08
Percentile (%25)	0.57	0.42	0.41	0.45	0.42	0.37	0.45	0.29
Percentile (%50)	1.66	1.65	1.50	1.45	1.38	1.28	1.44	0.77
Percentile (%75)	2.78	2.52	2.43	2.40	2.25	2.09	2.49	1.27
Percentile (%90)	3.28	3.18	2.82	2.85	2.74	2.61	2.97	1.49

Table E.75. Single TC Performances of Group 6 Policies - Mismatch Rates

TC	5.9.	1	2	3	4	5	6	7
[TC1]	0.21	0.16	0.25	0.25	0.20	0.15	0.26	0.14
[TC2]	0.58	0.64	0.65	0.71	0.54	0.49	0.71	0.46
[TC3]	0.70	0.87	0.73	0.74	0.70	0.65	0.97	0.53
[TC4]	0.84	1.14	1.04	1.11	0.95	0.77	0.96	0.71
[TC5]	0.77	1.05	0.99	0.90	0.84	0.92	0.94	0.72
[TC6]	0.51	0.65	0.74	0.66	0.50	0.42	0.72	0.53
[TC7]	0.81	0.89	0.81	0.82	0.71	0.64	0.98	0.68
[TC8]	0.76	1.02	0.87	0.90	0.84	0.75	0.88	0.63
[TC9]	0.87	1.09	0.95	0.95	0.98	0.90	1.14	0.74
[TC10]	0.80	1.00	0.91	0.97	0.84	0.75	0.89	0.68
[TC11]	0.68	0.77	0.79	0.76	0.70	0.57	0.92	0.51
[TC12]	1.00	0.91	1.02	0.92	0.92	0.83	1.15	0.73
[TC13]	1.03	0.99	0.95	1.02	0.90	0.85	1.09	0.73
[TC14]	0.52	0.64	0.63	0.73	0.50	0.45	0.75	0.46
[TC15]	0.88	0.98	0.89	0.78	0.66	0.66	1.00	0.67
[TC16]	0.78	1.05	0.91	0.91	0.85	0.81	1.05	0.77
[TC17]	0.93	1.12	0.99	0.97	0.83	0.84	1.01	0.74
[TC18]	0.14	0.07	0.16	0.14	0.14	0.12	0.16	0.02
[TC19]	0.27	0.26	0.30	0.33	0.26	0.19	0.34	0.17
[TC20]	0.38	0.46	0.49	0.51	0.37	0.27	0.53	0.29
[TC21]	0.91	0.97	1.06	1.09	0.91	0.88	1.23	0.70
[TC22]	0.81	0.86	0.80	0.78	0.64	0.64	0.87	0.60
[TC23]	0.54	0.66	0.69	0.64	0.48	0.48	0.71	0.42
[TC24]	0.73	0.86	0.79	0.80	0.72	0.64	1.00	0.57
[TC25]	0.82	1.00	0.98	1.00	0.87	0.88	1.14	0.73
[TC26]	0.93	1.00	1.01	0.88	0.82	0.82	0.94	0.73
[TC27]	0.53	0.70	0.76	0.77	0.58	0.50	0.79	0.51
[TC28]	0.55	0.69	0.66	0.72	0.49	0.44	0.75	0.52
[TC29]	0.41	0.49	0.48	0.54	0.40	0.30	0.57	0.32
[TC30]	0.94	1.01	0.87	0.87	1.01	0.76	0.97	0.68
[TC31]	0.53	0.76	0.65	0.72	0.50	0.47	0.81	0.45
[TC32]	0.91	0.86	1.10	1.14	0.79	0.75	1.12	0.60
[TC33]	2.03	2.02	1.97	2.01	1.97	1.88	2.30	1.72
[TC34]	0.96	0.86	1.10	0.98	0.83	0.75	1.11	0.62
[TC35]	2.08	2.53	2.41	2.13	2.36	2.23	2.42	2.22
[TC36]	2.48	2.55	2.44	2.28	2.48	2.52	2.64	2.37
[TC37]	1.82	2.06	1.82	1.87	1.76	1.89	2.14	1.72
[TC38]	0.17	0.17	0.22	0.21	0.18	0.12	0.26	0.10
[TC39]	0.44	0.39	0.42	0.42	0.34	0.33	0.52	0.30
[TC40]	0.28	0.30	0.32	0.36	0.26	0.16	0.36	0.21
[TC41]	0.30	0.42	0.43	0.49	0.33	0.31	0.43	0.31
[TC42]	0.73	0.82	0.76	0.78	0.72	0.73	0.79	0.77
[TC43]	0.68	0.82	0.82	0.78	0.76	0.71	0.75	0.67
[TC44]	0.64	0.77	0.56	0.66	0.58	0.62	0.72	0.60
[TC45]	0.70	0.72	0.70	0.81	0.67	0.69	0.74	0.57
[TC46]	0.80	0.75	0.64	0.79	0.64	0.65	0.71	0.71
[TC47]	0.64	0.73	0.60	0.59	0.67	0.51	0.70	0.65
[TC48]	0.20	0.19	0.23	0.25	0.21	0.14	0.28	0.11
[TC49]	0.73	0.73	0.73	0.73	0.60	0.71	0.75	0.64
Mean	0.77	0.87	0.84	0.84	0.75	0.71	0.92	0.65
Median	0.73	0.82	0.79	0.78	0.70	0.65	0.87	0.62
Max	2.48	2.55	2.44	2.28	2.48	2.52	2.64	2.37
Min	0.14	0.07	0.16	0.14	0.14	0.12	0.16	0.02
Percentile (%10)	0.28	0.29	0.32	0.35	0.26	0.18	0.36	0.20
Percentile (%25)	0.53	0.65	0.63	0.66	0.50	0.45	0.71	0.46
Percentile (%50)	0.73	0.82	0.79	0.78	0.70	0.65	0.87	0.62
Percentile (%75)	0.88	1.00	0.98	0.95	0.84	0.81	1.01	0.72
Percentile (%90)	1.00	1.12	1.10	1.11	0.98	0.91	1.17	0.77

Table E.76. Single TC Performances of Group 1 Policies - Shortage Rates

TC	5.9.	1	2	3	4	5	6	7
[TC1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC2]	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
[TC3]	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
[TC4]	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.02
[TC5]	0.02	0.03	0.04	0.02	0.02	0.04	0.04	0.04
[TC6]	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01
[TC7]	0.02	0.01	0.02	0.01	0.01	0.03	0.03	0.01
[TC8]	0.03	0.01	0.02	0.02	0.01	0.01	0.01	0.01
[TC9]	0.01	0.05	0.04	0.04	0.02	0.04	0.04	0.07
[TC10]	0.05	0.01	0.02	0.02	0.01	0.01	0.01	0.02
[TC11]	0.01	0.01	0.02	0.01	0.00	0.02	0.02	0.02
[TC12]	0.04	0.01	0.03	0.03	0.01	0.03	0.03	0.04
[TC13]	0.04	0.03	0.05	0.05	0.02	0.05	0.05	0.06
[TC14]	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
[TC15]	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.03
[TC16]	0.01	0.03	0.05	0.03	0.01	0.02	0.02	0.04
[TC17]	0.03	0.03	0.04	0.02	0.02	0.02	0.02	0.03
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC20]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC21]	0.01	0.01	0.03	0.04	0.02	0.04	0.04	0.04
[TC22]	0.02	0.01	0.03	0.02	0.01	0.02	0.02	0.02
[TC23]	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00
[TC24]	0.02	0.01	0.01	0.01	0.00	0.04	0.04	0.01
[TC25]	0.02	0.04	0.05	0.04	0.03	0.08	0.08	0.06
[TC26]	0.05	0.03	0.06	0.05	0.01	0.04	0.04	0.04
[TC27]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
[TC28]	0.00	0.00	0.01	0.01	0.00	0.02	0.02	0.00
[TC29]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC30]	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.04
[TC31]	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00
[TC32]	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.00
[TC33]	0.07	0.09	0.13	0.05	0.05	0.10	0.10	0.09
[TC34]	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
[TC35]	0.16	0.11	0.20	0.09	0.11	0.19	0.19	0.13
[TC36]	0.23	0.16	0.19	0.18	0.16	0.23	0.23	0.18
[TC37]	0.06	0.07	0.06	0.06	0.06	0.12	0.12	0.06
[TC38]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC39]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC40]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC41]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC42]	0.03	0.02	0.03	0.01	0.01	0.02	0.02	0.05
[TC43]	0.01	0.02	0.04	0.02	0.01	0.01	0.01	0.05
[TC44]	0.03	0.01	0.01	0.00	0.01	0.02	0.02	0.01
[TC45]	0.01	0.02	0.06	0.02	0.01	0.02	0.02	0.04
[TC46]	0.03	0.02	0.04	0.01	0.02	0.01	0.01	0.05
[TC47]	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02
[TC48]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC49]	0.02	0.02	0.03	0.03	0.02	0.01	0.01	0.06
Mean	0.02	0.02	0.03	0.02	0.02	0.03	0.03	0.03
Median	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02
Max	0.23	0.16	0.20	0.18	0.16	0.23	0.23	0.18
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%25)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%50)	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02
Percentile (%75)	0.03	0.02	0.04	0.02	0.02	0.03	0.03	0.04
Percentile (%90)	0.05	0.04	0.06	0.05	0.03	0.05	0.05	0.06

Table E.77. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group 0 + (Policy Group 6)

TC	5.9.	1	2	3	4	5	6	7
[TC1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC2]	0.04	0.04	0.01	0.03	0.01	0.02	0.03	0.01
[TC3]	0.09	0.16	0.13	0.11	0.10	0.13	0.14	0.05
[TC4]	0.31	0.15	0.09	0.14	0.15	0.16	0.23	0.14
[TC5]	0.28	0.37	0.24	0.23	0.26	0.21	0.33	0.23
[TC6]	0.11	0.03	0.03	0.07	0.03	0.04	0.06	0.06
[TC7]	0.31	0.12	0.12	0.09	0.11	0.07	0.23	0.06
[TC8]	0.32	0.13	0.12	0.10	0.07	0.12	0.10	0.09
[TC9]	0.29	0.37	0.24	0.30	0.25	0.39	0.38	0.33
[TC10]	0.42	0.12	0.09	0.14	0.14	0.07	0.13	0.09
[TC11]	0.14	0.09	0.09	0.08	0.06	0.08	0.16	0.07
[TC12]	0.36	0.33	0.32	0.28	0.35	0.31	0.48	0.39
[TC13]	0.38	0.37	0.29	0.23	0.32	0.29	0.32	0.32
[TC14]	0.06	0.03	0.02	0.02	0.01	0.02	0.04	0.01
[TC15]	0.29	0.14	0.11	0.18	0.09	0.13	0.09	0.12
[TC16]	0.22	0.37	0.32	0.40	0.27	0.24	0.26	0.24
[TC17]	0.37	0.30	0.20	0.22	0.25	0.27	0.28	0.18
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC20]	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
[TC21]	0.24	0.28	0.25	0.35	0.35	0.38	0.43	0.21
[TC22]	0.17	0.16	0.15	0.14	0.12	0.09	0.17	0.13
[TC23]	0.05	0.01	0.02	0.01	0.00	0.01	0.02	0.01
[TC24]	0.18	0.15	0.08	0.09	0.08	0.07	0.17	0.07
[TC25]	0.32	0.30	0.27	0.32	0.38	0.30	0.47	0.32
[TC26]	0.42	0.33	0.30	0.35	0.30	0.31	0.25	0.32
[TC27]	0.06	0.03	0.01	0.02	0.01	0.01	0.03	0.04
[TC28]	0.10	0.03	0.04	0.05	0.02	0.02	0.09	0.02
[TC29]	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
[TC30]	0.33	0.38	0.20	0.29	0.31	0.33	0.18	0.36
[TC31]	0.03	0.02	0.01	0.03	0.01	0.00	0.03	0.01
[TC32]	0.05	0.05	0.07	0.05	0.05	0.00	0.08	0.03
[TC33]	0.43	0.39	0.36	0.32	0.22	0.25	0.44	0.32
[TC34]	0.06	0.03	0.05	0.05	0.04	0.02	0.04	0.05
[TC35]	0.64	0.46	0.72	0.44	0.66	0.45	0.96	0.43
[TC36]	1.20	0.57	0.66	0.68	0.85	0.56	1.04	0.52
[TC37]	0.29	0.28	0.21	0.24	0.35	0.23	0.50	0.23
[TC38]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC39]	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.01
[TC40]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC41]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC42]	0.40	0.30	0.29	0.31	0.33	0.33	0.34	0.39
[TC43]	0.33	0.32	0.27	0.31	0.30	0.35	0.20	0.23
[TC44]	0.40	0.14	0.11	0.08	0.13	0.22	0.16	0.11
[TC45]	0.22	0.32	0.29	0.35	0.21	0.32	0.21	0.26
[TC46]	0.44	0.26	0.20	0.26	0.38	0.33	0.29	0.28
[TC47]	0.24	0.11	0.08	0.09	0.14	0.10	0.12	0.07
[TC48]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC49]	0.27	0.33	0.28	0.20	0.36	0.33	0.32	0.27
Mean	0.22	0.17	0.15	0.16	0.17	0.16	0.20	0.14
Median	0.18	0.12	0.10	0.09	0.10	0.10	0.13	0.08
Max	1.30	0.68	0.80	0.74	0.88	0.62	1.14	0.69
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%25)	0.03	0.02	0.01	0.02	0.01	0.01	0.03	0.01
Percentile (%50)	0.18	0.12	0.10	0.09	0.10	0.10	0.13	0.08
Percentile (%75)	0.32	0.30	0.22	0.25	0.26	0.26	0.28	0.24
Percentile (%90)	0.46	0.38	0.35	0.39	0.39	0.39	0.46	0.35

Table E.78. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group 0 - (Policy Group 6)

TC	5.9.	1	2	3	4	5	6	7	Selected Atb Values
[TC1]	0.24	0.38	2.29	0.32	0.28	0.27	0.41	0.14	*
[TC2]	3.61	4.14	2.31	4.57	3.76	3.58	3.65	3.05	0
[TC3]	7.22	6.74	4.06	7.27	7.53	8.05	7.58	5.11	0
[TC4]	9.79	10.49	6.31	11.86	10.60	9.73	11.23	5.90	0
[TC5]	11.40	11.43	6.02	12.04	10.46	13.61	11.12	7.81	0
[TC6]	6.50	7.22	3.74	5.41	5.86	6.28	6.93	4.18	0
[TC7]	9.37	9.45	5.25	8.74	9.15	8.64	9.23	5.56	0
[TC8]	9.11	10.37	4.64	9.85	10.13	9.62	10.80	6.12	0
[TC9]	13.83	12.62	6.54	13.44	13.93	12.52	14.90	8.80	0
[TC10]	12.40	10.31	5.33	9.53	9.63	10.23	9.61	6.76	0
[TC11]	7.64	7.78	3.76	8.18	7.25	7.09	7.57	4.90	0
[TC12]	14.79	14.15	8.10	14.14	15.86	16.21	15.79	8.82	0
[TC13]	13.22	15.41	7.86	15.63	16.21	13.93	15.78	7.18	0
[TC14]	3.78	4.86	2.89	5.44	4.79	4.38	5.27	3.96	0
[TC15]	8.80	12.00	4.91	8.99	9.84	11.32	10.19	6.33	0
[TC16]	12.64	12.59	5.94	11.26	10.57	13.13	13.98	7.06	0
[TC17]	14.33	13.87	6.99	14.63	13.60	14.21	13.16	8.90	0
[TC18]	0.09	0.06	2.08	0.03	0.04	0.04	0.03	0.01	*
[TC19]	0.71	0.59	1.97	0.64	0.45	0.55	0.46	0.35	*
[TC20]	1.61	1.65	1.99	1.18	1.46	1.44	1.95	0.81	*
[TC21]	14.12	15.76	8.31	15.22	14.46	14.94	15.47	7.94	0
[TC22]	7.44	8.02	3.99	8.92	7.06	8.47	8.82	4.65	0
[TC23]	3.88	4.04	3.30	3.57	3.77	2.74	3.40	2.72	*
[TC24]	7.15	8.46	4.32	8.64	7.30	8.92	8.32	4.80	0
[TC25]	11.83	12.48	6.93	12.70	12.02	11.91	12.81	7.00	0
[TC26]	17.12	17.13	6.98	16.24	15.83	15.22	16.69	8.95	0
[TC27]	3.96	4.62	3.64	5.09	4.95	4.78	5.06	3.02	0
[TC28]	5.05	5.74	3.57	6.56	6.21	6.17	5.96	4.04	0
[TC29]	1.30	1.84	1.95	1.68	1.64	1.35	1.89	1.01	*
[TC30]	15.64	17.15	7.41	12.90	15.52	14.84	17.05	9.46	0
[TC31]	2.57	3.45	2.33	3.50	2.68	2.90	3.60	2.77	0
[TC32]	5.31	6.72	10.28	7.17	6.49	5.84	7.08	4.18	*
[TC33]	17.31	18.64	12.20	20.34	19.77	18.60	20.06	18.19	0
[TC34]	7.82	5.66	10.06	5.21	4.64	4.94	5.73	3.16	*
[TC35]	20.63	23.32	13.33	21.88	23.38	20.04	23.26	18.84	0
[TC36]	25.45	26.74	16.02	26.36	24.96	28.43	25.81	20.96	0
[TC37]	16.86	18.19	10.65	21.72	16.63	17.06	19.33	14.98	0
[TC38]	0.49	0.56	2.22	0.61	0.48	0.60	0.68	0.49	*
[TC39]	2.78	2.20	2.76	2.71	2.38	3.25	3.60	2.60	*
[TC40]	1.31	1.25	2.43	1.57	0.99	1.14	1.63	1.02	*
[TC41]	1.25	1.42	2.25	1.77	1.34	1.45	1.76	1.39	*
[TC42]	15.60	15.49	9.13	14.95	15.46	16.18	16.03	11.09	0
[TC43]	12.35	15.23	8.19	12.98	12.70	13.68	12.36	8.79	0
[TC44]	9.57	10.19	6.30	10.73	9.65	9.37	9.59	6.06	0
[TC45]	11.89	13.84	7.56	13.97	12.51	12.05	14.04	10.43	0
[TC46]	15.56	15.37	8.26	15.27	14.16	15.94	14.18	8.60	0
[TC47]	8.98	8.39	6.00	9.45	8.48	7.25	9.83	6.17	0
[TC48]	0.46	0.71	2.23	0.92	0.54	0.64	0.79	0.53	*
[TC49]	15.67	17.05	9.14	15.42	15.17	16.63	15.02	8.81	0
Mean	8.99	9.51	5.81	9.41	9.03	9.19	9.58	6.21	
Median	8.15	8.22	4.46	7.88	7.32	8.07	8.39	5.22	
Max	29.26	30.12	18.28	31.04	30.13	29.64	30.07	23.46	
Min	0.09	0.06	1.85	0.03	0.04	0.04	0.03	0.01	
Percentile (%10)	1.12	1.07	1.96	1.00	0.79	0.79	1.23	0.69	
Percentile (%25)	3.03	3.45	2.54	3.29	2.90	2.80	3.56	3.01	
Percentile (%50)	8.15	8.22	4.46	7.88	7.32	8.07	8.39	5.22	
Percentile (%75)	13.31	13.14	7.13	14.03	13.75	13.38	13.87	7.95	
Percentile (%90)	16.88	17.86	14.91	16.57	16.93	17.31	17.20	9.94	

* Values given in Table 5.4. is selected

Table E.79. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group A+ (Policy Group 6)

TC	5.9.	1	2	3	4	5	6	7
[TC1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC2]	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
[TC3]	0.04	0.01	0.01	0.02	0.03	0.01	0.02	0.01
[TC4]	0.16	0.11	0.18	0.13	0.12	0.16	0.15	0.10
[TC5]	0.06	0.12	0.07	0.08	0.15	0.13	0.10	0.11
[TC6]	0.04	0.02	0.02	0.02	0.02	0.02	0.01	0.01
[TC7]	0.09	0.03	0.04	0.03	0.03	0.01	0.04	0.04
[TC8]	0.09	0.04	0.05	0.02	0.04	0.03	0.02	0.03
[TC9]	0.22	0.15	0.12	0.08	0.12	0.14	0.11	0.11
[TC10]	0.08	0.04	0.05	0.05	0.02	0.03	0.04	0.04
[TC11]	0.06	0.05	0.02	0.02	0.03	0.01	0.02	0.02
[TC12]	0.26	0.11	0.14	0.18	0.14	0.12	0.11	0.13
[TC13]	0.32	0.12	0.09	0.13	0.09	0.10	0.14	0.09
[TC14]	0.02	0.02	0.00	0.00	0.00	0.00	0.01	0.01
[TC15]	0.14	0.05	0.04	0.08	0.03	0.02	0.05	0.03
[TC16]	0.09	0.08	0.06	0.09	0.10	0.10	0.14	0.08
[TC17]	0.35	0.13	0.14	0.13	0.09	0.13	0.09	0.09
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC20]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC21]	0.27	0.13	0.12	0.10	0.21	0.10	0.11	0.15
[TC22]	0.05	0.03	0.05	0.02	0.02	0.05	0.03	0.02
[TC23]	0.01	0.00	0.01	0.02	0.01	0.00	0.01	0.01
[TC24]	0.04	0.02	0.04	0.03	0.02	0.02	0.04	0.01
[TC25]	0.16	0.08	0.07	0.07	0.09	0.09	0.11	0.05
[TC26]	0.27	0.13	0.14	0.12	0.15	0.11	0.14	0.08
[TC27]	0.02	0.00	0.01	0.01	0.01	0.00	0.01	0.01
[TC28]	0.02	0.00	0.02	0.00	0.01	0.01	0.01	0.01
[TC29]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC30]	0.27	0.08	0.16	0.09	0.18	0.10	0.18	0.14
[TC31]	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC32]	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01
[TC33]	0.10	0.09	0.13	0.07	0.02	0.08	0.06	0.03
[TC34]	0.00	0.03	0.01	0.01	0.00	0.01	0.00	0.01
[TC35]	0.07	0.17	0.14	0.18	0.09	0.15	0.20	0.15
[TC36]	0.24	0.36	0.36	0.46	0.41	0.50	0.28	0.40
[TC37]	0.05	0.09	0.04	0.09	0.02	0.02	0.05	0.03
[TC38]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC39]	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00
[TC40]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC41]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC42]	0.19	0.25	0.23	0.21	0.20	0.32	0.32	0.31
[TC43]	0.22	0.13	0.11	0.13	0.05	0.12	0.20	0.19
[TC44]	0.11	0.05	0.09	0.08	0.07	0.06	0.09	0.05
[TC45]	0.17	0.09	0.13	0.08	0.11	0.12	0.11	0.09
[TC46]	0.26	0.08	0.06	0.11	0.12	0.14	0.06	0.09
[TC47]	0.14	0.01	0.04	0.02	0.04	0.03	0.04	0.03
[TC48]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC49]	0.20	0.09	0.12	0.17	0.13	0.08	0.09	0.18
Mean	0.10	0.06	0.06	0.06	0.06	0.06	0.07	0.06
Median	0.06	0.03	0.04	0.02	0.02	0.02	0.03	0.03
Max	0.39	0.40	0.41	0.52	0.44	0.53	0.34	0.46
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%25)	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01
Percentile (%50)	0.06	0.03	0.04	0.02	0.02	0.02	0.03	0.03
Percentile (%75)	0.17	0.10	0.10	0.09	0.10	0.09	0.10	0.09
Percentile (%90)	0.27	0.14	0.14	0.14	0.16	0.15	0.16	0.14

Table E.80. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group A- (Policy Group 6)

TC	5.9.	1	2	3	4	5	6	7	Selected Atb Values
[TC1]	0.12	0.04	0.07	1.38	0.04	0.03	0.08	0.05	*
[TC2]	2.29	2.05	1.66	1.74	2.00	1.62	1.91	1.67	*
[TC3]	5.02	4.78	5.11	3.09	5.30	4.94	4.84	3.82	0
[TC4]	7.33	7.94	8.44	4.41	8.08	7.24	7.53	4.69	0
[TC5]	9.00	8.69	8.21	5.05	7.84	7.79	8.93	5.58	0
[TC6]	3.36	3.89	3.62	2.37	4.85	3.38	3.20	2.72	0
[TC7]	6.38	6.79	6.86	3.91	6.29	6.05	6.79	3.68	0
[TC8]	6.45	7.21	6.91	4.21	7.02	7.44	6.24	4.12	0
[TC9]	10.22	10.37	11.69	6.20	11.86	11.06	11.95	6.98	0
[TC10]	7.07	7.39	6.41	4.79	6.66	7.41	7.74	4.25	0
[TC11]	5.36	4.89	5.62	2.62	4.91	4.15	4.88	3.01	0
[TC12]	10.87	10.70	13.13	6.69	12.49	12.40	10.55	7.04	0
[TC13]	10.87	10.69	10.85	6.61	9.94	11.18	10.89	7.96	0
[TC14]	2.47	2.51	1.86	1.93	2.30	2.38	2.29	2.20	*
[TC15]	8.25	6.78	7.34	4.85	6.59	6.83	7.14	4.85	0
[TC16]	8.77	8.70	8.76	4.71	9.87	8.56	8.95	5.42	0
[TC17]	8.91	9.96	11.55	6.64	11.10	10.43	10.19	5.41	0
[TC18]	0.01	0.00	0.01	1.38	0.00	0.00	0.01	0.00	*
[TC19]	0.26	0.10	0.10	1.42	0.09	0.09	0.17	0.09	*
[TC20]	0.33	0.28	0.41	1.53	0.48	0.42	0.37	0.38	*
[TC21]	10.52	10.38	11.30	6.35	10.83	10.27	11.76	8.02	0
[TC22]	5.43	5.34	5.26	3.26	4.88	4.95	5.53	3.16	0
[TC23]	2.51	1.51	2.31	1.66	1.84	1.88	1.74	1.85	*
[TC24]	4.94	4.90	6.08	3.46	5.33	3.86	5.45	3.68	0
[TC25]	7.99	8.71	8.22	5.34	9.01	8.39	10.15	5.53	0
[TC26]	11.89	13.11	11.76	7.17	12.20	12.36	13.49	8.44	0
[TC27]	2.15	2.32	2.57	2.23	2.46	2.63	2.65	2.88	*
[TC28]	3.16	3.75	3.68	2.56	3.51	3.43	3.91	2.97	0
[TC29]	0.73	0.35	0.44	1.49	0.45	0.44	0.40	0.48	*
[TC30]	9.51	11.95	11.88	6.66	13.35	10.99	13.35	7.32	0
[TC31]	1.48	1.89	1.57	1.86	1.51	1.60	1.84	1.26	*
[TC32]	3.16	2.18	2.40	6.79	2.32	2.67	2.30	1.90	*
[TC33]	12.75	13.03	12.82	8.90	11.99	12.75	14.36	10.86	0
[TC34]	2.32	2.30	2.51	6.37	2.10	2.43	2.13	1.87	*
[TC35]	15.91	16.08	14.54	9.51	15.77	14.14	16.10	12.93	0
[TC36]	20.06	20.05	19.51	13.04	19.93	21.67	22.60	17.30	0
[TC37]	9.01	13.34	12.49	7.72	12.84	13.61	11.55	12.55	0
[TC38]	0.26	0.14	0.15	1.43	0.13	0.07	0.16	0.21	*
[TC39]	1.70	1.74	1.33	1.72	1.62	1.49	1.83	1.47	*
[TC40]	1.03	0.61	0.44	1.79	0.53	0.68	0.52	0.59	*
[TC41]	1.06	0.62	0.47	1.48	0.42	0.47	0.42	0.55	*
[TC42]	13.74	12.83	11.70	6.57	12.88	12.04	11.06	7.37	0
[TC43]	12.02	9.26	11.56	4.81	11.01	10.24	10.56	6.33	0
[TC44]	7.60	8.01	6.48	4.37	7.05	6.71	7.58	5.76	0
[TC45]	10.03	10.70	10.82	5.77	10.31	10.80	10.67	6.18	0
[TC46]	10.93	11.68	11.69	8.17	12.17	11.25	11.81	7.36	0
[TC47]	5.59	6.34	6.35	4.34	6.68	6.49	6.85	4.46	0
[TC48]	0.30	0.33	0.39	1.64	0.35	0.41	0.42	0.34	*
[TC49]	11.54	12.93	12.69	7.39	12.32	11.92	10.57	7.75	0
Mean	6.38	6.53	6.57	4.48	6.60	6.41	6.66	4.60	
Median	6.13	5.88	5.36	3.50	5.93	5.22	6.10	3.50	
Max	20.60	21.69	20.48	13.25	21.42	22.16	23.74	17.55	
Min	0.01	0.00	0.01	1.21	0.00	0.00	0.01	0.00	
Percentile (%10)	0.33	0.27	0.28	1.31	0.37	0.35	0.36	0.36	
Percentile (%25)	1.57	1.55	1.60	1.65	1.64	1.26	1.74	1.47	
Percentile (%50)	6.13	5.88	5.36	3.50	5.93	5.22	6.10	3.50	
Percentile (%75)	9.26	10.07	10.98	5.56	10.48	10.24	10.96	6.07	
Percentile (%90)	11.98	12.53	12.61	11.07	12.82	11.90	12.14	7.95	

* Values given in Table 5.4. is selected

Table E.81. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group B+ (Policy Group 6)

TC	5.9.	1	2	3	4	5	6	7
[TC1]	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
[TC2]	0.25	0.12	0.16	0.11	0.18	0.14	0.18	0.16
[TC3]	0.89	0.58	0.51	0.58	0.49	0.45	0.60	0.58
[TC4]	0.91	1.12	1.04	0.95	0.88	1.03	0.90	1.25
[TC5]	1.31	1.13	1.10	1.17	1.29	1.06	1.23	1.16
[TC6]	0.36	0.33	0.37	0.36	0.28	0.41	0.34	0.42
[TC7]	0.94	0.93	0.83	0.75	0.79	0.86	1.23	1.07
[TC8]	1.07	0.81	1.02	0.82	1.18	0.94	1.05	0.79
[TC9]	1.76	1.66	1.82	1.04	1.55	1.35	1.71	1.28
[TC10]	1.22	1.04	0.86	0.97	0.90	0.83	0.90	1.07
[TC11]	0.92	0.60	0.67	0.53	0.72	0.65	0.53	0.52
[TC12]	2.39	1.34	1.35	1.24	1.80	1.53	1.92	1.92
[TC13]	1.95	1.39	1.62	1.35	1.20	1.72	1.59	1.28
[TC14]	0.27	0.24	0.19	0.30	0.31	0.28	0.29	0.37
[TC15]	1.39	0.90	1.04	0.89	0.99	0.74	1.28	1.11
[TC16]	1.55	1.18	1.09	1.07	1.01	1.25	1.35	1.29
[TC17]	1.77	1.29	1.50	1.28	1.25	1.11	1.55	1.51
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
[TC20]	0.05	0.01	0.01	0.01	0.00	0.00	0.01	0.00
[TC21]	1.61	1.61	1.46	1.81	1.69	1.74	1.93	1.19
[TC22]	0.90	0.50	0.40	0.43	0.47	0.48	0.63	0.46
[TC23]	0.36	0.12	0.11	0.11	0.15	0.14	0.17	0.11
[TC24]	0.90	0.44	0.39	0.40	0.42	0.44	0.50	0.63
[TC25]	1.26	0.96	1.16	1.08	1.14	1.01	1.04	1.07
[TC26]	2.25	1.53	1.85	1.54	1.68	1.78	1.91	1.73
[TC27]	0.24	0.32	0.40	0.39	0.32	0.40	0.54	0.35
[TC28]	0.29	0.35	0.29	0.37	0.36	0.31	0.46	0.30
[TC29]	0.03	0.01	0.02	0.00	0.02	0.01	0.01	0.01
[TC30]	2.16	1.79	1.46	1.23	1.94	1.43	1.44	1.52
[TC31]	0.24	0.16	0.14	0.08	0.09	0.09	0.12	0.11
[TC32]	0.35	0.15	0.22	0.13	0.14	0.13	0.24	0.03
[TC33]	1.80	2.08	2.14	1.85	2.11	1.92	2.46	1.45
[TC34]	0.21	0.25	0.32	0.13	0.23	0.14	0.32	0.13
[TC35]	2.57	2.31	2.85	2.39	2.46	2.19	2.80	2.12
[TC36]	3.22	3.41	3.90	2.78	3.62	3.28	4.19	2.62
[TC37]	1.98	1.10	1.51	1.19	1.07	0.99	1.72	0.77
[TC38]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC39]	0.34	0.15	0.09	0.07	0.12	0.14	0.10	0.09
[TC40]	0.02	0.01	0.02	0.01	0.02	0.00	0.01	0.00
[TC41]	0.05	0.03	0.01	0.01	0.02	0.01	0.02	0.01
[TC42]	2.37	1.69	1.75	1.73	1.63	1.73	1.51	1.44
[TC43]	1.72	1.61	1.47	1.60	1.36	1.41	1.33	1.47
[TC44]	1.09	1.05	0.97	1.00	1.27	1.17	0.85	0.82
[TC45]	1.46	1.68	1.38	1.67	1.73	1.88	1.64	1.40
[TC46]	2.07	1.60	1.59	1.47	1.26	1.44	1.44	1.45
[TC47]	0.82	1.28	0.87	1.09	1.19	1.10	0.91	0.89
[TC48]	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
[TC49]	1.80	1.47	1.45	1.55	1.24	1.49	1.32	1.45
Mean	1.04	0.86	0.89	0.81	0.87	0.84	0.95	0.80
Median	0.67	0.81	0.71	0.77	0.79	0.77	0.72	0.74
Max	4.01	3.41	3.90	3.14	3.62	3.28	4.28	2.78
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00
Percentile (%25)	0.23	0.16	0.14	0.08	0.12	0.14	0.17	0.11
Percentile (%50)	0.67	0.81	0.71	0.77	0.79	0.77	0.72	0.74
Percentile (%75)	1.59	1.36	1.29	1.33	1.35	1.22	1.49	1.36
Percentile (%90)	2.20	1.86	1.88	1.65	1.87	1.89	1.97	1.77

Table E.82. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood
Group B- (Policy Group 6)

TC	5.9.	1	2	3	4	5	6	7	Selected Atb Values
[TC1]	2.29	1.88	2.31	2.58	3.81	1.68	2.13	0.91	*
[TC2]	15.42	16.52	16.83	17.45	8.45	16.21	16.05	10.77	0
[TC3]	23.41	25.45	25.99	24.71	11.98	25.11	23.98	13.60	0
[TC4]	26.55	31.93	30.04	30.81	14.43	31.14	30.35	16.07	0
[TC5]	34.81	32.22	34.49	35.36	13.39	32.57	32.70	17.46	0
[TC6]	18.18	23.28	23.74	24.20	8.83	20.03	21.51	12.01	0
[TC7]	28.61	30.89	29.65	26.94	13.96	28.45	28.63	16.76	0
[TC8]	26.82	28.44	28.53	31.25	12.62	26.43	29.45	16.26	0
[TC9]	35.12	33.42	37.69	37.86	17.60	33.40	39.90	17.14	0
[TC10]	27.11	31.32	32.19	32.23	14.75	30.10	29.77	17.82	0
[TC11]	23.93	26.02	31.00	23.17	8.99	24.38	25.20	15.97	0
[TC12]	38.57	37.67	38.26	36.15	15.59	37.47	38.65	16.83	0
[TC13]	38.01	37.25	38.22	35.91	15.49	36.82	35.78	23.03	0
[TC14]	13.97	18.87	17.18	17.97	8.59	17.16	19.12	10.37	0
[TC15]	30.34	28.57	30.41	27.55	14.69	33.40	29.28	17.52	0
[TC16]	31.74	35.31	37.33	34.28	14.57	33.21	34.91	19.12	0
[TC17]	34.97	39.29	35.95	33.19	16.73	36.39	35.83	17.52	0
[TC18]	1.54	0.65	0.58	0.58	3.63	0.51	0.78	0.28	*
[TC19]	3.94	4.70	4.35	5.00	4.23	3.75	3.59	2.00	*
[TC20]	5.45	7.17	7.54	7.40	3.92	6.17	6.44	6.89	0
[TC21]	34.72	35.11	35.69	39.08	14.14	36.75	35.70	19.83	0
[TC22]	22.98	27.98	26.56	26.22	11.64	25.45	25.59	14.27	0
[TC23]	13.69	15.02	15.08	16.64	6.78	14.56	18.47	10.01	0
[TC24]	24.77	26.91	25.26	25.98	12.23	23.20	26.18	15.50	0
[TC25]	33.29	32.91	30.90	33.39	14.48	35.33	32.24	20.04	0
[TC26]	39.66	36.91	39.20	42.21	18.98	41.38	38.27	22.78	0
[TC27]	16.36	18.58	19.75	16.61	8.44	17.12	17.82	10.26	0
[TC28]	19.95	21.64	21.30	22.44	9.73	19.77	21.44	12.94	0
[TC29]	6.71	6.70	7.02	7.77	4.40	7.11	6.49	7.56	0
[TC30]	39.76	39.31	36.38	39.73	20.16	37.51	35.23	18.89	0
[TC31]	12.41	13.92	16.20	13.68	6.91	15.04	15.08	9.92	0
[TC32]	13.27	13.08	15.47	12.30	9.82	12.12	12.83	10.57	0
[TC33]	35.69	35.82	36.19	35.13	18.81	36.78	35.25	22.38	0
[TC34]	11.89	13.44	13.80	11.12	9.97	11.30	12.52	10.88	0
[TC35]	40.38	39.72	40.50	39.10	19.06	39.87	39.96	19.79	0
[TC36]	48.65	52.30	57.20	52.87	27.14	49.77	52.74	25.24	0
[TC37]	29.95	35.19	34.54	29.79	19.38	31.61	35.45	19.19	0
[TC38]	3.62	3.24	3.05	2.69	4.40	2.80	2.95	2.20	*
[TC39]	13.22	13.47	11.65	10.66	10.33	12.19	13.83	10.26	0
[TC40]	5.91	6.82	5.93	6.60	5.39	5.54	6.20	6.69	0
[TC41]	6.87	9.01	8.99	8.89	4.72	7.15	7.70	6.38	0
[TC42]	35.93	38.42	37.71	38.25	17.79	40.88	40.40	19.86	0
[TC43]	34.82	35.02	37.55	34.15	20.11	35.43	34.37	17.38	0
[TC44]	29.71	29.04	25.36	30.16	14.30	28.42	31.91	19.01	0
[TC45]	35.71	33.90	33.85	33.31	17.76	34.19	34.38	19.68	0
[TC46]	36.60	39.01	36.83	34.83	19.20	34.61	37.24	23.44	0
[TC47]	29.29	27.65	28.11	23.09	13.84	25.77	24.45	18.11	0
[TC48]	3.89	4.09	4.29	4.11	5.79	3.98	4.61	2.53	*
[TC49]	39.41	36.58	37.02	35.57	20.48	35.74	35.17	22.86	0
Mean	24.08	25.14	25.38	24.71	12.50	24.40	24.87	14.42	
Median	27.24	28.44	29.25	27.67	13.54	27.64	28.09	16.39	
Max	50.16	53.24	57.48	53.68	28.20	49.94	52.96	25.56	
Min	1.54	0.65	0.58	0.58	2.76	0.51	0.78	0.28	
Percentile (%10)	5.31	5.72	5.35	5.23	3.98	4.74	4.83	4.69	
Percentile (%25)	11.97	12.90	11.85	11.95	6.74	12.14	12.82	9.40	
Percentile (%50)	27.24	28.44	29.25	27.67	13.54	27.64	28.09	16.39	
Percentile (%75)	36.07	36.83	38.21	36.96	16.17	36.39	37.24	19.24	
Percentile (%90)	39.29	40.69	41.21	40.53	21.64	39.77	40.11	22.69	

* Values given in Table 5.4. is selected

Table E.83. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group AB+ (Policy Group 6)

TC	5.9.	1	2	3	4	5	6	7	Selected Atb Values
[TC1]	0.01	0.02	0.03	0.02	0.03	0.02	1.28	0.04	*
[TC2]	1.26	0.85	1.00	0.90	1.20	0.84	1.69	1.00	*
[TC3]	1.78	2.18	2.46	2.59	2.14	1.86	2.35	2.01	*
[TC4]	4.47	4.57	4.52	4.45	4.42	4.54	3.62	3.05	0
[TC5]	5.64	4.06	5.60	4.69	5.04	5.52	3.62	3.31	0
[TC6]	2.17	1.88	1.68	1.64	1.73	1.22	1.41	1.67	*
[TC7]	3.51	3.67	3.38	3.49	3.96	3.36	2.38	2.69	0
[TC8]	4.24	4.27	3.66	4.83	3.85	3.65	2.72	3.07	0
[TC9]	5.69	5.88	7.06	5.40	5.20	6.44	4.52	5.00	0
[TC10]	4.39	4.15	4.36	4.06	3.79	4.09	3.42	3.08	0
[TC11]	2.22	2.19	2.09	2.17	2.27	2.24	2.14	1.87	*
[TC12]	6.77	6.75	6.62	6.94	6.42	7.38	4.17	5.04	0
[TC13]	6.09	5.34	5.41	6.54	6.61	6.93	3.91	4.48	0
[TC14]	1.30	1.22	1.20	1.19	1.19	1.49	1.27	1.30	*
[TC15]	4.40	4.13	3.95	3.75	3.70	4.12	3.01	2.75	0
[TC16]	6.46	4.31	4.85	4.89	5.26	5.69	3.65	4.29	0
[TC17]	5.46	6.92	6.34	5.83	5.82	5.10	4.01	4.51	0
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	1.19	0.00	*
[TC19]	0.07	0.03	0.07	0.03	0.03	0.02	1.37	0.04	*
[TC20]	0.27	0.10	0.15	0.14	0.13	0.11	1.35	0.12	*
[TC21]	7.25	6.63	6.83	6.57	7.53	7.43	3.84	4.10	0
[TC22]	3.06	2.60	2.35	1.90	2.30	1.98	1.80	2.30	0
[TC23]	1.13	0.95	1.09	1.02	1.06	1.03	1.65	1.17	*
[TC24]	2.08	2.23	2.28	2.39	1.80	2.21	2.68	2.32	*
[TC25]	5.77	5.04	4.76	4.76	5.38	5.29	3.04	3.97	0
[TC26]	7.10	8.02	8.15	7.86	6.98	7.94	4.81	4.14	0
[TC27]	1.07	1.06	1.30	1.44	1.60	1.39	1.51	1.39	*
[TC28]	1.92	1.67	1.36	1.37	1.52	1.12	1.80	1.52	*
[TC29]	0.16	0.37	0.39	0.37	0.30	0.29	1.61	0.33	*
[TC30]	6.72	6.90	6.31	6.63	7.41	7.13	3.91	4.30	0
[TC31]	1.12	1.12	0.60	1.06	0.73	0.97	1.69	0.94	*
[TC32]	1.38	1.63	1.37	1.08	0.97	1.05	4.47	0.93	*
[TC33]	6.40	6.73	6.27	5.94	5.81	5.92	5.77	4.88	*
[TC34]	1.57	1.16	1.00	0.94	1.23	1.00	4.52	0.90	*
[TC35]	9.46	11.49	11.51	9.00	9.57	9.57	6.76	10.27	0
[TC36]	12.74	13.08	14.07	13.05	12.88	12.70	8.53	11.18	0
[TC37]	5.75	5.71	5.86	4.55	4.36	6.09	4.74	5.28	*
[TC38]	0.05	0.03	0.03	0.06	0.06	0.04	1.37	0.05	*
[TC39]	1.00	0.81	0.86	0.83	0.76	0.85	1.29	0.78	*
[TC40]	0.29	0.32	0.37	0.37	0.25	0.24	1.33	0.19	*
[TC41]	0.25	1.05	1.18	1.15	1.11	1.07	1.48	1.26	*
[TC42]	7.14	7.07	7.28	6.47	6.89	7.88	5.23	5.46	0
[TC43]	6.70	6.80	6.04	6.14	5.30	6.11	4.31	4.62	0
[TC44]	3.33	4.10	3.95	3.82	4.37	4.29	2.78	2.73	0
[TC45]	6.16	4.94	5.64	5.77	5.72	5.95	4.06	4.34	0
[TC46]	6.99	6.96	5.97	5.76	6.26	6.47	3.77	4.83	0
[TC47]	3.30	3.31	3.30	3.20	2.59	3.19	2.27	3.02	0
[TC48]	0.12	0.18	0.18	0.14	0.11	0.09	1.27	0.10	*
[TC49]	8.30	6.77	6.57	7.75	7.83	7.27	3.56	5.62	0
Mean	3.77	3.70	3.70	3.57	3.58	3.70	3.04	2.90	
Median	3.10	3.02	2.79	3.06	2.72	3.19	2.37	2.69	
Max	13.71	14.93	14.91	13.29	13.07	13.25	8.92	12.50	
Min	0.00	0.00	0.00	0.00	0.00	0.00	1.04	0.00	
Percentile (%10)	0.15	0.15	0.16	0.13	0.10	0.09	1.26	0.09	
Percentile (%25)	0.78	0.64	0.71	0.69	0.60	0.71	1.38	0.83	
Percentile (%50)	3.10	3.02	2.79	3.06	2.72	3.19	2.37	2.69	
Percentile (%75)	6.45	5.56	5.59	5.24	5.45	5.79	3.80	4.29	
Percentile (%90)	7.32	7.50	7.03	7.32	7.38	7.44	6.89	5.08	

* Values given in Table 5.4. is selected

Table E.84. Sum of Outdate, Shortage, and Mismatch Rates of TCs for Blood Group AB- (Policy Group 6)

TC	5.9.	1	2	3	4	5	6	7	Selected Atb Values
[TC1]	16.14	12.51	13.54	14.03	12.26	11.23	12.54	11.97	0
[TC2]	47.26	49.72	47.45	47.87	50.77	23.14	50.01	23.00	0
[TC3]	55.80	65.39	61.62	65.33	61.96	27.00	63.61	29.69	0
[TC4]	64.53	68.37	70.13	71.04	65.90	32.51	65.18	33.53	0
[TC5]	66.48	70.12	75.87	73.39	65.76	31.77	66.72	35.70	0
[TC6]	56.34	58.65	57.07	54.26	54.22	26.00	53.66	26.90	0
[TC7]	60.61	72.17	65.45	63.19	57.61	27.25	65.42	31.95	0
[TC8]	66.53	72.31	61.60	68.77	63.60	26.92	64.64	30.40	0
[TC9]	69.33	77.62	72.54	75.44	79.43	35.14	76.52	38.41	0
[TC10]	67.89	69.98	67.74	71.59	67.02	26.38	61.54	32.88	0
[TC11]	61.50	63.15	62.98	59.21	58.86	25.94	58.70	29.46	0
[TC12]	70.03	78.48	77.98	72.23	79.43	32.22	78.67	30.48	0
[TC13]	73.96	73.62	71.58	72.95	72.04	30.86	79.49	37.20	0
[TC14]	46.63	49.71	51.30	50.54	48.20	25.32	52.49	24.72	0
[TC15]	62.28	68.65	71.19	64.14	65.45	30.39	60.86	32.82	0
[TC16]	71.38	70.20	74.77	72.85	69.91	30.16	65.67	36.76	0
[TC17]	74.62	79.65	77.66	80.66	71.51	29.65	77.31	37.05	0
[TC18]	10.65	5.83	6.28	6.01	6.78	10.88	6.13	2.29	*
[TC19]	18.74	17.26	16.70	17.36	18.45	10.16	19.18	12.20	0
[TC20]	29.56	36.39	34.91	33.19	31.19	15.88	31.45	17.74	0
[TC21]	71.75	74.26	76.65	79.50	76.04	31.32	83.02	39.49	0
[TC22]	62.87	62.60	64.14	58.88	58.13	27.73	62.04	32.28	0
[TC23]	44.35	44.38	47.39	46.45	43.82	25.90	48.34	26.22	0
[TC24]	55.42	61.57	61.28	64.22	60.14	28.99	66.73	33.12	0
[TC25]	64.58	61.68	74.45	79.14	70.52	30.16	74.62	36.05	0
[TC26]	73.11	81.28	77.84	80.92	78.79	36.78	82.21	35.36	0
[TC27]	46.28	55.45	54.96	59.09	51.95	20.85	50.45	26.21	0
[TC28]	55.37	56.96	53.79	53.42	54.27	26.26	57.33	26.80	0
[TC29]	32.54	34.90	32.33	31.79	30.86	15.82	35.16	16.88	0
[TC30]	72.42	78.10	74.54	72.32	77.94	26.90	73.21	38.32	0
[TC31]	39.62	46.50	45.25	44.71	39.29	18.99	47.58	22.00	0
[TC32]	34.86	32.22	38.53	37.34	33.20	23.90	32.63	21.30	0
[TC33]	63.28	65.85	64.32	64.62	62.19	37.18	64.89	33.20	0
[TC34]	34.13	32.70	34.32	31.86	35.01	24.33	33.36	22.14	0
[TC35]	69.44	76.04	73.91	67.04	71.38	39.61	77.38	37.33	0
[TC36]	88.86	74.07	76.18	87.30	78.53	38.61	81.26	37.88	0
[TC37]	69.52	62.15	57.62	61.37	59.63	35.66	65.87	36.85	0
[TC38]	13.91	13.52	13.15	11.96	11.39	8.13	13.35	8.42	0
[TC39]	34.66	34.20	38.67	35.75	35.01	19.07	35.10	20.26	0
[TC40]	24.22	23.76	24.03	25.28	22.61	13.92	23.49	13.34	0
[TC41]	22.25	22.04	22.63	22.42	22.73	12.39	26.12	13.51	0
[TC42]	62.92	71.10	61.81	70.28	63.53	27.31	67.35	32.76	0
[TC43]	60.37	68.24	66.06	67.95	60.06	28.37	64.40	28.48	0
[TC44]	53.68	57.66	63.06	55.88	52.83	27.22	56.19	25.35	0
[TC45]	61.48	63.15	59.11	67.02	63.69	26.49	64.81	26.62	0
[TC46]	65.87	61.95	63.28	67.53	65.78	30.64	64.40	32.98	0
[TC47]	50.52	54.53	54.52	53.39	59.56	22.61	53.50	25.49	0
[TC48]	19.18	18.74	15.19	17.98	16.97	9.88	17.64	10.23	0
[TC49]	64.42	69.61	65.30	66.14	60.86	31.23	66.27	25.03	0
Mean	53.11	55.49	54.95	55.42	53.41	25.61	55.07	27.33	
Median	61.43	65.88	63.90	62.46	61.01	27.00	62.60	31.51	
Max	88.86	88.77	87.49	93.20	84.79	45.89	91.49	44.28	
Min	7.03	5.83	5.51	6.01	6.43	3.48	6.13	2.25	
Percentile (%10)	16.36	18.69	17.00	17.84	16.60	9.18	16.40	8.67	
Percentile (%25)	33.05	32.78	32.90	34.88	33.89	18.83	36.34	15.87	
Percentile (%50)	61.43	65.88	63.90	62.46	61.01	27.00	62.60	31.51	
Percentile (%75)	72.20	75.80	76.10	74.83	72.79	32.88	76.52	36.45	
Percentile (%90)	76.54	82.39	79.90	82.54	79.74	38.56	81.38	39.02	

Values given in Table 5.4. is selected

Table E.85. Sum of Outdate, Shortage, and Mismatch Rates of TCs
(Policy Group 6)

TC	5.9.	1	2	3	4	5	6	7
[TC1]	0.22	0.18	0.27	0.28	0.21	0.16	0.28	0.15
[TC2]	1.16	1.15	1.07	1.20	1.01	0.90	1.17	0.76
[TC3]	1.97	2.01	1.90	1.90	1.74	1.60	2.05	1.22
[TC4]	2.85	2.93	2.73	2.85	2.57	2.34	2.81	1.61
[TC5]	3.28	3.16	3.01	2.99	2.70	2.74	3.04	1.82
[TC6]	1.65	1.74	1.61	1.60	1.43	1.28	1.66	1.03
[TC7]	2.49	2.55	2.33	2.28	2.11	1.96	2.46	1.43
[TC8]	2.64	2.72	2.41	2.53	2.28	2.09	2.52	1.50
[TC9]	3.71	3.66	3.53	3.39	3.25	3.15	3.77	2.18
[TC10]	2.88	2.75	2.55	2.67	2.34	2.23	2.59	1.59
[TC11]	2.08	2.00	2.00	1.88	1.68	1.56	2.01	1.21
[TC12]	4.20	3.84	3.77	3.64	3.56	3.46	3.91	2.17
[TC13]	3.90	3.73	3.44	3.60	3.26	3.23	3.69	2.19
[TC14]	1.21	1.32	1.19	1.34	1.12	1.03	1.37	0.90
[TC15]	2.86	2.75	2.51	2.44	2.24	2.22	2.65	1.55
[TC16]	3.43	3.26	3.03	2.99	2.84	2.78	3.30	1.98
[TC17]	3.74	3.80	3.46	3.46	3.18	2.95	3.52	2.04
[TC18]	0.14	0.08	0.16	0.14	0.14	0.12	0.16	0.03
[TC19]	0.30	0.30	0.34	0.37	0.29	0.21	0.38	0.19
[TC20]	0.49	0.57	0.59	0.62	0.46	0.38	0.62	0.36
[TC21]	3.92	3.87	3.68	3.71	3.44	3.30	3.90	2.15
[TC22]	2.18	2.11	1.96	1.94	1.72	1.69	2.08	1.22
[TC23]	1.13	1.09	1.12	1.10	0.90	0.85	1.17	0.76
[TC24]	2.03	2.05	1.93	1.99	1.71	1.62	2.17	1.30
[TC25]	3.24	3.14	3.01	3.13	2.82	2.74	3.28	1.93
[TC26]	4.40	4.36	3.89	4.02	3.65	3.69	4.14	2.31
[TC27]	1.20	1.34	1.35	1.36	1.16	1.05	1.40	0.92
[TC28]	1.56	1.62	1.47	1.59	1.36	1.25	1.64	1.01
[TC29]	0.54	0.60	0.58	0.64	0.49	0.40	0.68	0.41
[TC30]	4.07	4.18	3.65	3.62	3.76	3.31	3.91	2.23
[TC31]	0.92	1.08	0.98	1.05	0.79	0.77	1.13	0.66
[TC32]	1.13	1.10	1.34	1.35	0.98	0.96	1.33	0.75
[TC33]	3.77	3.85	3.66	3.71	3.40	3.35	4.01	2.64
[TC34]	1.14	1.06	1.27	1.15	0.97	0.91	1.28	0.76
[TC35]	4.81	5.05	4.75	4.52	4.33	4.19	4.96	3.35
[TC36]	6.44	6.42	6.13	6.01	5.70	5.72	6.41	4.05
[TC37]	3.37	3.57	3.24	3.26	2.99	3.12	3.57	2.55
[TC38]	0.24	0.23	0.28	0.27	0.23	0.17	0.32	0.16
[TC39]	1.00	0.91	0.93	0.88	0.84	0.73	1.03	0.67
[TC40]	0.48	0.49	0.51	0.56	0.41	0.36	0.54	0.35
[TC41]	0.49	0.57	0.59	0.63	0.48	0.43	0.59	0.44
[TC42]	4.50	4.39	4.10	4.07	3.77	3.65	4.23	2.45
[TC43]	3.95	3.94	3.68	3.59	3.34	3.12	3.62	2.06
[TC44]	2.87	2.85	2.56	2.67	2.45	2.28	2.68	1.57
[TC45]	3.71	3.78	3.54	3.62	3.27	3.08	3.69	2.02
[TC46]	4.30	4.11	3.71	3.89	3.59	3.32	3.88	2.29
[TC47]	2.54	2.54	2.37	2.34	2.24	1.91	2.36	1.54
[TC48]	0.30	0.34	0.36	0.40	0.34	0.24	0.41	0.20
[TC49]	4.41	4.33	4.00	4.05	3.76	3.43	3.91	2.29
Mean	2.45	2.44	2.30	2.31	2.11	2.00	2.41	1.45
Median	2.40	2.48	2.30	2.25	2.09	1.95	2.32	1.40
Max	6.46	6.42	6.14	6.01	5.77	5.72	6.41	4.19
Min	0.14	0.08	0.16	0.14	0.14	0.12	0.16	0.03
Percentile (%10)	0.38	0.40	0.42	0.46	0.35	0.28	0.46	0.29
Percentile (%25)	1.10	1.08	1.05	1.11	0.91	0.82	1.17	0.75
Percentile (%50)	2.40	2.48	2.30	2.25	2.09	1.95	2.32	1.40
Percentile (%75)	3.69	3.54	3.45	3.37	3.11	2.93	3.53	2.03
Percentile (%90)	4.33	4.35	3.98	4.01	3.75	3.57	4.19	2.33

Table E.86. Cities Performances and Performance of Region Including DCs and RBC of Group 7 Policies

Performance Measure		6.7.	1	2	3	4	5	6	7	8
Inventory Level	Antalya	3731	3731	3722	3512	3534	3532	3367	3379	3423
	Burdur	574	570	571	539	527	530	502	510	523
	Isparta	1470	1471	1476	1386	1396	1403	1329	1345	1366
	Overall	5774	5771	5769	5437	5457	5465	5199	5235	5312
Outdate Rate	Antalya	0.35	0.35	0.35	0.34	0.35	0.35	0.34	0.35	0.35
	Burdur	0.74	0.76	0.69	0.73	0.70	0.70	0.72	0.71	0.73
	Isparta	0.50	0.50	0.50	0.47	0.49	0.49	0.49	0.49	0.49
	Overall	0.43	0.43	0.43	0.42	0.42	0.42	0.42	0.42	0.42
Mismatch Rate	Antalya	0.34	0.33	0.32	0.34	0.31	0.30	0.32	0.32	0.31
	Burdur	1.06	1.04	1.11	1.09	1.17	1.24	1.21	1.22	1.07
	Isparta	0.28	0.27	0.24	0.29	0.25	0.27	0.29	0.28	0.26
	Overall	0.40	0.39	0.38	0.40	0.38	0.39	0.41	0.41	0.38
Shortage Rate	Antalya	0.01	0.02	0.01	0.01	0.01	0.00	0.01	0.01	0.01
	Burdur	0.04	0.04	0.07	0.03	0.10	0.09	0.11	0.06	0.05
	Isparta	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00
	Overall	0.01	0.02	0.01	0.01	0.02	0.01	0.02	0.01	0.01

Table E.87. Delivery Performance Measures of Group 7 Policies

Delivery Performances	Delivery Type	6.7.	1	2	3	4	5	6	7	8
Quantity	Routine Deliveries To TCs	56898	56314	54715	53634	51612	47436	49708	45947	38358
	Ad-Hoc Deliveries to TCs	24504	28647	37863	32108	38570	51569	37584	46029	61171
	Emergency Deliveries To TCs	21905	21813	21818	21897	21922	21803	21908	21802	21795
	Ad-hoc Deliveries Between DCs and RBC	2541	2535	2552	2570	2543	2510	2512	2530	2600
	Total	105848	109309	116948	110209	114646	123318	111712	116308	123924
Percentage	Routine Deliveries To TCs	53.75	51.52	46.79	48.67	45.02	38.47	44.50	39.51	30.95
	Ad-Hoc Deliveries to TCs	23.15	26.21	32.38	29.13	33.64	41.82	33.64	39.58	49.36
	Emergency Deliveries To TCs	20.69	19.96	18.66	19.87	19.12	17.68	19.61	18.74	17.59
	Ad-hoc Deliveries Between DCs and RBC	2.40	2.32	2.18	2.33	2.22	2.04	2.25	2.17	2.10

Table E.88. Selection Criterion Performance of Group 7 Policies

Performance Measure	Case	6.7.	1	2	3	4	5	6	7	8
Outdate Rate	Region Including Dcs and RBC	0.43	0.43	0.43	0.42	0.42	0.42	0.42	0.42	0.42
	Region Excluding Dcs And RBC	0.36	0.37	0.37	0.35	0.36	0.36	0.35	0.36	0.36
	Single TCs' Means	0.77	0.78	0.77	0.75	0.76	0.76	0.75	0.76	0.77
Mismatch Rate	Region Including Dcs and RBC	0.40	0.39	0.38	0.40	0.38	0.39	0.41	0.41	0.38
	Region Excluding Dcs And RBC	0.40	0.39	0.38	0.40	0.38	0.39	0.41	0.41	0.38
	Single TCs' Means	0.65	0.64	0.64	0.66	0.63	0.66	0.66	0.67	0.62
Shortage Rate	Region Including Dcs and RBC	0.01	0.02	0.01	0.01	0.02	0.01	0.02	0.01	0.01
	Region Excluding Dcs And RBC	0.01	0.02	0.01	0.01	0.02	0.01	0.02	0.01	0.01
	Single TCs' Means	0.03	0.04	0.03	0.03	0.04	0.03	0.05	0.03	0.02
Selection Criterion Performance		0.84	0.84	0.82	0.83	0.82	0.83	0.85	0.84	0.81

Table E.89. Single TC Performances of Group 7 Policies - Mean Inventory Levels

TC	6.7.	1	2	3	4	5	6	7	8
[TC1]	211.15	211.20	211.91	184.00	185.27	188.20	163.02	166.10	175.81
[TC2]	48.67	48.81	49.15	43.15	43.68	45.07	39.66	41.00	43.50
[TC3]	31.65	31.86	32.26	28.00	28.74	29.90	26.62	27.83	29.56
[TC4]	20.86	21.11	21.36	19.53	19.76	20.45	18.47	18.84	19.85
[TC5]	21.19	21.35	21.43	18.96	19.43	19.82	17.83	18.72	19.51
[TC6]	34.89	35.20	35.76	31.07	31.85	33.02	28.99	30.43	32.21
[TC7]	25.28	25.40	25.62	22.19	22.63	23.59	21.61	22.28	23.37
[TC8]	24.64	24.77	24.91	21.87	22.07	22.45	20.52	21.04	21.98
[TC9]	17.81	17.90	18.02	16.55	16.70	17.24	15.80	16.05	17.05
[TC10]	23.68	23.76	23.96	21.12	21.75	22.07	20.36	21.06	21.58
[TC11]	32.94	32.94	33.16	28.72	29.27	30.03	26.92	27.94	28.92
[TC12]	18.59	18.79	18.97	17.31	17.77	17.66	16.27	17.09	17.06
[TC13]	17.83	17.75	18.13	16.56	16.66	17.28	15.81	16.17	17.05
[TC14]	44.53	44.68	45.17	38.99	39.60	41.23	35.80	37.41	39.95
[TC15]	23.71	23.75	23.92	21.18	21.34	21.86	19.77	20.51	21.30
[TC16]	20.13	20.19	20.19	17.55	18.05	18.44	17.24	17.92	18.06
[TC17]	18.34	18.40	18.47	16.82	16.93	17.45	16.02	16.29	17.04
[TC18]	409.38	408.89	409.39	360.00	360.21	360.92	315.67	316.44	319.15
[TC19]	174.32	174.23	174.42	152.73	153.14	153.84	135.07	136.19	138.90
[TC20]	101.98	101.87	102.10	88.71	89.19	90.02	79.26	80.15	82.65
[TC21]	18.65	18.66	18.73	17.22	17.72	17.83	16.43	17.19	17.57
[TC22]	29.01	29.10	29.38	25.77	26.20	26.71	24.30	24.92	25.92
[TC23]	48.83	48.82	48.94	43.01	43.37	43.87	39.65	40.49	41.67
[TC24]	32.12	32.14	32.33	27.92	28.43	29.31	26.43	27.37	28.53
[TC25]	19.26	19.14	19.36	16.95	17.14	17.67	16.41	16.65	17.27
[TC26]	16.44	16.28	16.59	15.08	15.16	15.67	14.74	14.80	15.46
[TC27]	42.81	43.06	43.38	37.64	38.43	39.78	34.83	36.32	38.37
[TC28]	38.65	38.54	38.73	33.98	34.15	34.81	31.05	31.48	33.13
[TC29]	99.38	99.33	99.65	86.99	87.38	88.26	78.15	79.11	81.08
[TC30]	18.40	18.30	18.44	16.74	16.98	17.22	15.96	15.86	16.68
[TC31]	54.52	54.53	54.99	47.35	48.20	49.68	44.12	45.92	48.34
[TC32]	96.36	96.47	96.56	83.83	83.43	84.53	73.71	74.84	78.23
[TC33]	28.93	29.03	29.03	24.88	25.21	25.52	23.87	24.64	25.30
[TC34]	96.37	96.40	96.25	84.51	84.23	85.10	74.58	75.71	78.69
[TC35]	21.31	21.49	21.48	18.64	18.87	19.31	17.77	18.26	19.10
[TC36]	14.64	14.82	14.75	13.65	13.76	14.16	13.12	13.57	13.88
[TC37]	30.84	30.78	30.86	26.65	26.82	27.44	24.98	25.73	26.99
[TC38]	167.54	167.95	168.19	146.44	148.03	150.09	129.36	133.33	141.13
[TC39]	49.94	50.57	51.35	45.25	46.63	47.96	42.41	44.91	47.09
[TC40]	97.73	97.83	98.00	84.85	85.48	86.10	75.48	76.77	79.06
[TC41]	88.44	88.61	89.21	77.07	77.70	80.19	69.46	71.35	77.06
[TC42]	17.43	17.36	17.49	15.74	16.20	16.33	14.89	15.63	16.01
[TC43]	17.22	17.61	17.81	16.28	16.56	17.21	15.84	16.17	17.20
[TC44]	23.92	23.83	24.04	21.23	21.56	21.70	19.74	20.54	20.88
[TC45]	19.04	19.06	19.11	17.31	17.52	17.81	16.33	16.67	17.68
[TC46]	17.47	17.41	17.70	16.06	16.13	16.54	15.54	15.52	16.10
[TC47]	25.79	25.69	25.88	22.12	22.52	22.87	21.44	21.74	22.53
[TC48]	116.92	117.84	119.48	102.46	105.74	110.07	93.51	100.21	107.66
[TC49]	16.08	16.05	16.27	15.12	15.12	15.70	14.66	14.72	15.45
Mean	54.81	54.89	55.15	48.28	48.75	49.59	43.87	44.90	46.71
Median	28.93	29.03	29.03	24.88	25.21	25.52	23.87	24.64	25.30
Max	409.38	408.89	409.39	360.00	360.21	360.92	315.67	316.44	319.15
Min	14.64	14.82	14.75	13.65	13.76	14.16	13.12	13.57	13.88
Percentile (%10)	17.46	17.57	17.79	16.24	16.49	17.08	15.75	15.81	16.56
Percentile (%25)	19.04	19.06	19.11	17.31	17.72	17.81	16.41	17.09	17.57
Percentile (%50)	28.93	29.03	29.03	24.88	25.21	25.52	23.87	24.64	25.30
Percentile (%75)	49.94	50.57	51.35	45.25	46.63	47.96	42.41	44.91	47.09
Percentile (%90)	104.97	105.07	105.58	91.46	92.50	94.03	82.11	84.17	87.66

Table E.90. Single TC Performances of Group 7 Policies - Outdate Rates

TC	6.7.	1	2	3	4	5	6	7	8
[TC1]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
[TC2]	0.29	0.32	0.31	0.31	0.32	0.29	0.32	0.32	0.27
[TC3]	0.69	0.69	0.70	0.69	0.70	0.68	0.65	0.73	0.72
[TC4]	0.89	0.99	1.01	1.05	0.96	1.01	0.91	0.99	0.98
[TC5]	1.06	1.11	1.08	1.08	1.13	0.99	1.11	1.14	1.10
[TC6]	0.49	0.53	0.58	0.53	0.50	0.51	0.49	0.52	0.53
[TC7]	0.74	0.76	0.77	0.75	0.76	0.77	0.70	0.81	0.78
[TC8]	0.86	0.93	0.88	0.87	0.89	0.82	0.89	0.83	0.92
[TC9]	1.37	1.41	1.31	1.33	1.26	1.31	1.29	1.25	1.39
[TC10]	0.90	0.93	0.87	0.86	0.92	0.89	0.84	0.87	0.91
[TC11]	0.68	0.64	0.69	0.70	0.74	0.77	0.68	0.71	0.66
[TC12]	1.40	1.50	1.59	1.47	1.51	1.45	1.37	1.37	1.47
[TC13]	1.39	1.38	1.33	1.29	1.30	1.39	1.34	1.33	1.42
[TC14]	0.44	0.45	0.44	0.40	0.41	0.45	0.36	0.40	0.42
[TC15]	0.85	0.89	0.79	0.85	0.80	0.84	0.83	0.86	0.86
[TC16]	1.16	1.13	1.15	1.03	1.19	1.20	1.17	1.13	1.03
[TC17]	1.27	1.37	1.28	1.27	1.30	1.34	1.33	1.32	1.28
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02
[TC20]	0.07	0.09	0.08	0.07	0.07	0.06	0.07	0.07	0.07
[TC21]	1.41	1.33	1.30	1.35	1.36	1.31	1.37	1.41	1.45
[TC22]	0.60	0.62	0.64	0.58	0.62	0.65	0.63	0.63	0.63
[TC23]	0.34	0.34	0.32	0.31	0.31	0.31	0.30	0.30	0.30
[TC24]	0.72	0.71	0.73	0.63	0.69	0.72	0.70	0.70	0.71
[TC25]	1.14	1.05	1.10	1.03	1.07	1.10	1.07	1.15	1.00
[TC26]	1.54	1.53	1.61	1.45	1.59	1.55	1.51	1.60	1.57
[TC27]	0.40	0.37	0.41	0.40	0.41	0.42	0.41	0.40	0.39
[TC28]	0.48	0.45	0.46	0.42	0.48	0.42	0.41	0.42	0.43
[TC29]	0.09	0.08	0.08	0.08	0.08	0.09	0.08	0.07	0.07
[TC30]	1.50	1.48	1.55	1.46	1.53	1.48	1.48	1.46	1.47
[TC31]	0.22	0.20	0.21	0.20	0.22	0.21	0.21	0.23	0.21
[TC32]	0.15	0.15	0.14	0.15	0.14	0.14	0.15	0.15	0.15
[TC33]	0.83	0.89	0.90	0.84	0.84	0.80	0.85	0.81	0.90
[TC34]	0.13	0.12	0.12	0.12	0.11	0.11	0.12	0.11	0.12
[TC35]	1.00	1.11	1.02	1.04	1.06	1.00	0.91	1.02	0.97
[TC36]	1.49	1.54	1.50	1.48	1.50	1.45	1.43	1.44	1.33
[TC37]	0.77	0.77	0.68	0.70	0.68	0.73	0.69	0.65	0.80
[TC38]	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.05
[TC39]	0.37	0.37	0.37	0.36	0.38	0.36	0.35	0.41	0.37
[TC40]	0.14	0.15	0.16	0.14	0.15	0.14	0.15	0.15	0.14
[TC41]	0.13	0.12	0.13	0.13	0.12	0.12	0.11	0.12	0.14
[TC42]	1.64	1.52	1.66	1.56	1.54	1.61	1.69	1.59	1.51
[TC43]	1.34	1.59	1.39	1.37	1.28	1.38	1.35	1.37	1.54
[TC44]	0.96	0.90	0.93	0.93	0.96	0.90	0.89	0.88	0.94
[TC45]	1.41	1.37	1.42	1.36	1.38	1.30	1.35	1.43	1.49
[TC46]	1.54	1.52	1.58	1.42	1.59	1.53	1.53	1.50	1.58
[TC47]	0.88	0.84	0.87	0.78	0.87	0.81	0.87	0.78	0.85
[TC48]	0.10	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10
[TC49]	1.59	1.57	1.57	1.64	1.59	1.73	1.59	1.52	1.55
Mean	0.77	0.78	0.77	0.75	0.76	0.76	0.75	0.76	0.77
Median	0.77	0.77	0.77	0.75	0.76	0.77	0.70	0.78	0.80
Max	1.64	1.59	1.66	1.64	1.59	1.73	1.69	1.60	1.58
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.08	0.09	0.08	0.08	0.08	0.09	0.08	0.07	0.07
Percentile (%25)	0.29	0.32	0.31	0.31	0.31	0.29	0.30	0.30	0.27
Percentile (%50)	0.77	0.77	0.77	0.75	0.76	0.77	0.70	0.78	0.80
Percentile (%75)	1.27	1.33	1.28	1.27	1.26	1.30	1.29	1.25	1.28
Percentile (%90)	1.49	1.52	1.56	1.45	1.51	1.46	1.44	1.45	1.49

Table E.91. Single TC Performances of Group 7 Policies - Mismatch Rates

TC	6.7.	1	2	3	4	5	6	7	8
[TC1]	0.14	0.14	0.13	0.14	0.13	0.13	0.14	0.13	0.15
[TC2]	0.46	0.45	0.43	0.38	0.45	0.40	0.42	0.41	0.42
[TC3]	0.53	0.49	0.56	0.56	0.56	0.46	0.51	0.52	0.46
[TC4]	0.71	0.64	0.59	0.69	0.64	0.59	0.63	0.57	0.58
[TC5]	0.72	0.70	0.64	0.76	0.64	0.67	0.67	0.77	0.63
[TC6]	0.53	0.54	0.48	0.50	0.48	0.54	0.48	0.51	0.55
[TC7]	0.68	0.74	0.60	0.61	0.64	0.56	0.66	0.70	0.54
[TC8]	0.63	0.61	0.64	0.67	0.57	0.66	0.58	0.73	0.64
[TC9]	0.74	0.74	0.70	0.70	0.70	0.68	0.70	0.67	0.64
[TC10]	0.68	0.60	0.60	0.66	0.59	0.61	0.61	0.69	0.69
[TC11]	0.51	0.55	0.47	0.53	0.45	0.46	0.46	0.54	0.53
[TC12]	0.73	0.71	0.61	0.76	0.65	0.62	0.66	0.70	0.68
[TC13]	0.73	0.72	0.69	0.76	0.66	0.66	0.61	0.67	0.64
[TC14]	0.46	0.41	0.42	0.49	0.39	0.39	0.40	0.38	0.38
[TC15]	0.67	0.72	0.79	0.70	0.57	0.65	0.66	0.71	0.70
[TC16]	0.77	0.70	0.65	0.69	0.70	0.76	0.68	0.68	0.70
[TC17]	0.74	0.70	0.70	0.69	0.65	0.73	0.74	0.70	0.66
[TC18]	0.02	0.02	0.03	0.04	0.02	0.03	0.04	0.02	0.02
[TC19]	0.17	0.16	0.17	0.17	0.18	0.14	0.18	0.17	0.16
[TC20]	0.29	0.26	0.22	0.26	0.28	0.19	0.27	0.24	0.28
[TC21]	0.70	0.72	0.73	0.81	0.63	0.65	0.76	0.76	0.66
[TC22]	0.60	0.53	0.56	0.56	0.55	0.56	0.53	0.62	0.51
[TC23]	0.42	0.46	0.41	0.42	0.36	0.36	0.39	0.37	0.41
[TC24]	0.57	0.50	0.49	0.60	0.52	0.43	0.54	0.53	0.51
[TC25]	0.73	0.74	0.71	0.76	0.63	0.68	0.71	0.71	0.69
[TC26]	0.73	0.64	0.81	0.70	0.68	0.67	0.73	0.68	0.62
[TC27]	0.51	0.43	0.47	0.52	0.43	0.40	0.49	0.47	0.48
[TC28]	0.52	0.49	0.49	0.51	0.46	0.48	0.57	0.54	0.51
[TC29]	0.32	0.29	0.25	0.32	0.25	0.25	0.28	0.28	0.26
[TC30]	0.68	0.68	0.80	0.73	0.60	0.61	0.71	0.70	0.66
[TC31]	0.45	0.49	0.42	0.47	0.40	0.41	0.45	0.48	0.39
[TC32]	0.60	0.62	0.61	0.64	0.73	0.69	0.77	0.77	0.60
[TC33]	1.72	1.68	1.87	1.87	1.77	2.18	1.89	1.99	1.80
[TC34]	0.62	0.55	0.59	0.61	0.66	0.65	0.70	0.69	0.56
[TC35]	2.22	2.31	2.53	2.31	2.42	2.68	2.43	2.48	2.39
[TC36]	2.37	2.17	2.74	2.35	2.56	2.71	2.63	2.66	2.32
[TC37]	1.72	1.82	1.77	1.78	1.96	2.16	1.94	1.95	1.86
[TC38]	0.10	0.07	0.07	0.11	0.08	0.07	0.10	0.08	0.09
[TC39]	0.30	0.30	0.25	0.33	0.30	0.31	0.33	0.31	0.29
[TC40]	0.21	0.18	0.17	0.22	0.19	0.19	0.23	0.20	0.20
[TC41]	0.31	0.31	0.25	0.29	0.27	0.28	0.30	0.29	0.27
[TC42]	0.77	0.68	0.57	0.70	0.52	0.65	0.77	0.69	0.72
[TC43]	0.67	0.64	0.66	0.70	0.62	0.64	0.70	0.64	0.60
[TC44]	0.60	0.56	0.61	0.62	0.63	0.65	0.74	0.70	0.61
[TC45]	0.57	0.69	0.59	0.62	0.61	0.65	0.64	0.59	0.59
[TC46]	0.71	0.71	0.64	0.67	0.60	0.67	0.64	0.72	0.59
[TC47]	0.65	0.69	0.62	0.65	0.60	0.68	0.66	0.74	0.65
[TC48]	0.11	0.10	0.09	0.12	0.10	0.11	0.11	0.12	0.10
[TC49]	0.64	0.75	0.66	0.66	0.63	0.70	0.60	0.63	0.52
Mean	0.65	0.64	0.64	0.66	0.63	0.66	0.66	0.67	0.62
Median	0.62	0.61	0.59	0.62	0.59	0.61	0.61	0.64	0.58
Max	2.37	2.31	2.74	2.35	2.56	2.71	2.63	2.66	2.39
Min	0.02	0.02	0.03	0.04	0.02	0.03	0.04	0.02	0.02
Percentile (%10)	0.20	0.18	0.17	0.21	0.18	0.18	0.22	0.19	0.19
Percentile (%25)	0.46	0.45	0.42	0.47	0.40	0.40	0.42	0.41	0.41
Percentile (%50)	0.62	0.61	0.59	0.62	0.59	0.61	0.61	0.64	0.58
Percentile (%75)	0.72	0.71	0.66	0.70	0.64	0.67	0.70	0.70	0.66
Percentile (%90)	0.77	0.74	0.81	0.77	0.71	0.74	0.77	0.77	0.70

Table E.92. Single TC Performances of Group 7 Policies - Shortage Rates

TC	6.7.	1	2	3	4	5	6	7	8
[TC1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC2]	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00
[TC3]	0.01	0.02	0.01	0.03	0.00	0.00	0.03	0.01	0.00
[TC4]	0.02	0.03	0.01	0.02	0.01	0.01	0.01	0.03	0.02
[TC5]	0.04	0.03	0.01	0.05	0.01	0.01	0.06	0.02	0.00
[TC6]	0.01	0.03	0.01	0.01	0.00	0.00	0.01	0.00	0.00
[TC7]	0.01	0.06	0.01	0.04	0.01	0.01	0.02	0.01	0.01
[TC8]	0.01	0.04	0.01	0.02	0.00	0.00	0.02	0.01	0.02
[TC9]	0.07	0.13	0.04	0.05	0.03	0.03	0.05	0.05	0.03
[TC10]	0.02	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01
[TC11]	0.02	0.02	0.00	0.02	0.00	0.00	0.02	0.00	0.00
[TC12]	0.04	0.07	0.02	0.05	0.02	0.02	0.06	0.01	0.03
[TC13]	0.06	0.11	0.03	0.04	0.02	0.02	0.06	0.07	0.04
[TC14]	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.02
[TC15]	0.03	0.03	0.01	0.02	0.01	0.01	0.02	0.02	0.02
[TC16]	0.04	0.07	0.03	0.05	0.03	0.03	0.05	0.03	0.03
[TC17]	0.03	0.09	0.04	0.05	0.04	0.04	0.03	0.06	0.03
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC20]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC21]	0.04	0.05	0.03	0.04	0.02	0.02	0.06	0.03	0.03
[TC22]	0.02	0.05	0.01	0.03	0.02	0.02	0.02	0.01	0.03
[TC23]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
[TC24]	0.01	0.03	0.02	0.02	0.00	0.00	0.02	0.02	0.00
[TC25]	0.06	0.13	0.06	0.05	0.02	0.02	0.05	0.08	0.05
[TC26]	0.04	0.12	0.03	0.06	0.02	0.02	0.03	0.07	0.04
[TC27]	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.00
[TC28]	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00
[TC29]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC30]	0.04	0.10	0.05	0.05	0.03	0.03	0.05	0.04	0.02
[TC31]	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01
[TC32]	0.00	0.00	0.02	0.00	0.01	0.01	0.03	0.01	0.01
[TC33]	0.09	0.08	0.13	0.09	0.23	0.23	0.24	0.11	0.09
[TC34]	0.01	0.00	0.02	0.00	0.01	0.01	0.02	0.00	0.00
[TC35]	0.13	0.11	0.20	0.12	0.24	0.24	0.33	0.21	0.15
[TC36]	0.18	0.28	0.29	0.14	0.38	0.38	0.44	0.29	0.35
[TC37]	0.06	0.07	0.13	0.06	0.18	0.18	0.20	0.11	0.07
[TC38]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC39]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC40]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC41]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC42]	0.05	0.01	0.01	0.03	0.02	0.02	0.04	0.02	0.01
[TC43]	0.05	0.03	0.01	0.07	0.02	0.02	0.05	0.07	0.02
[TC44]	0.01	0.01	0.01	0.02	0.00	0.00	0.01	0.00	0.02
[TC45]	0.04	0.03	0.01	0.05	0.03	0.03	0.06	0.05	0.02
[TC46]	0.05	0.06	0.02	0.03	0.02	0.02	0.04	0.06	0.02
[TC47]	0.02	0.01	0.00	0.01	0.00	0.00	0.02	0.00	0.01
[TC48]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC49]	0.06	0.05	0.02	0.04	0.03	0.03	0.03	0.05	0.01
Mean	0.03	0.04	0.03	0.03	0.03	0.03	0.05	0.03	0.02
Median	0.02	0.03	0.01	0.02	0.01	0.01	0.02	0.01	0.01
Max	0.18	0.28	0.29	0.14	0.38	0.38	0.44	0.29	0.35
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%25)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%50)	0.02	0.03	0.01	0.02	0.01	0.01	0.02	0.01	0.01
Percentile (%75)	0.04	0.06	0.03	0.05	0.02	0.02	0.05	0.05	0.03
Percentile (%90)	0.06	0.11	0.05	0.06	0.03	0.03	0.06	0.07	0.04

Table E.93. Cities Performances and Performance of Region Including DCs and RBC of Group 8 Policies

Performance Measure	Case	7.8.	1	2	3	4	5	6
Inventory Level	Antalya	3423	3410	3426	3431	3429	3428	3447
	Burdur	523	561	614	677	726	785	843
	Isparta	1366	1366	1366	1363	1369	1367	1370
	Overall	5312	5338	5406	5471	5523	5580	5659
Outdate Rate	Antalya	0.35	0.35	0.35	0.36	0.36	0.35	0.36
	Burdur	0.73	0.71	0.75	0.60	0.65	0.68	0.74
	Isparta	0.49	0.50	0.48	0.49	0.48	0.48	0.50
	Overall	0.42	0.42	0.43	0.41	0.42	0.42	0.43
Mismatch Rate	Antalya	0.31	0.32	0.30	0.30	0.29	0.29	0.29
	Burdur	1.07	1.03	0.90	0.92	0.76	0.75	0.76
	Isparta	0.26	0.26	0.24	0.25	0.24	0.25	0.25
	Overall	0.38	0.38	0.35	0.35	0.33	0.33	0.33
Shortage Rate	Antalya	0.01	0.01	0.00	0.00	0.00	0.00	0.00
	Burdur	0.05	0.04	0.03	0.01	0.01	0.01	0.01
	Isparta	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Overall	0.01	0.01	0.01	0.00	0.00	0.00	0.00

Table E.94. Delivery Performance Measures of Group 8 Policies

Delivery Performances	Delivery Type	7.8.	1	2	3	4	5	6
Quantity	Routine Deliveries To TCs	38358	38398	38373	38465	38451	38463	38425
	Ad-Hoc Deliveries to TCs	61171	61373	61058	60971	60955	60967	60998
	Emergency Deliveries To TCs	21795	21815	21890	21897	21805	21920	21941
	Ad-hoc Deliveries Between DCs and RBC	2600	2393	2278	2364	2283	2196	2152
	Total	123924	123980	123598	123697	123495	123546	123516
Percentage	Routine Deliveries To TCs	30.95	30.97	31.05	31.10	31.14	31.13	31.11
	Ad-Hoc Deliveries to TCs	49.36	49.50	49.40	49.29	49.36	49.35	49.38
	Emergency Deliveries To TCs	17.59	17.60	17.71	17.70	17.66	17.74	17.76
	Ad-hoc Deliveries Between DCs and RBC	2.10	1.93	1.84	1.91	1.85	1.78	1.74

Table E.95. Selection Criterion Performance of Group 8 Policies

Performance Measure	Case	7.8.	1	2	3	4	5	6
Outdate Rate	Region Including Dcs and RBC	0.42	0.42	0.43	0.41	0.42	0.42	0.43
	Region Excluding DCs And RBC	0.36	0.36	0.37	0.37	0.37	0.38	0.39
	Single TCs' Means	0.77	0.76	0.78	0.79	0.79	0.80	0.81
Mismatch Rate	Region Including Dcs and RBC	0.38	0.38	0.35	0.35	0.33	0.33	0.33
	Region Excluding DCs And RBC	0.38	0.38	0.35	0.35	0.33	0.33	0.33
	Single TCs' Means	0.62	0.62	0.58	0.57	0.54	0.53	0.53
Shortage Rate	Region Including Dcs and RBC	0.01	0.01	0.01	0.00	0.00	0.00	0.00
	Region Excluding DCs And RBC	0.01	0.01	0.01	0.00	0.00	0.00	0.00
	Single TCs' Means	0.02	0.03	0.01	0.01	0.01	0.01	0.01
Selection Criterion Performance		0.81	0.81	0.78	0.77	0.75	0.75	0.76

Table E.96. Single TC Performances of Group 8 Policies - Mean Inventory Levels

TC	7.8.	1	2	3	4	5	6
[TC1]	175.81	176.00	175.83	176.00	176.10	175.87	176.06
[TC2]	43.50	43.52	43.46	43.58	43.53	43.58	43.47
[TC3]	29.56	29.51	29.53	29.57	29.53	29.68	29.51
[TC4]	19.85	19.89	19.92	19.94	19.93	20.02	19.88
[TC5]	19.51	19.54	19.43	19.53	19.56	19.40	19.43
[TC6]	32.21	32.15	32.10	32.30	32.34	32.32	32.33
[TC7]	23.37	23.27	23.27	23.33	23.33	23.43	23.25
[TC8]	21.98	21.92	21.96	21.98	22.08	21.92	22.03
[TC9]	17.05	17.03	17.07	16.97	17.07	17.01	17.06
[TC10]	21.58	21.53	21.54	21.56	21.58	21.50	21.67
[TC11]	28.92	29.10	29.13	29.16	29.18	29.15	29.21
[TC12]	17.06	17.26	17.16	17.08	17.25	17.10	17.07
[TC13]	17.05	17.06	17.02	17.06	17.06	17.13	17.11
[TC14]	39.95	39.91	39.91	39.92	39.75	39.89	40.10
[TC15]	21.30	21.21	21.25	21.26	21.30	21.37	21.21
[TC16]	18.06	18.05	18.16	18.14	18.05	18.13	18.13
[TC17]	17.04	17.07	17.05	17.16	16.99	17.05	16.96
[TC18]	319.15	319.13	319.43	319.28	319.33	319.29	319.41
[TC19]	138.90	138.64	138.86	138.88	138.95	138.83	138.94
[TC20]	82.65	82.68	82.73	82.80	82.79	82.68	82.94
[TC21]	17.57	17.51	17.57	17.71	17.55	17.65	17.67
[TC22]	25.92	25.85	26.05	25.98	25.84	25.96	25.93
[TC23]	41.67	41.65	41.73	41.66	41.86	41.79	41.73
[TC24]	28.53	28.51	28.40	28.36	28.55	28.36	28.54
[TC25]	17.27	17.43	17.34	17.35	17.21	17.28	17.32
[TC26]	15.46	15.43	15.65	15.47	15.50	15.44	15.48
[TC27]	38.37	38.42	38.37	38.43	38.31	38.51	38.46
[TC28]	33.13	33.10	33.12	33.07	33.26	33.24	33.17
[TC29]	81.08	81.10	81.12	81.20	81.17	81.16	81.16
[TC30]	16.68	16.67	16.54	16.58	16.55	16.66	16.60
[TC31]	48.34	48.34	48.26	48.20	48.24	48.28	48.33
[TC32]	78.23	78.27	78.42	78.67	78.71	78.92	78.95
[TC33]	25.30	25.36	25.42	25.65	25.54	25.59	25.55
[TC34]	78.69	78.81	78.95	79.13	79.20	79.39	79.24
[TC35]	19.10	19.13	19.32	19.31	19.40	19.38	19.45
[TC36]	13.88	14.05	14.06	14.24	14.23	14.20	14.14
[TC37]	26.99	26.93	26.96	27.12	27.16	27.19	27.20
[TC38]	141.13	141.24	141.18	141.20	141.17	141.08	141.22
[TC39]	47.09	46.93	47.05	46.98	46.96	46.96	47.02
[TC40]	79.06	79.14	79.09	79.04	78.95	78.94	79.01
[TC41]	77.06	77.04	77.09	77.01	76.90	77.03	77.01
[TC42]	16.01	16.11	16.00	15.88	16.02	16.07	15.93
[TC43]	17.20	17.02	17.01	17.05	17.08	17.00	17.00
[TC44]	20.88	20.91	20.94	20.89	20.87	20.87	20.93
[TC45]	17.68	17.61	17.54	17.58	17.48	17.60	17.53
[TC46]	16.10	15.94	15.96	15.94	15.94	15.97	16.09
[TC47]	22.53	22.38	22.37	22.49	22.33	22.45	22.46
[TC48]	107.66	107.60	107.52	107.63	107.73	107.73	107.61
[TC49]	15.45	15.51	15.54	15.55	15.51	15.55	15.56
Mean	46.71	46.70	46.72	46.75	46.75	46.77	46.78
Median	25.30	25.36	25.42	25.65	25.54	25.59	25.55
Max	319.15	319.13	319.43	319.28	319.33	319.29	319.41
Min	13.88	14.05	14.06	14.24	14.23	14.20	14.14
Percentile (%10)	16.56	16.56	16.43	16.45	16.44	16.54	16.50
Percentile (%25)	17.57	17.51	17.54	17.58	17.48	17.60	17.53
Percentile (%50)	25.30	25.36	25.42	25.65	25.54	25.59	25.55
Percentile (%75)	47.09	46.93	47.05	46.98	46.96	46.96	47.02
Percentile (%90)	87.66	87.66	87.69	87.76	87.78	87.69	87.88

Table E.97. Single TC Performances of Group 8 Policies - Outdate Rates

TC	7.8.	1	2	3	4	5	6
[TC1]	0.01	0.01	0.01	0.01	0.01	0.01	0.01
[TC2]	0.27	0.32	0.32	0.32	0.31	0.32	0.29
[TC3]	0.72	0.71	0.72	0.70	0.74	0.72	0.74
[TC4]	0.98	0.95	0.98	1.00	0.98	0.97	0.96
[TC5]	1.10	1.09	1.02	1.09	1.12	1.05	1.04
[TC6]	0.53	0.47	0.52	0.52	0.55	0.52	0.57
[TC7]	0.78	0.80	0.77	0.78	0.79	0.86	0.80
[TC8]	0.92	0.83	0.85	0.87	0.91	0.83	0.88
[TC9]	1.39	1.30	1.31	1.26	1.40	1.27	1.31
[TC10]	0.91	0.84	0.95	0.94	0.91	0.82	0.92
[TC11]	0.66	0.71	0.76	0.79	0.74	0.68	0.73
[TC12]	1.47	1.55	1.48	1.40	1.50	1.43	1.51
[TC13]	1.42	1.30	1.32	1.33	1.38	1.42	1.29
[TC14]	0.42	0.43	0.45	0.45	0.38	0.44	0.48
[TC15]	0.86	0.73	0.83	0.79	0.79	0.90	0.85
[TC16]	1.03	1.07	1.09	1.19	1.04	1.10	1.10
[TC17]	1.28	1.30	1.26	1.34	1.25	1.34	1.23
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.02	0.02	0.02	0.02	0.03	0.02	0.02
[TC20]	0.07	0.07	0.07	0.08	0.09	0.08	0.08
[TC21]	1.45	1.48	1.33	1.43	1.39	1.46	1.41
[TC22]	0.63	0.60	0.66	0.64	0.60	0.61	0.64
[TC23]	0.30	0.30	0.32	0.32	0.33	0.31	0.31
[TC24]	0.71	0.67	0.66	0.69	0.77	0.66	0.75
[TC25]	1.00	1.10	1.13	1.09	1.08	1.05	1.08
[TC26]	1.57	1.58	1.70	1.66	1.61	1.57	1.68
[TC27]	0.39	0.39	0.39	0.39	0.40	0.40	0.39
[TC28]	0.43	0.47	0.45	0.47	0.50	0.47	0.47
[TC29]	0.07	0.08	0.08	0.08	0.09	0.09	0.08
[TC30]	1.47	1.50	1.53	1.58	1.56	1.57	1.60
[TC31]	0.21	0.20	0.19	0.22	0.21	0.22	0.24
[TC32]	0.15	0.14	0.15	0.12	0.14	0.16	0.19
[TC33]	0.90	0.84	0.97	1.02	1.04	1.18	1.18
[TC34]	0.12	0.11	0.14	0.10	0.10	0.12	0.14
[TC35]	0.97	1.02	1.21	1.15	1.22	1.38	1.65
[TC36]	1.33	1.56	1.80	1.82	2.04	2.08	2.22
[TC37]	0.80	0.74	0.84	0.84	0.89	0.99	1.09
[TC38]	0.05	0.06	0.06	0.05	0.06	0.06	0.06
[TC39]	0.37	0.34	0.37	0.35	0.37	0.36	0.37
[TC40]	0.14	0.15	0.16	0.14	0.14	0.15	0.16
[TC41]	0.14	0.14	0.14	0.12	0.11	0.13	0.12
[TC42]	1.51	1.65	1.68	1.62	1.63	1.62	1.51
[TC43]	1.54	1.32	1.44	1.34	1.47	1.41	1.35
[TC44]	0.94	0.90	0.91	0.90	0.85	0.87	0.90
[TC45]	1.49	1.45	1.44	1.42	1.28	1.45	1.35
[TC46]	1.58	1.52	1.44	1.51	1.40	1.44	1.53
[TC47]	0.85	0.80	0.84	0.89	0.77	0.79	0.80
[TC48]	0.10	0.11	0.09	0.11	0.11	0.11	0.10
[TC49]	1.55	1.68	1.61	1.69	1.66	1.60	1.66
Mean	0.77	0.76	0.78	0.79	0.79	0.80	0.81
Median	0.80	0.74	0.83	0.79	0.79	0.82	0.80
Max	1.58	1.68	1.80	1.82	2.04	2.08	2.22
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.07	0.08	0.07	0.08	0.09	0.09	0.08
Percentile (%25)	0.27	0.30	0.32	0.32	0.31	0.31	0.29
Percentile (%50)	0.80	0.74	0.83	0.79	0.79	0.82	0.80
Percentile (%75)	1.28	1.30	1.26	1.26	1.25	1.34	1.29

Table E.98. Single TC Performances of Group 8 Policies - Mismatch Rates

TC	7.8.	1	2	3	4	5	6
[TC1]	0.15	0.13	0.12	0.14	0.13	0.13	0.11
[TC2]	0.42	0.44	0.41	0.38	0.39	0.39	0.41
[TC3]	0.46	0.48	0.40	0.44	0.46	0.47	0.42
[TC4]	0.58	0.60	0.56	0.59	0.61	0.53	0.52
[TC5]	0.63	0.72	0.60	0.67	0.59	0.67	0.61
[TC6]	0.55	0.51	0.46	0.46	0.50	0.46	0.39
[TC7]	0.54	0.60	0.56	0.53	0.53	0.57	0.56
[TC8]	0.64	0.57	0.58	0.59	0.57	0.59	0.68
[TC9]	0.64	0.75	0.66	0.67	0.64	0.61	0.74
[TC10]	0.69	0.62	0.61	0.61	0.59	0.59	0.61
[TC11]	0.53	0.44	0.45	0.41	0.43	0.42	0.45
[TC12]	0.68	0.68	0.68	0.66	0.64	0.60	0.58
[TC13]	0.64	0.71	0.70	0.73	0.64	0.70	0.73
[TC14]	0.38	0.45	0.39	0.35	0.39	0.34	0.35
[TC15]	0.70	0.70	0.69	0.67	0.75	0.65	0.61
[TC16]	0.70	0.63	0.67	0.61	0.66	0.66	0.62
[TC17]	0.66	0.71	0.67	0.75	0.63	0.58	0.70
[TC18]	0.02	0.02	0.03	0.02	0.03	0.02	0.02
[TC19]	0.16	0.17	0.15	0.16	0.13	0.16	0.15
[TC20]	0.28	0.25	0.24	0.22	0.21	0.22	0.23
[TC21]	0.66	0.68	0.68	0.56	0.68	0.60	0.60
[TC22]	0.51	0.60	0.56	0.52	0.53	0.57	0.50
[TC23]	0.41	0.42	0.37	0.44	0.32	0.39	0.36
[TC24]	0.51	0.50	0.50	0.43	0.43	0.52	0.46
[TC25]	0.69	0.64	0.69	0.59	0.62	0.66	0.64
[TC26]	0.62	0.75	0.71	0.78	0.70	0.64	0.64
[TC27]	0.48	0.44	0.47	0.40	0.42	0.43	0.39
[TC28]	0.51	0.57	0.51	0.52	0.46	0.52	0.46
[TC29]	0.26	0.27	0.24	0.26	0.24	0.24	0.24
[TC30]	0.66	0.68	0.66	0.71	0.61	0.65	0.58
[TC31]	0.39	0.40	0.41	0.40	0.38	0.39	0.36
[TC32]	0.60	0.59	0.49	0.62	0.48	0.50	0.53
[TC33]	1.80	1.72	1.35	1.42	1.13	1.20	1.04
[TC34]	0.56	0.59	0.51	0.63	0.51	0.52	0.51
[TC35]	2.39	2.07	2.02	1.69	1.55	1.43	1.36
[TC36]	2.32	2.38	2.04	1.90	1.50	1.42	1.54
[TC37]	1.86	1.66	1.59	1.25	1.14	1.03	1.13
[TC38]	0.09	0.08	0.08	0.07	0.06	0.07	0.08
[TC39]	0.29	0.27	0.26	0.30	0.28	0.24	0.26
[TC40]	0.20	0.22	0.15	0.17	0.16	0.19	0.18
[TC41]	0.27	0.27	0.24	0.26	0.25	0.27	0.27
[TC42]	0.72	0.59	0.61	0.59	0.63	0.58	0.57
[TC43]	0.60	0.65	0.61	0.67	0.70	0.65	0.57
[TC44]	0.61	0.67	0.61	0.63	0.60	0.69	0.64
[TC45]	0.59	0.56	0.51	0.57	0.56	0.57	0.62
[TC46]	0.59	0.65	0.74	0.64	0.68	0.55	0.60
[TC47]	0.65	0.74	0.62	0.63	0.61	0.61	0.56
[TC48]	0.10	0.10	0.09	0.09	0.09	0.10	0.09
[TC49]	0.52	0.56	0.57	0.64	0.53	0.62	0.59
Mean	0.62	0.62	0.58	0.57	0.54	0.53	0.53
Median	0.58	0.59	0.56	0.59	0.53	0.57	0.56
Max	2.39	2.38	2.04	1.90	1.55	1.43	1.54
Min	0.02	0.02	0.03	0.02	0.03	0.02	0.02
Percentile (%10)	0.19	0.21	0.15	0.17	0.16	0.18	0.17
Percentile (%25)	0.41	0.44	0.40	0.40	0.39	0.39	0.36
Percentile (%50)	0.58	0.59	0.56	0.59	0.53	0.57	0.56
Percentile (%75)	0.66	0.68	0.67	0.66	0.64	0.64	0.62
Percentile (%90)	0.70	0.75	0.71	0.76	0.71	0.70	0.73

Table E.99. Single TC Performances of Group 8 Policies - Shortage Rates

TC	7.8.	1	2	3	4	5	6
[TC1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC3]	0.00	0.01	0.00	0.00	0.00	0.00	0.00
[TC4]	0.02	0.03	0.01	0.00	0.00	0.01	0.01
[TC5]	0.00	0.05	0.00	0.00	0.01	0.00	0.02
[TC6]	0.00	0.02	0.00	0.00	0.00	0.00	0.00
[TC7]	0.01	0.02	0.00	0.00	0.00	0.00	0.00
[TC8]	0.02	0.02	0.00	0.00	0.00	0.00	0.01
[TC9]	0.03	0.03	0.03	0.01	0.02	0.05	0.02
[TC10]	0.01	0.03	0.01	0.00	0.00	0.00	0.00
[TC11]	0.00	0.02	0.00	0.00	0.00	0.00	0.00
[TC12]	0.03	0.03	0.02	0.01	0.02	0.01	0.02
[TC13]	0.04	0.07	0.02	0.01	0.04	0.01	0.02
[TC14]	0.02	0.00	0.00	0.00	0.00	0.00	0.00
[TC15]	0.02	0.01	0.00	0.00	0.01	0.00	0.00
[TC16]	0.03	0.03	0.02	0.01	0.01	0.01	0.02
[TC17]	0.03	0.07	0.02	0.01	0.02	0.01	0.02
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC20]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC21]	0.03	0.05	0.03	0.02	0.02	0.01	0.02
[TC22]	0.03	0.04	0.00	0.01	0.00	0.00	0.00
[TC23]	0.00	0.01	0.00	0.00	0.00	0.00	0.00
[TC24]	0.00	0.01	0.00	0.00	0.00	0.00	0.00
[TC25]	0.05	0.04	0.02	0.03	0.03	0.03	0.03
[TC26]	0.04	0.07	0.03	0.02	0.03	0.03	0.01
[TC27]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC28]	0.00	0.01	0.01	0.00	0.00	0.00	0.00
[TC29]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC30]	0.02	0.04	0.01	0.01	0.01	0.01	0.02
[TC31]	0.01	0.01	0.00	0.00	0.00	0.00	0.00
[TC32]	0.01	0.00	0.00	0.00	0.00	0.00	0.00
[TC33]	0.09	0.06	0.07	0.01	0.00	0.01	0.00
[TC34]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC35]	0.15	0.13	0.08	0.02	0.02	0.02	0.02
[TC36]	0.35	0.26	0.15	0.05	0.06	0.08	0.05
[TC37]	0.07	0.07	0.05	0.01	0.01	0.01	0.00
[TC38]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC39]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC40]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC41]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC42]	0.01	0.02	0.02	0.02	0.03	0.02	0.02
[TC43]	0.02	0.02	0.01	0.02	0.02	0.03	0.02
[TC44]	0.02	0.00	0.00	0.02	0.01	0.01	0.01
[TC45]	0.02	0.01	0.01	0.01	0.01	0.02	0.03
[TC46]	0.02	0.03	0.02	0.02	0.01	0.02	0.02
[TC47]	0.01	0.00	0.00	0.00	0.00	0.00	0.00
[TC48]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC49]	0.01	0.01	0.02	0.02	0.01	0.02	0.02
Mean	0.02	0.03	0.01	0.01	0.01	0.01	0.01
Median	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Max	0.35	0.26	0.15	0.05	0.06	0.08	0.05
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%25)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%50)	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Percentile (%75)	0.03	0.03	0.02	0.01	0.01	0.01	0.02
Percentile (%90)	0.04	0.07	0.03	0.02	0.02	0.02	0.02

Table E.100. Cities Performances and Performance of Region Including DCs and RBC of Group 9 Policies

Performance Measure		8.4.	1	2	3	4	5
Inventory Level	Antalya	3429	3512	3610	3710	3802	3889
	Burdur	726	745	773	799	837	847
	Isparta	1369	1376	1416	1456	1498	1539
	Overall	5523	5633	5800	5965	6137	6276
Outdate Rate	Antalya	0.36	0.38	0.38	0.39	0.40	0.41
	Burdur	0.65	0.44	0.49	0.55	0.62	0.70
	Isparta	0.48	0.31	0.32	0.34	0.35	0.34
	Overall	0.42	0.37	0.38	0.40	0.41	0.43
Mismatch Rate	Antalya	0.29	0.27	0.24	0.23	0.23	0.22
	Burdur	0.76	1.01	0.91	0.83	0.79	0.79
	Isparta	0.24	0.36	0.34	0.35	0.31	0.32
	Overall	0.33	0.37	0.34	0.32	0.31	0.31
Shortage Rate	Antalya	0.00	0.00	0.00	0.00	0.00	0.00
	Burdur	0.01	0.02	0.01	0.01	0.00	0.01
	Isparta	0.00	0.00	0.00	0.00	0.00	0.00
	Overall	0.00	0.01	0.00	0.00	0.00	0.00

Table E.101. Delivery Performance Measures of Group 9 Policies

Delivery Performances	Delivery Type	8.4.	1	2	3	4	5
Quantity	Routine Deliveries To TCs	38451	38417	38386	38356	38444	38350
	Ad-Hoc Deliveries to TCs	60955	61160	60912	61055	60996	61003
	Emergency Deliveries To TCs	21805	21841	21865	21874	21875	22004
	Ad-hoc Deliveries Between DCs and RBC	2283	1716	1331	985	826	702
	Total	123495	123134	122494	122271	122141	122059
Percentage	Routine Deliveries To TCs	31.14	31.20	31.34	31.37	31.48	31.42
	Ad-Hoc Deliveries to TCs	49.36	49.67	49.73	49.93	49.94	49.98
	Emergency Deliveries To TCs	17.66	17.74	17.85	17.89	17.91	18.03
	Ad-hoc Deliveries Between DCs and RBC	1.85	1.39	1.09	0.81	0.68	0.58

Table E.102. Selection Criterion Performance of Group 9 Policies

Performance Measure	Case	8.4.	1	2	3	4	5
Outdate Rate	Region Including Dcs and RBC	0.42	0.37	0.38	0.40	0.41	0.43
	Region Excluding DCs And RBC	0.37	0.37	0.38	0.39	0.41	0.42
	Single TCs' Means	0.79	0.79	0.81	0.84	0.87	0.90
Mismatch Rate	Region Including Dcs and RBC	0.33	0.37	0.34	0.32	0.31	0.31
	Region Excluding DCs And RBC	0.33	0.37	0.34	0.32	0.31	0.31
	Single TCs' Means	0.54	0.60	0.55	0.52	0.50	0.51
Shortage Rate	Region Including Dcs and RBC	0.00	0.01	0.00	0.00	0.00	0.00
	Region Excluding DCs And RBC	0.00	0.01	0.00	0.00	0.00	0.00
	Single TCs' Means	0.01	0.01	0.01	0.01	0.01	0.01
Selection Criterion Performance		0.75	0.74	0.72	0.72	0.72	0.74

Table E.103. Single TC Performances of Group 9 Policies - Mean Inventory Levels

TC	8.4.	1	2	3	4	5
[TC1]	176.10	176.01	176.18	176.05	176.10	176.07
[TC2]	43.53	43.62	43.36	43.67	43.56	43.47
[TC3]	29.53	29.57	29.46	29.59	29.60	29.72
[TC4]	19.93	19.99	20.05	20.02	19.97	20.06
[TC5]	19.56	19.45	19.65	19.58	19.44	19.50
[TC6]	32.34	32.33	32.34	32.38	32.26	32.27
[TC7]	23.33	23.34	23.32	23.33	23.41	23.39
[TC8]	22.08	21.99	22.02	22.07	22.01	21.86
[TC9]	17.07	17.04	17.11	17.07	17.02	17.03
[TC10]	21.58	21.59	21.49	21.54	21.68	21.63
[TC11]	29.18	29.12	29.19	29.14	29.25	29.17
[TC12]	17.25	17.13	17.06	17.15	17.16	17.13
[TC13]	17.06	17.03	17.13	17.06	17.08	17.10
[TC14]	39.75	39.96	39.99	40.01	39.91	39.91
[TC15]	21.30	21.46	21.16	21.35	21.36	21.27
[TC16]	18.05	18.11	18.22	18.06	18.21	18.02
[TC17]	16.99	16.96	17.01	16.94	17.00	17.02
[TC18]	319.33	319.47	319.55	319.21	319.57	319.42
[TC19]	138.95	138.97	138.97	139.02	138.90	138.92
[TC20]	82.79	82.80	82.81	82.79	82.81	82.74
[TC21]	17.55	17.61	17.64	17.55	17.61	17.60
[TC22]	25.84	25.92	25.89	25.91	25.90	26.00
[TC23]	41.86	41.69	41.74	41.75	41.65	41.74
[TC24]	28.55	28.51	28.62	28.52	28.57	28.58
[TC25]	17.21	17.39	17.28	17.30	17.32	17.28
[TC26]	15.50	15.47	15.48	15.49	15.30	15.52
[TC27]	38.31	38.59	38.56	38.50	38.51	38.46
[TC28]	33.26	33.21	33.19	33.19	33.15	33.14
[TC29]	81.17	81.19	81.14	81.18	81.18	81.15
[TC30]	16.55	16.62	16.66	16.60	16.54	16.66
[TC31]	48.24	48.39	48.32	48.25	48.30	48.27
[TC32]	78.71	78.63	78.75	78.77	78.93	78.84
[TC33]	25.54	25.43	25.54	25.71	25.71	25.52
[TC34]	79.20	79.10	79.17	79.33	79.45	79.32
[TC35]	19.40	19.31	19.31	19.44	19.42	19.46
[TC36]	14.23	14.24	14.10	14.28	14.18	14.15
[TC37]	27.16	27.06	27.06	27.19	27.12	27.19
[TC38]	141.17	141.18	140.93	140.97	141.20	141.08
[TC39]	46.96	46.96	46.94	47.14	47.00	47.03
[TC40]	78.95	79.01	78.99	79.02	79.03	79.04
[TC41]	76.90	77.04	76.82	77.00	77.11	77.03
[TC42]	16.02	16.05	16.00	16.06	16.01	16.05
[TC43]	17.08	17.09	16.91	17.07	17.01	16.99
[TC44]	20.87	20.94	20.94	20.99	20.93	20.98
[TC45]	17.48	17.46	17.65	17.59	17.56	17.53
[TC46]	15.94	16.14	16.14	16.06	16.04	16.09
[TC47]	22.33	22.48	22.44	22.43	22.55	22.45
[TC48]	107.73	107.56	107.48	107.61	107.54	107.60
[TC49]	15.51	15.55	15.51	15.60	15.48	15.47
Mean	46.75	46.77	46.76	46.79	46.79	46.77
Median	25.54	25.43	25.54	25.71	25.71	25.52
Max	319.33	319.47	319.55	319.21	319.57	319.42
Min	14.23	14.24	14.10	14.28	14.18	14.15
Percentile (%10)	16.44	16.52	16.55	16.50	16.44	16.55
Percentile (%25)	17.48	17.46	17.64	17.55	17.56	17.53
Percentile (%50)	25.54	25.43	25.54	25.71	25.71	25.52
Percentile (%75)	46.96	46.96	46.94	47.14	47.00	47.03
Percentile (%90)	87.78	87.75	87.75	87.75	87.76	87.71

Table E.104. Single TC Performances of Group 9 Policies - Outdate Rates

TC	8.4.	1	2	3	4	5
[TC1]	0.01	0.01	0.01	0.01	0.01	0.02
[TC2]	0.31	0.37	0.34	0.36	0.37	0.37
[TC3]	0.74	0.76	0.70	0.81	0.86	0.87
[TC4]	0.98	1.07	1.11	1.08	1.10	1.17
[TC5]	1.12	1.10	1.22	1.20	1.18	1.21
[TC6]	0.55	0.55	0.57	0.58	0.59	0.65
[TC7]	0.79	0.84	0.80	0.86	0.92	0.93
[TC8]	0.91	0.94	0.93	1.03	0.99	0.93
[TC9]	1.40	1.26	1.46	1.44	1.45	1.61
[TC10]	0.91	1.02	0.95	1.01	1.03	1.09
[TC11]	0.74	0.74	0.77	0.79	0.81	0.86
[TC12]	1.50	1.54	1.52	1.61	1.61	1.60
[TC13]	1.38	1.35	1.47	1.41	1.47	1.56
[TC14]	0.38	0.47	0.45	0.47	0.49	0.51
[TC15]	0.79	0.92	0.85	0.92	0.93	0.93
[TC16]	1.04	1.22	1.25	1.21	1.28	1.26
[TC17]	1.25	1.34	1.28	1.38	1.44	1.50
[TC18]	0.00	0.00	0.00	0.00	0.00	0.01
[TC19]	0.03	0.03	0.03	0.03	0.03	0.03
[TC20]	0.09	0.09	0.09	0.10	0.11	0.10
[TC21]	1.39	1.48	1.54	1.50	1.60	1.64
[TC22]	0.60	0.73	0.67	0.65	0.75	0.74
[TC23]	0.33	0.34	0.37	0.37	0.35	0.36
[TC24]	0.77	0.75	0.75	0.77	0.85	0.87
[TC25]	1.08	1.18	1.14	1.15	1.24	1.13
[TC26]	1.61	1.84	1.72	1.79	1.66	1.84
[TC27]	0.40	0.45	0.46	0.46	0.47	0.50
[TC28]	0.50	0.49	0.53	0.52	0.56	0.53
[TC29]	0.09	0.08	0.08	0.11	0.11	0.10
[TC30]	1.56	1.51	1.66	1.65	1.62	1.78
[TC31]	0.21	0.23	0.26	0.29	0.27	0.26
[TC32]	0.14	0.10	0.12	0.11	0.16	0.18
[TC33]	1.04	0.92	1.11	1.18	1.29	1.38
[TC34]	0.10	0.09	0.10	0.10	0.12	0.15
[TC35]	1.22	1.18	1.20	1.45	1.57	1.68
[TC36]	2.04	1.91	1.98	2.24	2.43	2.50
[TC37]	0.89	0.79	0.85	1.04	1.01	1.17
[TC38]	0.06	0.02	0.02	0.02	0.03	0.02
[TC39]	0.37	0.30	0.27	0.34	0.32	0.32
[TC40]	0.14	0.08	0.09	0.10	0.10	0.09
[TC41]	0.11	0.07	0.07	0.08	0.08	0.07
[TC42]	1.63	1.30	1.58	1.59	1.55	1.67
[TC43]	1.47	1.36	1.28	1.38	1.41	1.42
[TC44]	0.85	0.86	0.86	0.93	0.95	0.92
[TC45]	1.28	1.23	1.45	1.27	1.43	1.34
[TC46]	1.40	1.44	1.48	1.51	1.49	1.57
[TC47]	0.77	0.66	0.69	0.72	0.87	0.74
[TC48]	0.11	0.04	0.05	0.06	0.06	0.06
[TC49]	1.66	1.56	1.59	1.65	1.61	1.64
Mean	0.79	0.79	0.81	0.84	0.87	0.90
Median	0.79	0.79	0.80	0.86	0.92	0.92
Max	2.04	1.91	1.98	2.24	2.43	2.50
Min	0.00	0.00	0.00	0.00	0.00	0.01
Percentile (%10)	0.09	0.06	0.06	0.07	0.07	0.07
Percentile (%25)	0.31	0.30	0.27	0.34	0.32	0.32
Percentile (%50)	0.79	0.79	0.80	0.86	0.92	0.92
Percentile (%75)	1.25	1.23	1.28	1.38	1.43	1.42
Percentile (%90)	1.51	1.48	1.55	1.59	1.61	1.64

Table E.105. Single TC Performances of Group 9 Policies - Mismatch Rates

TC	8.4.	1	2	3	4	5
[TC1]	0.13	0.09	0.07	0.06	0.08	0.05
[TC2]	0.39	0.36	0.28	0.28	0.29	0.32
[TC3]	0.46	0.43	0.39	0.34	0.41	0.32
[TC4]	0.61	0.52	0.51	0.46	0.45	0.45
[TC5]	0.59	0.67	0.58	0.53	0.54	0.56
[TC6]	0.50	0.42	0.42	0.39	0.40	0.40
[TC7]	0.53	0.52	0.47	0.46	0.47	0.48
[TC8]	0.57	0.59	0.55	0.50	0.51	0.51
[TC9]	0.64	0.66	0.58	0.57	0.60	0.61
[TC10]	0.59	0.56	0.51	0.48	0.54	0.53
[TC11]	0.43	0.40	0.42	0.33	0.38	0.35
[TC12]	0.64	0.69	0.58	0.54	0.57	0.55
[TC13]	0.64	0.59	0.55	0.58	0.56	0.53
[TC14]	0.39	0.34	0.30	0.24	0.27	0.24
[TC15]	0.75	0.65	0.58	0.51	0.58	0.59
[TC16]	0.66	0.59	0.60	0.54	0.60	0.50
[TC17]	0.63	0.68	0.63	0.54	0.54	0.51
[TC18]	0.03	0.02	0.01	0.01	0.01	0.01
[TC19]	0.13	0.09	0.09	0.09	0.09	0.08
[TC20]	0.21	0.17	0.15	0.14	0.16	0.13
[TC21]	0.68	0.64	0.52	0.64	0.59	0.55
[TC22]	0.53	0.50	0.48	0.46	0.42	0.44
[TC23]	0.32	0.33	0.32	0.32	0.30	0.30
[TC24]	0.43	0.46	0.48	0.36	0.35	0.39
[TC25]	0.62	0.69	0.60	0.57	0.48	0.59
[TC26]	0.70	0.59	0.60	0.58	0.51	0.53
[TC27]	0.42	0.41	0.37	0.33	0.34	0.31
[TC28]	0.46	0.47	0.39	0.38	0.38	0.43
[TC29]	0.24	0.19	0.16	0.16	0.15	0.14
[TC30]	0.61	0.69	0.60	0.54	0.53	0.62
[TC31]	0.38	0.35	0.34	0.31	0.31	0.29
[TC32]	0.48	0.68	0.61	0.62	0.58	0.56
[TC33]	1.13	1.59	1.38	1.22	1.19	1.20
[TC34]	0.51	0.69	0.59	0.60	0.56	0.49
[TC35]	1.55	1.96	1.64	1.43	1.30	1.45
[TC36]	1.50	1.77	1.88	1.41	1.43	1.56
[TC37]	1.14	1.47	1.39	1.11	1.07	1.16
[TC38]	0.06	0.17	0.16	0.16	0.13	0.14
[TC39]	0.28	0.37	0.35	0.36	0.38	0.32
[TC40]	0.16	0.27	0.27	0.29	0.25	0.24
[TC41]	0.25	0.35	0.36	0.37	0.36	0.33
[TC42]	0.63	0.77	0.66	0.70	0.74	0.67
[TC43]	0.70	0.73	0.73	0.77	0.69	0.68
[TC44]	0.60	0.79	0.66	0.68	0.63	0.70
[TC45]	0.56	0.77	0.69	0.69	0.52	0.73
[TC46]	0.68	0.82	0.75	0.80	0.67	0.68
[TC47]	0.61	0.77	0.78	0.81	0.60	0.77
[TC48]	0.09	0.20	0.17	0.18	0.16	0.17
[TC49]	0.53	0.72	0.71	0.75	0.58	0.64
Mean	0.54	0.60	0.55	0.52	0.50	0.51
Median	0.53	0.59	0.52	0.50	0.51	0.50
Max	1.55	1.96	1.88	1.43	1.43	1.56
Min	0.03	0.02	0.01	0.01	0.01	0.01
Percentile (%10)	0.16	0.19	0.16	0.16	0.15	0.14
Percentile (%25)	0.39	0.36	0.35	0.33	0.34	0.32
Percentile (%50)	0.53	0.59	0.52	0.50	0.51	0.50
Percentile (%75)	0.64	0.69	0.61	0.62	0.58	0.61
Percentile (%90)	0.71	0.80	0.76	0.80	0.70	0.74

Table E.106. Single TC Performances of Group 9 Policies - Shortage Rates

TC	8.4.	1	2	3	4	5
[TC1]	0.00	0.00	0.00	0.00	0.00	0.00
[TC2]	0.00	0.00	0.00	0.00	0.00	0.00
[TC3]	0.00	0.00	0.00	0.01	0.00	0.00
[TC4]	0.00	0.00	0.00	0.01	0.01	0.00
[TC5]	0.01	0.01	0.01	0.02	0.01	0.01
[TC6]	0.00	0.00	0.00	0.00	0.00	0.01
[TC7]	0.00	0.00	0.00	0.00	0.00	0.00
[TC8]	0.00	0.00	0.00	0.00	0.00	0.00
[TC9]	0.02	0.04	0.02	0.02	0.01	0.05
[TC10]	0.00	0.01	0.01	0.01	0.00	0.03
[TC11]	0.00	0.00	0.00	0.00	0.00	0.00
[TC12]	0.02	0.04	0.03	0.03	0.01	0.02
[TC13]	0.04	0.03	0.03	0.01	0.03	0.03
[TC14]	0.00	0.00	0.00	0.00	0.00	0.00
[TC15]	0.01	0.00	0.01	0.00	0.00	0.01
[TC16]	0.01	0.02	0.02	0.03	0.01	0.03
[TC17]	0.02	0.02	0.02	0.02	0.02	0.02
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.00	0.00	0.00	0.00	0.00	0.00
[TC20]	0.00	0.00	0.00	0.00	0.00	0.00
[TC21]	0.02	0.02	0.00	0.04	0.02	0.01
[TC22]	0.00	0.01	0.01	0.01	0.00	0.01
[TC23]	0.00	0.00	0.00	0.00	0.00	0.00
[TC24]	0.00	0.00	0.00	0.00	0.00	0.01
[TC25]	0.03	0.02	0.03	0.04	0.03	0.01
[TC26]	0.03	0.04	0.02	0.03	0.03	0.03
[TC27]	0.00	0.00	0.00	0.00	0.00	0.00
[TC28]	0.00	0.00	0.00	0.00	0.00	0.01
[TC29]	0.00	0.00	0.00	0.00	0.00	0.00
[TC30]	0.01	0.01	0.01	0.02	0.01	0.02
[TC31]	0.00	0.00	0.00	0.00	0.00	0.00
[TC32]	0.00	0.00	0.00	0.00	0.00	0.00
[TC33]	0.00	0.04	0.00	0.01	0.01	0.01
[TC34]	0.00	0.00	0.00	0.00	0.00	0.00
[TC35]	0.02	0.05	0.02	0.04	0.01	0.01
[TC36]	0.06	0.09	0.05	0.05	0.04	0.05
[TC37]	0.01	0.03	0.02	0.02	0.01	0.01
[TC38]	0.00	0.00	0.00	0.00	0.00	0.00
[TC39]	0.00	0.00	0.00	0.00	0.00	0.00
[TC40]	0.00	0.00	0.00	0.00	0.00	0.00
[TC41]	0.00	0.00	0.00	0.00	0.00	0.00
[TC42]	0.03	0.03	0.01	0.02	0.01	0.02
[TC43]	0.02	0.02	0.01	0.02	0.01	0.04
[TC44]	0.01	0.01	0.01	0.00	0.00	0.01
[TC45]	0.01	0.01	0.01	0.02	0.01	0.01
[TC46]	0.01	0.03	0.01	0.03	0.02	0.01
[TC47]	0.00	0.00	0.01	0.00	0.00	0.00
[TC48]	0.00	0.00	0.00	0.00	0.00	0.00
[TC49]	0.01	0.01	0.01	0.01	0.01	0.03
Mean	0.01	0.01	0.01	0.01	0.01	0.01
Median	0.00	0.00	0.00	0.00	0.00	0.01
Max	0.06	0.09	0.05	0.05	0.04	0.05
Min	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%25)	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%50)	0.00	0.00	0.00	0.00	0.00	0.01
Percentile (%75)	0.01	0.02	0.01	0.02	0.01	0.01
Percentile (%90)	0.02	0.04	0.02	0.03	0.02	0.03

Table E.107. Comparison of City Performances of Best Policies of Groups

Performance Measure		0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
Inventory Level	Antalya	8987.41	9394.00	7245.30	2920.67	3263.58	3598.57	3730.83	3423.32	3428.50	3610.48
	Burdur	1568.05	1629.28	1443.70	434.78	497.43	541.09	573.73	522.94	725.62	772.94
	Isparta	4072.39	4242.77	4091.46	1175.14	1306.45	1444.65	1469.55	1365.97	1368.84	1416.43
	Overall	14627.86	15266.04	12780.46	4530.59	5067.45	5584.31	5774.11	5312.23	5522.97	5799.85
Outdate Rate	Antalya	31.53	31.02	3.47	0.63	0.66	0.73	0.35	0.35	0.36	0.38
	Burdur	35.74	35.18	9.34	0.86	0.94	0.93	0.74	0.73	0.65	0.49
	Isparta	40.31	40.49	16.34	0.71	0.74	0.79	0.50	0.49	0.48	0.32
	Overall	34.41	34.09	7.67	0.67	0.71	0.76	0.43	0.42	0.42	0.38
Mismatch Rate	Antalya	3.03	0.71	0.70	0.55	0.52	0.45	0.34	0.31	0.29	0.24
	Burdur	3.67	0.91	0.85	1.75	1.34	1.31	1.06	1.07	0.76	0.91
	Isparta	3.02	0.67	0.32	0.46	0.43	0.34	0.28	0.26	0.24	0.34
	Overall	3.09	0.72	0.62	0.65	0.58	0.51	0.40	0.38	0.33	0.34
Shortage Rate	Antalya	0.59	0.05	0.04	0.01	0.01	0.01	0.01	0.01	0.00	0.00
	Burdur	0.64	0.04	0.01	0.17	0.07	0.05	0.04	0.05	0.01	0.01
	Isparta	0.51	0.04	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00
	Overall	0.57	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.00	0.00

Table E.108. Comparison of Delivery Performances Measures of Best Policies of Groups

Performance Measure		0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
Quantity	Routine Deliveries To TCs	75653	76509	72998	69473	69386	72539	56898	38358	38451	38386
	Ad-Hoc Deliveries to TCs	64452	62129	62070	56396	56346	43950	24504	61171	60955	60912
	Emergency Deliveries To TCs	0	0	0	0	0	0	21905	21795	21805	21865
	Ad-hoc Deliveries Between DCs and RBC	0	0	0	2673	2528	2458	2541	2600	2283	1331
	Total	140105	138638	135068	128542	128260	118946	105848	123924	123495	122494
Percentage	Routine Deliveries To TCs	54.00	55.19	54.04	54.05	54.10	60.98	53.75	30.95	31.14	31.34
	Ad-Hoc Deliveries to TCs	46.00	44.81	45.96	43.87	43.93	36.95	23.15	49.36	49.36	49.73
	Emergency Deliveries To TCs	0.00	0.00	0.00	0.00	0.00	0.00	20.69	17.59	17.66	17.85
	Ad-hoc Deliveries Between DCs and RBC	0.00	0.00	0.00	2.08	1.97	2.07	2.40	2.10	1.85	1.09

Table E.109. Comparision of Selection Criterion Performance of Best Policies of Groups

Performance Measure		0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
Outdate Rate	Region Including Dcs and RBC	34.41	34.09	7.67	0.67	0.71	0.76	0.43	0.42	0.42	0.38
	Region Excluding DCs And RBC	20.60	19.47	4.72	0.67	0.70	0.76	0.36	0.36	0.37	0.38
	Single TCs' Means	30.51	29.51	8.30	1.50	1.55	1.65	0.77	0.77	0.79	0.81
Mismatch Rate	Region Including Dcs and RBC	3.09	0.72	0.62	0.65	0.58	0.51	0.40	0.38	0.33	0.34
	Region Excluding DCs And RBC	3.09	0.72	0.62	0.65	0.58	0.51	0.40	0.38	0.33	0.34
	Single TCs' Means	4.56	1.21	0.94	0.96	0.87	0.77	0.65	0.62	0.54	0.55
Shortage Rate	Region Including Dcs and RBC	0.57	0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.00	0.00
	Region Excluding DCs And RBC	0.57	0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.00	0.00
	Single TCs' Means	1.08	0.10	0.06	0.05	0.03	0.02	0.03	0.02	0.01	0.01
Selection Criterion Performance		38.08	34.86	8.32	1.35	1.31	1.29	0.84	0.81	0.75	0.72

Table E.110. Percentage Change In City Performances Achieved with Best Policies of Groups

Performance Measure		0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
Inventory Level	Antalya	8987.41	4.52%	-19.38%	-67.50%	-63.69%	-59.96%	-58.49%	-61.91%	-61.85%	-59.83%
	Burdur	1568.05	3.90%	-7.93%	-72.27%	-68.28%	-65.49%	-63.41%	-66.65%	-53.72%	-50.71%
	Isparta	4072.39	4.18%	0.47%	-71.14%	-67.92%	-64.53%	-63.91%	-66.46%	-66.39%	-65.22%
	Overall	14627.86	4.36%	-12.63%	-69.03%	-65.36%	-61.82%	-60.53%	-63.68%	-62.24%	-60.35%
Outdate Rate	Antalya	31.53	-1.61%	-88.99%	-98.01%	-97.90%	-97.69%	-98.89%	-98.90%	-98.87%	-98.79%
	Burdur	35.74	-1.59%	-73.87%	-97.59%	-97.38%	-97.39%	-97.94%	-97.95%	-98.19%	-98.63%
	Isparta	40.31	0.43%	-59.48%	-98.23%	-98.16%	-98.05%	-98.77%	-98.78%	-98.81%	-99.20%
	Overall	34.41	-0.92%	-77.71%	-98.04%	-97.93%	-97.78%	-98.76%	-98.77%	-98.78%	-98.90%
Mismatch Rate	Antalya	3.03	-76.57%	-76.77%	-81.94%	-82.87%	-85.25%	-88.84%	-89.69%	-90.51%	-92.06%
	Burdur	3.67	-75.19%	-76.94%	-52.38%	-63.44%	-64.28%	-71.21%	-70.83%	-79.21%	-75.17%
	Isparta	3.02	-77.97%	-89.46%	-84.90%	-85.88%	-88.65%	-90.65%	-91.36%	-91.98%	-88.72%
	Overall	3.09	-76.73%	-79.89%	-78.94%	-81.16%	-83.44%	-87.06%	-87.73%	-89.44%	-89.12%
Shortage Rate	Antalya	0.59	-91.79%	-93.72%	-98.24%	-98.27%	-98.89%	-98.61%	-98.96%	-99.52%	-99.51%
	Burdur	0.64	-93.19%	-97.68%	-73.17%	-89.83%	-92.39%	-93.54%	-92.17%	-99.09%	-98.95%
	Isparta	0.51	-92.83%	-98.39%	-98.17%	-98.27%	-99.04%	-98.41%	-99.39%	-99.48%	-99.54%
	Overall	0.57	-92.19%	-95.23%	-95.25%	-97.27%	-96.49%	-97.97%	-98.25%	-99.46%	-99.45%

Table E.111. Percentage Change In Delivery Performance Measures Achieved with Best Policies of Groups

Performance Measure		0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
Quantity	Routine Deliveries To TCs	75653	1.13%	-3.51%	-8.17%	-8.28%	-4.12%	-24.79%	-49.30%	-49.17%	-49.26%
	Ad-Hoc Deliveries to TCs	64452	-3.60%	-3.70%	-12.50%	-12.58%	-31.81%	-61.98%	-5.09%	-5.43%	-5.49%
	Emergency Deliveries To TCs	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Ad-hoc Deliveries Between DCs and RBC	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	140105	-1.05%	-3.60%	-8.25%	-8.45%	-15.10%	-24.45%	-11.55%	-11.86%	-12.57%
Percentage	Routine Deliveries To TCs	54.00	2.20%	0.09%	0.09%	0.18%	12.94%	-0.45%	-42.68%	-42.34%	-41.97%
	Ad-Hoc Deliveries to TCs	46.00	-2.58%	-0.10%	-4.63%	-4.50%	-19.68%	-49.68%	7.30%	7.30%	8.10%
	Emergency Deliveries To TCs	0.00	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Ad-hoc Deliveries Between DCs and RBC	0.00	NA	NA	NA	NA	NA	NA	NA	NA	NA

** NA : Not applicable,

Table E.112. Percentage Change In Selection Criterion Performance Achieved with Best Policies of Groups

Performance Measure		0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
Outdate Rate	Region Including Des and RBC	34.41	-0.92%	-77.71%	-98.04%	-97.93%	-97.78%	-98.76%	-98.77%	-98.78%	-98.90%
	Region Excluding DCs And RBC	20.60	-5.52%	-77.08%	-96.73%	-96.60%	-96.34%	-98.23%	-98.24%	-98.19%	-98.17%
	Single TCs' Means	30.51	-3.30%	-72.79%	-95.10%	-94.90%	-94.59%	-97.49%	-97.49%	-97.41%	-97.34%
Mismatch Rate	Region Including Des and RBC	3.09	-76.73%	-79.89%	-78.94%	-81.16%	-83.44%	-87.06%	-87.73%	-89.44%	-89.12%
	Region Excluding DCs And RBC	3.09	-76.73%	-79.89%	-78.94%	-81.16%	-83.44%	-87.06%	-87.73%	-89.44%	-89.12%
	Single TCs' Means	4.56	-73.37%	-79.47%	-79.01%	-80.90%	-83.09%	-85.65%	-86.35%	-88.22%	-87.95%
Shortage Rate	Region Including Des and RBC	0.57	-92.19%	-95.23%	-95.25%	-97.27%	-98.15%	-97.97%	-98.25%	-99.46%	-99.45%
	Region Excluding DCs And RBC	0.57	-92.19%	-95.23%	-95.25%	-97.27%	-98.15%	-97.97%	-98.25%	-99.46%	-99.45%
	Single TCs' Means	1.08	-90.75%	-94.63%	-94.94%	-96.97%	-97.78%	-97.39%	-97.72%	-99.23%	-99.25%
Selection Criterion Performance		38.08	-8.45%	-78.16%	-96.45%	-96.56%	-96.62%	-97.79%	-97.86%	-98.04%	-98.12%

Table E.113. Comparison of Single TC Performances of Best Policies of Groups -
Mean Inventory Levels

TC	0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
[TC1]	97.99	140.81	144.29	144.93	145.08	187.54	211.15	175.81	176.10	176.18
[TC2]	27.85	37.46	37.93	38.16	38.12	46.61	48.67	43.50	43.53	43.36
[TC3]	19.76	25.51	25.67	25.86	26.00	32.47	31.65	29.56	29.53	29.46
[TC4]	16.71	20.75	20.92	21.20	21.16	23.84	20.86	19.85	19.93	20.05
[TC5]	15.23	19.07	19.20	19.43	19.43	23.99	21.19	19.51	19.56	19.65
[TC6]	21.08	27.76	28.02	28.18	28.29	35.74	34.89	32.21	32.34	32.34
[TC7]	18.23	23.11	23.40	23.52	23.53	27.22	25.28	23.37	23.33	23.32
[TC8]	16.22	20.71	20.80	21.03	21.03	26.51	24.64	21.98	22.08	22.02
[TC9]	13.98	17.54	17.60	17.77	17.76	21.47	17.81	17.05	17.07	17.11
[TC10]	16.31	20.73	20.76	20.95	20.95	25.60	23.68	21.58	21.58	21.49
[TC11]	19.58	25.45	25.56	25.87	25.91	30.48	32.94	28.92	29.18	29.19
[TC12]	13.52	16.65	16.71	16.94	16.98	20.65	18.59	17.06	17.25	17.06
[TC13]	14.19	17.47	17.56	17.81	17.78	21.48	17.83	17.05	17.06	17.13
[TC14]	25.15	33.27	33.69	33.88	33.94	40.58	44.53	39.95	39.75	39.99
[TC15]	16.73	21.32	21.40	21.66	21.73	26.41	23.71	21.30	21.30	21.16
[TC16]	15.37	19.20	19.23	19.47	19.58	24.06	20.13	18.06	18.05	18.22
[TC17]	14.04	17.53	17.50	17.80	17.81	21.40	18.34	17.04	16.99	17.01
[TC18]	170.54	247.31	253.43	254.13	254.64	331.67	409.38	319.15	319.33	319.55
[TC19]	74.71	107.07	109.76	110.18	110.21	144.56	174.32	138.90	138.95	138.97
[TC20]	48.02	67.55	68.96	69.31	69.30	89.07	101.98	82.65	82.79	82.81
[TC21]	14.24	17.54	17.58	17.85	17.89	21.59	18.65	17.57	17.55	17.64
[TC22]	18.98	24.76	24.84	25.02	25.01	29.68	29.01	25.92	25.84	25.89
[TC23]	27.65	37.31	37.85	38.06	38.05	47.64	48.83	41.67	41.86	41.74
[TC24]	19.74	25.36	25.55	25.87	25.90	30.55	32.12	28.53	28.55	28.62
[TC25]	15.10	19.06	19.12	19.27	19.38	23.91	19.26	17.27	17.21	17.28
[TC26]	13.61	16.62	16.75	17.02	16.94	19.73	16.44	15.46	15.50	15.48
[TC27]	25.14	33.36	33.89	34.02	34.05	40.70	42.81	38.37	38.31	38.56
[TC28]	21.66	28.54	28.87	29.02	29.10	37.46	38.65	33.13	33.26	33.19
[TC29]	47.02	65.83	67.24	67.50	67.52	86.06	99.38	81.08	81.17	81.14
[TC30]	13.52	16.74	16.75	17.02	16.97	20.63	18.40	16.68	16.55	16.66
[TC31]	30.45	41.40	41.99	42.15	42.24	51.70	54.52	48.34	48.24	48.32
[TC32]	43.89	61.65	63.00	61.81	62.50	81.56	96.36	78.23	78.71	78.75
[TC33]	18.22	23.16	23.21	22.95	23.22	26.90	28.93	25.30	25.54	25.54
[TC34]	47.70	67.16	68.70	67.45	68.21	86.45	96.37	78.69	79.20	79.17
[TC35]	15.26	19.07	19.14	18.82	19.14	21.80	21.31	19.10	19.40	19.31
[TC36]	13.10	15.98	15.82	15.74	15.83	17.69	14.64	13.88	14.23	14.10
[TC37]	17.76	22.97	23.05	22.70	23.02	29.33	30.84	26.99	27.16	27.06
[TC38]	77.77	111.17	114.60	114.56	114.66	148.14	167.54	141.13	141.17	140.93
[TC39]	27.83	37.78	38.70	38.86	38.93	50.44	49.94	47.09	46.96	46.94
[TC40]	43.78	61.59	63.27	63.42	63.45	82.67	97.73	79.06	78.95	78.99
[TC41]	45.69	64.04	65.84	65.95	66.04	84.51	88.44	77.06	76.90	76.82
[TC42]	13.47	16.49	16.56	17.04	17.15	19.79	17.43	16.01	16.02	16.00
[TC43]	13.99	17.37	17.41	17.82	17.95	21.55	17.22	17.20	17.08	16.91
[TC44]	16.12	20.57	20.70	21.16	21.11	25.71	23.92	20.88	20.87	20.94
[TC45]	13.72	17.23	17.27	17.84	17.84	21.52	19.04	17.68	17.48	17.65
[TC46]	13.48	16.55	16.54	17.09	17.12	19.74	17.47	16.10	15.94	16.14
[TC47]	16.50	21.26	21.44	21.88	21.94	27.44	25.79	22.53	22.33	22.44
[TC48]	57.36	82.07	84.56	84.63	84.65	111.31	116.92	107.66	107.73	107.48
[TC49]	13.44	16.52	16.56	17.07	17.03	19.80	16.08	15.45	15.51	15.51
Mean	29.21	39.70	40.39	40.56	40.65	51.17	54.81	46.71	46.75	46.76
Median	18.22	23.11	23.21	22.95	23.22	27.44	28.93	25.30	25.54	25.54
Max	170.54	247.31	253.43	254.13	254.64	331.67	409.38	319.15	319.33	319.55
Min	13.10	15.98	15.82	15.74	15.83	17.69	14.64	13.88	14.23	14.10
Percentile (%10)	13.52	16.64	16.74	17.06	17.10	20.47	17.46	16.56	16.44	16.55
Percentile (%25)	14.24	17.54	17.60	17.85	17.95	21.59	19.04	17.57	17.48	17.64
Percentile (%50)	18.22	23.11	23.21	22.95	23.22	27.44	28.93	25.30	25.54	25.54
Percentile (%75)	27.85	37.78	38.70	38.86	38.93	50.44	49.94	47.09	46.96	46.94
Percentile (%90)	49.88	70.46	72.08	72.38	72.37	93.52	104.97	87.66	87.78	87.75

Table E.114. Comparison of Single TC Performances of Best Policies of Groups -
Outdate Rates

TC	0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
[TC1]	14.14	12.82	0.27	0.01	0.01	0.01	0.01	0.01	0.01	0.01
[TC2]	26.83	25.89	3.06	0.49	0.48	0.57	0.29	0.27	0.31	0.34
[TC3]	31.80	30.54	5.26	1.14	1.17	1.26	0.69	0.72	0.74	0.70
[TC4]	35.02	34.06	7.68	1.82	1.92	1.99	0.89	0.98	0.98	1.11
[TC5]	35.21	34.34	7.89	2.06	2.22	2.49	1.06	1.10	1.12	1.22
[TC6]	29.43	28.35	4.22	0.86	0.98	1.13	0.49	0.53	0.55	0.57
[TC7]	33.99	33.20	7.01	1.58	1.58	1.66	0.74	0.78	0.79	0.80
[TC8]	32.74	32.00	6.66	1.59	1.69	1.85	0.86	0.92	0.91	0.93
[TC9]	35.89	35.57	8.70	2.60	2.62	2.83	1.37	1.39	1.40	1.46
[TC10]	33.88	32.86	7.17	1.66	1.78	2.03	0.90	0.91	0.91	0.95
[TC11]	31.47	30.33	5.40	1.13	1.24	1.39	0.68	0.66	0.74	0.77
[TC12]	37.02	36.36	9.37	2.83	2.90	3.16	1.40	1.47	1.50	1.52
[TC13]	36.78	36.29	9.11	2.54	2.83	2.83	1.39	1.42	1.38	1.47
[TC14]	28.23	26.77	3.58	0.59	0.60	0.69	0.44	0.42	0.38	0.45
[TC15]	33.26	31.97	6.51	1.74	1.75	1.95	0.85	0.86	0.79	0.85
[TC16]	36.24	35.49	8.52	2.05	2.39	2.64	1.16	1.03	1.04	1.25
[TC17]	36.19	35.18	8.64	2.57	2.62	2.78	1.27	1.28	1.25	1.28
[TC18]	10.12	9.08	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	15.80	14.38	0.40	0.02	0.02	0.04	0.02	0.02	0.03	0.03
[TC20]	19.85	18.18	0.97	0.09	0.10	0.11	0.07	0.07	0.09	0.09
[TC21]	37.23	36.63	9.54	2.82	2.96	2.99	1.41	1.45	1.39	1.54
[TC22]	31.13	30.52	5.52	1.08	1.18	1.36	0.60	0.63	0.60	0.67
[TC23]	26.04	24.86	2.75	0.45	0.49	0.58	0.34	0.30	0.33	0.37
[TC24]	31.66	30.71	5.39	1.13	1.17	1.29	0.72	0.71	0.77	0.75
[TC25]	34.59	34.33	8.07	2.05	2.20	2.40	1.14	1.00	1.08	1.14
[TC26]	38.48	38.57	10.61	3.15	3.22	3.41	1.54	1.57	1.61	1.72
[TC27]	27.87	26.24	3.51	0.58	0.58	0.67	0.40	0.39	0.40	0.46
[TC28]	28.50	27.07	4.00	0.77	0.80	1.01	0.48	0.43	0.50	0.53
[TC29]	20.23	19.01	1.07	0.10	0.11	0.12	0.09	0.07	0.09	0.08
[TC30]	37.22	36.61	9.87	2.89	2.99	3.11	1.50	1.47	1.56	1.66
[TC31]	24.83	23.78	2.44	0.33	0.36	0.39	0.22	0.21	0.21	0.26
[TC32]	19.79	18.07	2.66	0.19	0.17	0.21	0.15	0.15	0.14	0.12
[TC33]	32.73	31.50	10.87	1.79	1.78	1.66	0.83	0.90	1.04	1.11
[TC34]	18.79	17.11	2.33	0.19	0.17	0.17	0.13	0.12	0.10	0.10
[TC35]	34.88	33.93	13.25	2.36	2.50	2.58	1.00	0.97	1.22	1.20
[TC36]	38.89	38.38	16.34	3.70	3.78	3.73	1.49	1.33	2.04	1.98
[TC37]	29.89	28.56	8.93	1.42	1.46	1.48	0.77	0.80	0.89	0.85
[TC38]	17.98	16.74	3.26	0.04	0.04	0.07	0.06	0.05	0.06	0.02
[TC39]	28.26	26.86	10.48	0.50	0.53	0.57	0.37	0.37	0.37	0.27
[TC40]	22.68	21.36	6.20	0.16	0.16	0.20	0.14	0.14	0.14	0.09
[TC41]	22.76	21.84	6.30	0.17	0.18	0.19	0.13	0.14	0.11	0.07
[TC42]	41.97	41.37	23.77	3.62	3.55	3.74	1.64	1.51	1.63	1.58
[TC43]	40.59	39.93	22.37	2.99	3.25	3.25	1.34	1.54	1.47	1.28
[TC44]	36.65	35.94	18.77	1.98	1.96	2.20	0.96	0.94	0.85	0.86
[TC45]	39.44	38.80	21.34	2.85	3.00	2.99	1.41	1.49	1.28	1.45
[TC46]	41.18	39.61	22.17	3.30	3.36	3.46	1.54	1.58	1.40	1.48
[TC47]	35.30	34.25	16.84	1.80	1.87	1.87	0.88	0.85	0.77	0.69
[TC48]	20.03	18.50	4.30	0.09	0.08	0.10	0.10	0.10	0.11	0.05
[TC49]	41.64	41.16	23.37	3.44	3.41	3.66	1.59	1.55	1.66	1.59
Mean	30.51	29.51	8.30	1.50	1.55	1.65	0.77	0.77	0.79	0.81
Median	32.73	31.50	7.01	1.58	1.58	1.66	0.77	0.80	0.79	0.80
Max	41.97	41.37	23.77	3.70	3.78	3.74	1.64	1.58	2.04	1.98
Min	10.12	9.08	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	19.59	17.88	2.08	0.09	0.09	0.11	0.08	0.07	0.09	0.06
Percentile (%25)	26.04	24.86	3.58	0.45	0.48	0.57	0.29	0.27	0.31	0.27
Percentile (%50)	32.73	31.50	7.01	1.58	1.58	1.66	0.77	0.80	0.79	0.80
Percentile (%75)	36.24	35.57	9.87	2.54	2.62	2.78	1.27	1.28	1.25	1.28
Percentile (%90)	39.00	38.62	19.28	3.02	3.23	3.28	1.49	1.49	1.51	1.55

Table E.115. Comparison of Single TC Performances of Best Policies of Groups - Mismatch Rates

TC	0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
[TC1]	1.32	0.21	0.30	0.26	0.22	0.21	0.14	0.15	0.13	0.07
[TC2]	3.86	0.68	0.78	0.60	0.54	0.58	0.46	0.42	0.39	0.28
[TC3]	5.23	1.29	1.17	0.91	0.84	0.70	0.53	0.46	0.46	0.39
[TC4]	5.28	1.68	1.25	1.05	0.92	0.84	0.71	0.58	0.61	0.51
[TC5]	5.41	1.46	1.31	1.03	0.96	0.77	0.72	0.63	0.59	0.58
[TC6]	5.32	1.16	1.10	0.74	0.75	0.51	0.53	0.55	0.50	0.42
[TC7]	4.92	1.37	1.09	0.88	0.86	0.81	0.68	0.54	0.53	0.47
[TC8]	5.67	1.77	1.37	1.11	1.08	0.76	0.63	0.64	0.57	0.55
[TC9]	5.94	1.78	1.50	1.00	1.09	0.87	0.74	0.64	0.64	0.58
[TC10]	5.61	1.67	1.38	1.03	0.95	0.80	0.68	0.69	0.59	0.51
[TC11]	5.26	1.33	1.22	0.86	0.87	0.68	0.51	0.53	0.43	0.42
[TC12]	5.69	1.73	1.43	1.05	1.01	1.00	0.73	0.68	0.64	0.58
[TC13]	5.66	1.77	1.38	1.05	0.94	1.03	0.73	0.64	0.64	0.55
[TC14]	3.91	0.88	1.01	0.63	0.68	0.52	0.46	0.38	0.39	0.30
[TC15]	5.58	1.53	1.23	0.97	0.93	0.88	0.67	0.70	0.75	0.58
[TC16]	5.75	1.72	1.26	1.03	1.04	0.78	0.77	0.70	0.66	0.60
[TC17]	6.47	1.91	1.44	1.11	1.12	0.93	0.74	0.66	0.63	0.63
[TC18]	0.76	0.10	0.19	0.16	0.15	0.14	0.02	0.02	0.03	0.01
[TC19]	1.76	0.29	0.45	0.40	0.34	0.27	0.17	0.16	0.13	0.09
[TC20]	2.71	0.46	0.60	0.49	0.44	0.38	0.29	0.28	0.21	0.15
[TC21]	5.40	1.84	1.36	0.99	0.99	0.91	0.70	0.66	0.68	0.52
[TC22]	5.10	1.45	1.13	0.87	0.96	0.81	0.60	0.51	0.53	0.48
[TC23]	4.06	0.75	0.86	0.64	0.58	0.54	0.42	0.41	0.32	0.32
[TC24]	5.18	1.31	1.24	0.93	0.95	0.73	0.57	0.51	0.43	0.48
[TC25]	5.76	1.55	1.32	1.04	0.97	0.82	0.73	0.69	0.62	0.60
[TC26]	5.74	1.59	1.35	0.99	0.97	0.93	0.73	0.62	0.70	0.60
[TC27]	4.21	0.90	1.01	0.73	0.70	0.53	0.51	0.48	0.42	0.37
[TC28]	4.99	1.07	1.12	0.79	0.77	0.55	0.52	0.51	0.46	0.39
[TC29]	2.66	0.50	0.56	0.49	0.46	0.41	0.32	0.26	0.24	0.16
[TC30]	5.65	1.80	1.42	1.07	1.11	0.94	0.68	0.66	0.61	0.60
[TC31]	3.73	0.76	0.80	0.63	0.54	0.53	0.45	0.39	0.38	0.34
[TC32]	3.06	0.62	0.75	1.33	1.08	0.91	0.60	0.60	0.48	0.61
[TC33]	5.00	1.35	1.06	2.41	1.89	2.03	1.72	1.80	1.13	1.38
[TC34]	2.66	0.57	0.63	1.34	0.98	0.96	0.62	0.56	0.51	0.59
[TC35]	5.59	1.68	1.23	2.75	2.15	2.08	2.22	2.39	1.55	1.64
[TC36]	5.52	1.74	1.24	2.83	2.01	2.48	2.37	2.32	1.50	1.88
[TC37]	5.31	1.51	1.17	2.45	1.89	1.82	1.72	1.86	1.14	1.39
[TC38]	1.60	0.26	0.18	0.24	0.21	0.17	0.10	0.09	0.06	0.16
[TC39]	3.95	0.69	0.31	0.55	0.47	0.44	0.30	0.29	0.28	0.35
[TC40]	2.79	0.54	0.24	0.42	0.37	0.28	0.21	0.20	0.16	0.27
[TC41]	2.58	0.43	0.22	0.33	0.32	0.30	0.31	0.27	0.25	0.36
[TC42]	5.31	1.66	0.79	0.91	0.93	0.73	0.77	0.72	0.63	0.66
[TC43]	5.77	1.68	0.84	0.97	0.87	0.68	0.67	0.60	0.70	0.73
[TC44]	5.65	1.53	0.72	0.89	0.90	0.64	0.60	0.61	0.60	0.66
[TC45]	5.92	1.74	0.69	0.88	0.90	0.70	0.57	0.59	0.56	0.69
[TC46]	5.39	1.77	0.77	0.97	1.05	0.80	0.71	0.59	0.68	0.75
[TC47]	5.25	1.31	0.52	0.75	0.71	0.64	0.65	0.65	0.61	0.78
[TC48]	2.15	0.37	0.19	0.30	0.28	0.20	0.11	0.10	0.09	0.17
[TC49]	5.34	1.71	0.66	1.05	0.88	0.73	0.64	0.52	0.53	0.71
Mean	4.56	1.21	0.94	0.96	0.87	0.77	0.65	0.62	0.54	0.55
Median	5.26	1.37	1.06	0.91	0.90	0.73	0.62	0.58	0.53	0.52
Max	6.47	1.91	1.50	2.83	2.15	2.48	2.37	2.39	1.55	1.88
Min	0.76	0.10	0.18	0.16	0.15	0.14	0.02	0.02	0.03	0.01
Percentile (%10)	2.49	0.42	0.29	0.39	0.34	0.28	0.20	0.19	0.16	0.16
Percentile (%25)	3.86	0.69	0.66	0.63	0.58	0.53	0.46	0.41	0.39	0.35
Percentile (%50)	5.26	1.37	1.06	0.91	0.90	0.73	0.62	0.58	0.53	0.52
Percentile (%75)	5.61	1.68	1.25	1.05	0.99	0.88	0.72	0.66	0.64	0.61
Percentile (%90)	5.75	1.77	1.38	1.33	1.11	1.00	0.77	0.70	0.71	0.76

Table E.116. Comparison of Single TC Performances of Best Policies of Groups - Shortage Rates

TC	0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
[TC1]	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC2]	0.66	0.02	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00
[TC3]	1.43	0.11	0.06	0.04	0.03	0.01	0.01	0.00	0.00	0.00
[TC4]	1.18	0.13	0.06	0.03	0.02	0.02	0.02	0.02	0.00	0.00
[TC5]	1.34	0.10	0.08	0.02	0.02	0.02	0.04	0.00	0.01	0.01
[TC6]	1.15	0.08	0.07	0.01	0.01	0.00	0.01	0.00	0.00	0.00
[TC7]	1.29	0.11	0.10	0.02	0.01	0.02	0.01	0.01	0.00	0.00
[TC8]	1.37	0.11	0.09	0.02	0.02	0.03	0.01	0.02	0.00	0.00
[TC9]	1.56	0.24	0.18	0.05	0.06	0.01	0.07	0.03	0.02	0.02
[TC10]	1.33	0.10	0.12	0.01	0.03	0.05	0.02	0.01	0.00	0.01
[TC11]	1.47	0.14	0.07	0.03	0.02	0.01	0.02	0.00	0.00	0.00
[TC12]	1.53	0.21	0.15	0.04	0.03	0.04	0.04	0.03	0.02	0.03
[TC13]	1.47	0.23	0.13	0.03	0.04	0.04	0.06	0.04	0.04	0.03
[TC14]	1.07	0.08	0.04	0.01	0.02	0.00	0.00	0.02	0.00	0.00
[TC15]	1.54	0.12	0.12	0.02	0.03	0.02	0.03	0.02	0.01	0.01
[TC16]	1.33	0.12	0.10	0.04	0.02	0.01	0.04	0.03	0.01	0.02
[TC17]	1.57	0.21	0.16	0.04	0.05	0.03	0.03	0.03	0.02	0.02
[TC18]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC19]	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC20]	0.25	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC21]	1.37	0.19	0.12	0.05	0.02	0.01	0.04	0.03	0.02	0.00
[TC22]	1.68	0.16	0.07	0.03	0.03	0.02	0.02	0.03	0.00	0.01
[TC23]	0.82	0.02	0.03	0.01	0.00	0.01	0.00	0.00	0.00	0.00
[TC24]	1.44	0.14	0.09	0.04	0.03	0.02	0.01	0.00	0.00	0.00
[TC25]	1.28	0.09	0.10	0.02	0.03	0.02	0.06	0.05	0.03	0.03
[TC26]	1.43	0.19	0.16	0.05	0.05	0.05	0.04	0.04	0.03	0.02
[TC27]	1.10	0.06	0.07	0.02	0.02	0.00	0.01	0.00	0.00	0.00
[TC28]	1.27	0.08	0.04	0.02	0.02	0.00	0.00	0.00	0.00	0.00
[TC29]	0.24	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC30]	1.62	0.18	0.12	0.05	0.07	0.03	0.04	0.02	0.01	0.01
[TC31]	0.61	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00
[TC32]	0.24	0.01	0.00	0.08	0.03	0.01	0.00	0.01	0.00	0.00
[TC33]	1.29	0.10	0.03	0.30	0.13	0.07	0.09	0.09	0.00	0.00
[TC34]	0.29	0.00	0.00	0.06	0.03	0.01	0.01	0.00	0.00	0.00
[TC35]	1.29	0.11	0.03	0.39	0.17	0.16	0.13	0.15	0.02	0.02
[TC36]	1.23	0.17	0.08	0.50	0.16	0.23	0.18	0.35	0.06	0.05
[TC37]	1.61	0.12	0.05	0.34	0.12	0.06	0.06	0.07	0.01	0.02
[TC38]	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC39]	0.66	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC40]	0.27	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC41]	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC42]	1.54	0.17	0.04	0.05	0.03	0.03	0.05	0.01	0.03	0.01
[TC43]	1.69	0.15	0.05	0.06	0.04	0.01	0.05	0.02	0.02	0.01
[TC44]	1.47	0.11	0.03	0.03	0.02	0.03	0.01	0.02	0.01	0.01
[TC45]	1.66	0.22	0.05	0.05	0.05	0.01	0.04	0.02	0.01	0.01
[TC46]	1.61	0.22	0.03	0.06	0.06	0.03	0.05	0.02	0.01	0.01
[TC47]	1.70	0.13	0.02	0.02	0.03	0.02	0.02	0.01	0.00	0.01
[TC48]	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[TC49]	1.52	0.14	0.04	0.04	0.04	0.02	0.06	0.01	0.01	0.01
Mean	1.08	0.10	0.06	0.05	0.03	0.02	0.03	0.02	0.01	0.01
Median	1.29	0.11	0.05	0.03	0.02	0.01	0.02	0.01	0.00	0.00
Max	1.70	0.24	0.18	0.50	0.17	0.23	0.18	0.35	0.06	0.05
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%10)	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percentile (%25)	0.66	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Percentile (%50)	1.29	0.11	0.05	0.03	0.02	0.01	0.02	0.01	0.00	0.00
Percentile (%75)	1.52	0.15	0.09	0.05	0.04	0.03	0.04	0.03	0.01	0.01
Percentile (%90)	1.61	0.21	0.12	0.07	0.06	0.05	0.06	0.04	0.02	0.02

Table E.117. Comparison of Single TC Performances of Best Policie of Groups -
Selection Criterion Values Rates

TC	0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
[TC1]	15.47	13.03	0.58	0.27	0.23	0.22	0.15	0.15	0.13	0.08
[TC2]	31.36	26.59	3.87	1.09	1.02	1.16	0.76	0.69	0.69	0.63
[TC3]	38.46	31.94	6.49	2.09	2.05	1.97	1.22	1.18	1.21	1.09
[TC4]	41.48	35.87	8.99	2.89	2.87	2.85	1.61	1.58	1.59	1.62
[TC5]	41.96	35.90	9.27	3.11	3.21	3.28	1.82	1.74	1.72	1.81
[TC6]	35.90	29.60	5.39	1.62	1.75	1.65	1.03	1.08	1.05	0.99
[TC7]	40.19	34.67	8.21	2.48	2.46	2.49	1.43	1.33	1.32	1.27
[TC8]	39.79	33.88	8.12	2.72	2.79	2.64	1.50	1.58	1.49	1.48
[TC9]	43.39	37.59	10.38	3.65	3.77	3.71	2.18	2.05	2.06	2.06
[TC10]	40.82	34.62	8.68	2.70	2.75	2.88	1.59	1.61	1.49	1.47
[TC11]	38.21	31.79	6.69	2.02	2.13	2.08	1.21	1.19	1.18	1.19
[TC12]	44.23	38.30	10.94	3.92	3.94	4.20	2.17	2.18	2.16	2.12
[TC13]	43.91	38.29	10.62	3.63	3.82	3.90	2.19	2.10	2.06	2.05
[TC14]	33.21	27.74	4.62	1.22	1.30	1.21	0.90	0.81	0.77	0.74
[TC15]	40.38	33.62	7.86	2.73	2.71	2.86	1.55	1.57	1.55	1.44
[TC16]	43.32	37.32	9.88	3.12	3.44	3.43	1.98	1.75	1.71	1.88
[TC17]	44.23	37.30	10.25	3.72	3.80	3.74	2.04	1.97	1.89	1.93
[TC18]	10.88	9.18	0.29	0.16	0.15	0.14	0.03	0.03	0.03	0.01
[TC19]	17.61	14.67	0.85	0.42	0.37	0.30	0.19	0.19	0.16	0.12
[TC20]	22.81	18.64	1.59	0.58	0.54	0.49	0.36	0.35	0.29	0.24
[TC21]	44.00	38.67	11.03	3.86	3.97	3.92	2.15	2.14	2.08	2.07
[TC22]	37.91	32.14	6.72	1.99	2.18	2.18	1.22	1.17	1.14	1.15
[TC23]	30.91	25.64	3.63	1.10	1.07	1.13	0.76	0.71	0.65	0.69
[TC24]	38.27	32.16	6.72	2.10	2.15	2.03	1.30	1.22	1.20	1.23
[TC25]	41.63	35.97	9.49	3.10	3.20	3.24	1.93	1.73	1.72	1.77
[TC26]	45.65	40.35	12.11	4.19	4.24	4.40	2.31	2.22	2.34	2.34
[TC27]	33.18	27.20	4.60	1.33	1.30	1.20	0.92	0.87	0.82	0.83
[TC28]	34.76	28.23	5.17	1.59	1.59	1.56	1.01	0.95	0.96	0.92
[TC29]	23.12	19.51	1.63	0.59	0.57	0.54	0.41	0.33	0.32	0.24
[TC30]	44.49	38.59	11.41	4.01	4.16	4.07	2.23	2.15	2.19	2.27
[TC31]	29.16	24.55	3.26	0.96	0.91	0.92	0.66	0.61	0.59	0.60
[TC32]	23.08	18.70	3.41	1.60	1.28	1.13	0.75	0.75	0.63	0.73
[TC33]	39.01	32.95	11.96	4.50	3.79	3.77	2.64	2.79	2.17	2.49
[TC34]	21.74	17.68	2.96	1.59	1.17	1.14	0.76	0.69	0.61	0.69
[TC35]	41.76	35.72	14.51	5.50	4.82	4.81	3.35	3.51	2.79	2.87
[TC36]	45.64	40.28	17.66	7.04	5.95	6.44	4.05	4.01	3.59	3.91
[TC37]	36.80	30.18	10.14	4.21	3.48	3.37	2.55	2.73	2.03	2.26
[TC38]	19.64	16.99	3.44	0.27	0.25	0.24	0.16	0.14	0.12	0.19
[TC39]	32.86	27.57	10.80	1.05	1.00	1.00	0.67	0.66	0.64	0.62
[TC40]	25.74	21.91	6.44	0.59	0.53	0.48	0.35	0.34	0.31	0.37
[TC41]	25.63	22.27	6.53	0.50	0.50	0.49	0.44	0.41	0.35	0.43
[TC42]	48.82	43.19	24.60	4.58	4.52	4.50	2.45	2.24	2.29	2.25
[TC43]	48.04	41.76	23.26	4.01	4.15	3.95	2.06	2.16	2.18	2.02
[TC44]	43.77	37.57	19.51	2.90	2.88	2.87	1.57	1.57	1.46	1.52
[TC45]	47.02	40.76	22.08	3.78	3.95	3.71	2.02	2.09	1.86	2.15
[TC46]	48.18	41.60	22.97	4.33	4.47	4.30	2.29	2.18	2.10	2.25
[TC47]	42.26	35.70	17.38	2.58	2.61	2.54	1.54	1.50	1.38	1.48
[TC48]	22.29	18.87	4.49	0.39	0.37	0.30	0.20	0.20	0.19	0.23
[TC49]	48.50	43.01	24.07	4.52	4.33	4.41	2.29	2.08	2.20	2.31
Mean	36.15	30.82	9.30	2.51	2.46	2.45	1.45	1.41	1.34	1.37
Median	39.29	32.98	8.12	2.51	2.51	2.40	1.40	1.39	1.33	1.33
Max	50.14	43.52	25.45	7.04	6.11	6.46	4.19	4.31	3.65	3.91
Min	10.88	9.18	0.28	0.16	0.15	0.14	0.03	0.03	0.03	0.01
Percentile (%10)	22.30	18.30	2.37	0.48	0.43	0.38	0.29	0.26	0.24	0.23
Percentile (%25)	30.55	25.56	4.26	1.08	1.06	1.10	0.75	0.68	0.69	0.62
Percentile (%50)	39.29	32.98	8.12	2.51	2.51	2.40	1.40	1.39	1.33	1.33
Percentile (%75)	43.37	37.40	11.21	3.64	3.65	3.69	2.03	1.96	1.90	1.90
Percentile (%90)	46.36	40.60	20.79	4.41	4.40	4.33	2.33	2.23	2.24	2.33

Table E.118. Percentage Change in Single TC Performances of Best Policies of Groups - Mean Inventory Levels

TC	0 (Baseline)	1.4.	2.4.	3.32.	4.61.	5.9.	6.7.	7.8.	8.4.	9.2.
[TC1]	97.99	43.70%	47.25%	47.91%	48.06%	91.39%	115.49%	79.42%	79.72%	79.81%
[TC2]	27.85	34.51%	36.21%	37.04%	36.88%	67.38%	74.76%	56.19%	56.30%	55.72%
[TC3]	19.76	29.09%	29.92%	30.89%	31.58%	64.34%	60.18%	49.60%	49.47%	49.11%
[TC4]	16.71	24.18%	25.20%	26.90%	26.67%	42.69%	24.87%	18.82%	19.28%	19.99%
[TC5]	15.23	25.25%	26.06%	27.58%	27.59%	57.52%	39.17%	28.13%	28.47%	29.04%
[TC6]	21.08	31.69%	32.96%	33.70%	34.21%	69.56%	65.55%	52.81%	53.47%	53.43%
[TC7]	18.23	26.74%	28.37%	29.02%	29.09%	49.31%	38.64%	28.17%	27.94%	27.88%
[TC8]	16.22	27.64%	28.23%	29.65%	29.62%	63.45%	51.92%	35.49%	36.10%	35.72%
[TC9]	13.98	25.47%	25.87%	27.12%	27.05%	53.52%	27.40%	21.94%	22.12%	22.40%
[TC10]	16.31	27.09%	27.26%	28.40%	28.43%	56.90%	45.15%	32.29%	32.27%	31.73%
[TC11]	19.58	29.93%	30.51%	32.11%	32.31%	55.61%	68.20%	47.68%	48.98%	49.05%
[TC12]	13.52	23.13%	23.59%	25.28%	25.57%	52.75%	37.46%	26.15%	27.58%	26.21%
[TC13]	14.19	23.08%	23.73%	25.47%	25.28%	51.36%	25.65%	20.12%	20.16%	20.69%
[TC14]	25.15	32.31%	33.97%	34.73%	34.97%	61.37%	77.10%	58.89%	58.07%	59.05%
[TC15]	16.73	27.39%	27.89%	29.44%	29.85%	57.83%	41.69%	27.29%	27.27%	26.46%
[TC16]	15.37	24.87%	25.11%	26.67%	27.39%	56.52%	30.94%	17.51%	17.41%	18.55%
[TC17]	14.04	24.88%	24.65%	26.79%	26.83%	52.42%	30.59%	21.35%	21.03%	21.18%
[TC18]	170.54	45.02%	48.60%	49.01%	49.31%	94.48%	140.04%	87.14%	87.24%	87.37%
[TC19]	74.71	43.31%	46.91%	47.48%	47.51%	93.50%	133.32%	85.92%	85.98%	86.02%
[TC20]	48.02	40.69%	43.62%	44.36%	44.32%	85.50%	112.40%	72.14%	72.43%	72.47%
[TC21]	14.24	23.13%	23.44%	25.35%	25.61%	51.55%	30.93%	23.32%	23.20%	23.85%
[TC22]	18.98	30.47%	30.90%	31.80%	31.79%	56.38%	52.86%	36.57%	36.14%	36.39%
[TC23]	27.65	34.91%	36.87%	37.64%	37.61%	72.27%	76.57%	50.67%	51.36%	50.94%
[TC24]	19.74	28.49%	29.42%	31.04%	31.21%	54.75%	62.71%	44.52%	44.62%	44.97%
[TC25]	15.10	26.21%	26.64%	27.60%	28.32%	58.32%	27.55%	14.35%	13.98%	14.47%
[TC26]	13.61	22.09%	23.07%	25.03%	24.43%	44.93%	20.82%	13.60%	13.91%	13.73%
[TC27]	25.14	32.68%	34.77%	35.30%	35.43%	61.88%	70.27%	52.59%	52.38%	53.37%
[TC28]	21.66	31.73%	33.27%	33.97%	34.34%	72.92%	78.41%	52.93%	53.53%	53.23%
[TC29]	47.02	40.00%	43.00%	43.54%	43.59%	83.02%	111.35%	72.42%	72.62%	72.56%
[TC30]	13.52	23.82%	23.90%	25.90%	25.56%	52.64%	36.13%	23.38%	22.45%	23.23%
[TC31]	30.45	35.94%	37.87%	38.42%	38.70%	69.75%	79.01%	58.75%	58.40%	58.66%
[TC32]	43.89	40.45%	43.54%	40.83%	42.40%	85.82%	119.56%	78.23%	79.33%	79.43%
[TC33]	18.22	27.07%	27.34%	25.92%	27.40%	47.58%	58.76%	38.85%	40.12%	40.12%
[TC34]	47.70	40.79%	44.03%	41.40%	43.01%	81.25%	102.04%	64.96%	66.03%	65.97%
[TC35]	15.26	24.99%	25.40%	23.35%	25.43%	42.84%	39.64%	25.17%	27.11%	26.56%
[TC36]	13.10	21.95%	20.74%	20.14%	20.83%	35.02%	11.74%	5.93%	8.62%	7.66%
[TC37]	17.76	29.31%	29.77%	27.83%	29.59%	65.11%	73.63%	51.98%	52.89%	52.38%
[TC38]	77.77	42.95%	47.36%	47.31%	47.43%	90.48%	115.43%	81.47%	81.52%	81.21%
[TC39]	27.83	35.75%	39.06%	39.62%	39.87%	81.22%	79.42%	69.18%	68.74%	68.66%
[TC40]	43.78	40.66%	44.51%	44.85%	44.93%	88.82%	123.21%	80.57%	80.31%	80.42%
[TC41]	45.69	40.17%	44.10%	44.34%	44.55%	84.98%	93.57%	68.65%	68.31%	68.13%
[TC42]	13.47	22.41%	22.88%	26.46%	27.28%	46.87%	29.35%	18.84%	18.89%	18.78%
[TC43]	13.99	24.21%	24.47%	27.37%	28.34%	54.07%	23.10%	22.95%	22.08%	20.93%
[TC44]	16.12	27.60%	28.46%	31.29%	31.00%	59.55%	48.38%	29.55%	29.52%	29.95%
[TC45]	13.72	25.61%	25.85%	30.04%	30.00%	56.82%	38.80%	28.90%	27.37%	28.65%
[TC46]	13.48	22.77%	22.72%	26.81%	27.02%	46.49%	29.62%	19.46%	18.30%	19.74%
[TC47]	16.50	28.83%	29.93%	32.57%	32.93%	66.28%	56.29%	36.50%	35.30%	35.94%
[TC48]	57.36	43.07%	47.40%	47.54%	47.57%	94.04%	103.82%	87.69%	87.81%	87.37%
[TC49]	13.44	22.88%	23.16%	26.98%	26.66%	47.30%	19.62%	14.93%	15.41%	15.39%
Mean	29.21	35.90%	38.27%	38.86%	39.17%	75.16%	87.62%	59.88%	60.04%	60.07%
Median	18.22	26.80%	27.34%	25.92%	27.40%	50.59%	58.76%	38.85%	40.12%	40.12%
Max	170.54	45.02%	48.60%	49.01%	49.31%	94.48%	140.04%	87.14%	87.24%	87.37%
Min	13.10	21.95%	20.74%	20.14%	20.83%	35.02%	11.74%	5.93%	8.62%	7.66%
Percentile (%10)	13.52	23.10%	23.81%	26.22%	26.48%	51.37%	29.15%	22.50%	21.63%	22.43%
Percentile (%25)	14.24	23.16%	23.56%	25.35%	26.03%	51.55%	33.70%	23.32%	22.69%	23.85%
Percentile (%50)	18.22	26.80%	27.34%	25.92%	27.40%	50.59%	58.76%	38.85%	40.12%	40.12%
Percentile (%75)	27.85	35.67%	38.98%	39.54%	39.79%	81.12%	79.32%	69.08%	68.64%	68.56%
Percentile (%90)	49.88	41.24%	44.49%	45.09%	45.07%	87.47%	110.43%	75.72%	75.96%	75.90%

Table E.119. Percentage Change in Single TC Performances of Best Policies of Groups - Outdate Rates

TC	0 (Baseline)	4	2.4.	32	61	5.9.	6.7.	7.8.	8.4.	2
[TC1]	14.14	-9.30%	-98.10%	-99.91%	-99.93%	-99.91%	-99.96%	-99.95%	-99.94%	-99.91%
[TC2]	26.83	-3.52%	-88.60%	-98.19%	-98.23%	-97.86%	-98.91%	-99.01%	-98.86%	-98.72%
[TC3]	31.80	-3.96%	-83.45%	-96.42%	-96.32%	-96.03%	-97.84%	-97.74%	-97.67%	-97.79%
[TC4]	35.02	-2.76%	-78.08%	-94.82%	-94.51%	-94.32%	-97.47%	-97.20%	-97.22%	-96.83%
[TC5]	35.21	-2.47%	-77.61%	-94.15%	-93.70%	-92.94%	-96.98%	-96.87%	-96.81%	-96.54%
[TC6]	29.43	-3.67%	-85.65%	-97.07%	-96.67%	-96.16%	-98.33%	-98.19%	-98.12%	-98.05%
[TC7]	33.99	-2.33%	-79.36%	-95.36%	-95.34%	-95.13%	-97.82%	-97.70%	-97.68%	-97.64%
[TC8]	32.74	-2.27%	-79.68%	-95.14%	-94.85%	-94.34%	-97.37%	-97.18%	-97.22%	-97.16%
[TC9]	35.89	-0.91%	-75.76%	-92.75%	-92.70%	-92.12%	-96.18%	-96.14%	-96.10%	-95.94%
[TC10]	33.88	-3.02%	-78.83%	-95.09%	-94.76%	-94.02%	-97.35%	-97.31%	-97.33%	-97.19%
[TC11]	31.47	-3.63%	-82.85%	-96.40%	-96.05%	-95.58%	-97.83%	-97.91%	-97.63%	-97.56%
[TC12]	37.02	-1.78%	-74.69%	-92.36%	-92.17%	-91.45%	-96.21%	-96.04%	-95.96%	-95.91%
[TC13]	36.78	-1.33%	-75.22%	-93.08%	-92.31%	-92.30%	-96.22%	-96.13%	-96.25%	-96.01%
[TC14]	28.23	-5.16%	-87.33%	-97.93%	-97.88%	-97.56%	-98.46%	-98.52%	-98.65%	-98.42%
[TC15]	33.26	-3.88%	-80.44%	-94.76%	-94.73%	-94.13%	-97.43%	-97.41%	-97.61%	-97.44%
[TC16]	36.24	-2.08%	-76.48%	-94.34%	-93.42%	-92.70%	-96.79%	-97.16%	-97.13%	-96.55%
[TC17]	36.19	-2.79%	-76.12%	-92.90%	-92.76%	-92.31%	-96.50%	-96.46%	-96.54%	-96.45%
[TC18]	10.12	-10.32%	-99.00%	-99.99%	-99.99%	-99.99%	-99.95%	-99.97%	-99.96%	-99.96%
[TC19]	15.80	-8.99%	-97.46%	-99.88%	-99.87%	-99.76%	-99.88%	-99.84%	-99.84%	-99.82%
[TC20]	19.85	-8.43%	-95.10%	-99.53%	-99.52%	-99.46%	-99.62%	-99.65%	-99.57%	-99.53%
[TC21]	37.23	-1.61%	-74.37%	-92.42%	-92.05%	-91.98%	-96.21%	-96.11%	-96.27%	-95.86%
[TC22]	31.13	-1.95%	-82.26%	-96.52%	-96.21%	-95.63%	-98.07%	-97.98%	-98.07%	-97.86%
[TC23]	26.04	-4.53%	-89.45%	-98.28%	-98.11%	-97.77%	-98.71%	-98.87%	-98.75%	-98.59%
[TC24]	31.66	-2.98%	-82.98%	-96.43%	-96.31%	-95.94%	-97.74%	-97.75%	-97.56%	-97.64%
[TC25]	34.59	-0.77%	-76.68%	-94.07%	-93.65%	-93.06%	-96.70%	-97.12%	-96.89%	-96.71%
[TC26]	38.48	0.23%	-72.44%	-91.82%	-91.63%	-91.13%	-96.00%	-95.93%	-95.81%	-95.52%
[TC27]	27.87	-5.87%	-87.39%	-97.93%	-97.91%	-97.59%	-98.56%	-98.59%	-98.56%	-98.34%
[TC28]	28.50	-4.99%	-85.95%	-97.28%	-97.19%	-96.46%	-98.30%	-98.48%	-98.25%	-98.14%
[TC29]	20.23	-6.03%	-94.70%	-99.52%	-99.47%	-99.39%	-99.57%	-99.65%	-99.57%	-99.61%
[TC30]	37.22	-1.65%	-73.48%	-92.25%	-91.97%	-91.65%	-95.96%	-96.06%	-95.80%	-95.54%
[TC31]	24.83	-4.23%	-90.17%	-98.67%	-98.54%	-98.45%	-99.13%	-99.15%	-99.16%	-98.96%
[TC32]	19.79	-8.65%	-86.55%	-99.04%	-99.14%	-98.95%	-99.26%	-99.25%	-99.28%	-99.39%
[TC33]	32.73	-3.77%	-66.78%	-94.53%	-94.57%	-94.92%	-97.46%	-97.24%	-96.83%	-96.62%
[TC34]	18.79	-8.94%	-87.58%	-98.99%	-99.11%	-99.10%	-99.30%	-99.37%	-99.46%	-99.48%
[TC35]	34.88	-2.72%	-62.00%	-93.25%	-92.83%	-92.61%	-97.12%	-97.22%	-96.51%	-96.56%
[TC36]	38.89	-1.32%	-57.98%	-90.47%	-90.27%	-90.41%	-96.16%	-96.57%	-94.75%	-94.92%
[TC37]	29.89	-4.45%	-70.14%	-95.24%	-95.10%	-95.04%	-97.43%	-97.33%	-97.03%	-97.15%
[TC38]	17.98	-6.93%	-81.86%	-99.79%	-99.78%	-99.59%	-99.68%	-99.73%	-99.67%	-99.87%
[TC39]	28.26	-4.93%	-62.91%	-98.23%	-98.13%	-98.00%	-98.68%	-98.69%	-98.71%	-99.05%
[TC40]	22.68	-5.82%	-72.66%	-99.27%	-99.28%	-99.13%	-99.37%	-99.38%	-99.37%	-99.59%
[TC41]	22.76	-4.06%	-72.31%	-99.25%	-99.22%	-99.15%	-99.45%	-99.39%	-99.52%	-99.71%
[TC42]	41.97	-1.43%	-43.36%	-91.38%	-91.54%	-91.08%	-96.10%	-96.40%	-96.12%	-96.24%
[TC43]	40.59	-1.64%	-44.90%	-92.65%	-92.01%	-92.00%	-96.70%	-96.22%	-96.39%	-96.84%
[TC44]	36.65	-1.94%	-48.80%	-94.61%	-94.66%	-94.01%	-97.38%	-97.42%	-97.68%	-97.66%
[TC45]	39.44	-1.63%	-45.89%	-92.77%	-92.40%	-92.41%	-96.44%	-96.23%	-96.75%	-96.33%
[TC46]	41.18	-3.83%	-46.17%	-91.99%	-91.85%	-91.59%	-96.27%	-96.17%	-96.59%	-96.41%
[TC47]	35.30	-2.98%	-52.31%	-94.91%	-94.70%	-94.70%	-97.51%	-97.60%	-97.81%	-98.05%
[TC48]	20.03	-7.63%	-78.53%	-99.57%	-99.58%	-99.48%	-99.51%	-99.51%	-99.47%	-99.73%
[TC49]	41.64	-1.17%	-43.89%	-91.75%	-91.82%	-91.22%	-96.19%	-96.28%	-96.01%	-96.19%
Mean	30.51	-3.30%	-72.79%	-95.10%	-94.90%	-94.59%	-97.49%	-97.49%	-97.41%	-97.34%
Median	32.73	-3.77%	-78.57%	-95.19%	-95.16%	-94.94%	-97.65%	-97.56%	-97.59%	-97.55%
Max	41.97	-1.43%	-43.36%	-91.17%	-90.99%	-91.08%	-96.10%	-96.25%	-95.14%	-95.29%
Min	10.12	-10.32%	-99.00%	-99.99%	-99.99%	-99.99%	-99.95%	-99.97%	-99.96%	-99.96%
Percentile (%10)	19.59	-8.71%	-89.37%	-99.53%	-99.52%	-99.46%	-99.57%	-99.64%	-99.56%	-99.68%
Percentile (%25)	26.04	-4.53%	-86.26%	-98.28%	-98.17%	-97.83%	-98.88%	-98.98%	-98.82%	-98.97%
Percentile (%50)	32.73	-3.77%	-78.57%	-95.19%	-95.16%	-94.94%	-97.65%	-97.56%	-97.59%	-97.55%
Percentile (%75)	36.24	-1.87%	-72.76%	-92.98%	-92.77%	-92.32%	-96.50%	-96.46%	-96.55%	-96.47%
Percentile (%90)	39.00	-0.99%	-50.56%	-92.26%	-91.73%	-91.58%	-96.17%	-96.18%	-96.13%	-96.03%

Table E.120. Percentage Change in Single TC Performances of Best Policies of Groups - Mismatch Rates

TC	0 (Baseline)	4	2.4.	32	61	5.9.	6.7.	7.8.	8.4.	2
[TC1]	1.32	-84.26%	-76.91%	-80.41%	-83.11%	-83.95%	-89.28%	-88.88%	-90.37%	-94.83%
[TC2]	3.86	-82.26%	-79.74%	-84.36%	-85.95%	-84.99%	-87.99%	-89.10%	-89.95%	-92.68%
[TC3]	5.23	-75.36%	-77.58%	-82.53%	-83.86%	-86.67%	-89.91%	-91.18%	-91.14%	-92.49%
[TC4]	5.28	-68.19%	-76.37%	-80.19%	-82.48%	-84.15%	-86.56%	-89.03%	-88.38%	-90.33%
[TC5]	5.41	-73.01%	-75.76%	-81.06%	-82.20%	-85.71%	-86.72%	-88.40%	-89.18%	-89.22%
[TC6]	5.32	-78.10%	-79.31%	-86.05%	-85.85%	-90.37%	-89.97%	-89.67%	-90.63%	-92.13%
[TC7]	4.92	-72.19%	-77.86%	-82.04%	-82.54%	-83.49%	-86.14%	-89.02%	-89.29%	-90.46%
[TC8]	5.67	-68.78%	-75.76%	-80.42%	-80.93%	-86.59%	-88.89%	-88.75%	-89.89%	-90.37%
[TC9]	5.94	-70.04%	-74.68%	-83.09%	-81.59%	-85.31%	-87.58%	-89.26%	-89.17%	-90.23%
[TC10]	5.61	-70.28%	-75.34%	-81.70%	-83.04%	-85.67%	-87.91%	-87.78%	-89.56%	-90.97%
[TC11]	5.26	-74.74%	-76.75%	-83.73%	-83.49%	-87.17%	-90.34%	-90.00%	-91.76%	-91.97%
[TC12]	5.69	-69.53%	-74.90%	-81.56%	-82.23%	-82.45%	-87.24%	-88.01%	-88.75%	-89.79%
[TC13]	5.66	-68.65%	-75.56%	-81.50%	-83.30%	-81.81%	-87.03%	-88.74%	-88.64%	-90.31%
[TC14]	3.91	-77.45%	-74.27%	-83.99%	-82.50%	-86.80%	-88.21%	-90.35%	-89.97%	-92.37%
[TC15]	5.58	-72.58%	-77.97%	-82.62%	-83.27%	-84.17%	-88.03%	-87.51%	-86.56%	-89.64%
[TC16]	5.75	-70.14%	-78.08%	-81.99%	-81.93%	-86.49%	-86.55%	-87.89%	-88.51%	-89.50%
[TC17]	6.47	-70.55%	-77.71%	-82.81%	-82.65%	-85.61%	-88.53%	-89.87%	-90.34%	-90.31%
[TC18]	0.76	-86.46%	-75.29%	-78.62%	-80.73%	-81.52%	-96.74%	-96.76%	-96.63%	-98.74%
[TC19]	1.76	-83.28%	-74.47%	-77.22%	-80.40%	-84.90%	-90.50%	-90.65%	-92.61%	-94.60%
[TC20]	2.71	-82.82%	-77.77%	-82.04%	-83.75%	-85.79%	-89.40%	-89.69%	-92.35%	-94.48%
[TC21]	5.40	-65.89%	-74.84%	-81.69%	-81.63%	-83.06%	-87.00%	-87.79%	-87.48%	-90.30%
[TC22]	5.10	-71.52%	-77.94%	-82.86%	-81.13%	-84.18%	-88.27%	-89.93%	-89.54%	-90.66%
[TC23]	4.06	-81.45%	-78.81%	-84.18%	-85.81%	-86.62%	-89.61%	-89.98%	-92.11%	-92.14%
[TC24]	5.18	-74.70%	-75.97%	-82.08%	-81.59%	-85.93%	-88.98%	-90.18%	-91.78%	-90.70%
[TC25]	5.76	-73.06%	-77.09%	-82.00%	-83.16%	-85.77%	-87.34%	-88.04%	-89.27%	-89.64%
[TC26]	5.74	-72.28%	-76.54%	-82.74%	-83.11%	-83.72%	-87.23%	-89.23%	-87.88%	-89.58%
[TC27]	4.21	-78.63%	-75.96%	-82.64%	-83.47%	-87.37%	-87.90%	-88.65%	-90.08%	-91.31%
[TC28]	4.99	-78.52%	-77.50%	-84.17%	-84.59%	-89.01%	-89.56%	-89.79%	-90.79%	-92.15%
[TC29]	2.66	-81.29%	-79.00%	-81.62%	-82.70%	-84.45%	-87.82%	-90.15%	-91.06%	-93.83%
[TC30]	5.65	-68.07%	-74.81%	-81.04%	-80.36%	-83.37%	-87.89%	-88.25%	-89.17%	-89.44%
[TC31]	3.73	-79.50%	-78.45%	-83.10%	-85.43%	-85.67%	-87.95%	-89.48%	-89.88%	-90.77%
[TC32]	3.06	-79.71%	-75.37%	-56.59%	-64.59%	-70.25%	-80.34%	-80.31%	-84.17%	-80.18%
[TC33]	5.00	-72.98%	-78.87%	-51.73%	-62.26%	-59.27%	-65.53%	-64.05%	-77.45%	-72.34%
[TC34]	2.66	-78.76%	-76.45%	-49.77%	-63.30%	-64.03%	-76.87%	-78.78%	-80.92%	-77.82%
[TC35]	5.59	-69.94%	-77.98%	-50.83%	-61.58%	-62.85%	-60.31%	-57.29%	-72.26%	-70.60%
[TC36]	5.52	-68.44%	-77.56%	-48.73%	-63.65%	-55.05%	-56.97%	-57.89%	-72.89%	-65.86%
[TC37]	5.31	-71.58%	-78.01%	-53.74%	-64.30%	-65.61%	-67.56%	-64.87%	-78.58%	-73.83%
[TC38]	1.60	-84.05%	-89.04%	-85.17%	-86.99%	-89.57%	-93.48%	-94.44%	-96.10%	-89.90%
[TC39]	3.95	-82.47%	-92.03%	-85.97%	-88.04%	-88.94%	-92.38%	-92.56%	-93.00%	-91.13%
[TC40]	2.79	-80.53%	-91.57%	-84.92%	-86.76%	-90.01%	-92.38%	-92.78%	-94.22%	-90.23%
[TC41]	2.58	-83.41%	-91.31%	-87.31%	-87.63%	-88.54%	-87.95%	-89.67%	-90.48%	-85.87%
[TC42]	5.31	-68.80%	-85.18%	-82.84%	-82.42%	-86.25%	-85.54%	-86.47%	-88.20%	-87.66%
[TC43]	5.77	-70.83%	-85.38%	-83.26%	-85.00%	-88.13%	-88.39%	-89.60%	-87.93%	-87.29%
[TC44]	5.65	-73.00%	-87.29%	-84.23%	-84.04%	-88.61%	-89.44%	-89.24%	-89.39%	-88.34%
[TC45]	5.92	-70.55%	-88.41%	-85.21%	-84.86%	-88.10%	-90.35%	-90.10%	-90.48%	-88.25%
[TC46]	5.39	-67.12%	-85.65%	-82.09%	-80.44%	-85.10%	-86.83%	-89.04%	-87.34%	-86.00%
[TC47]	5.25	-74.99%	-90.10%	-85.66%	-86.45%	-87.72%	-87.70%	-87.67%	-88.47%	-85.14%
[TC48]	2.15	-82.76%	-91.14%	-85.82%	-86.86%	-90.68%	-95.10%	-95.18%	-95.98%	-92.06%
[TC49]	5.34	-67.98%	-87.58%	-80.37%	-83.45%	-86.38%	-87.94%	-90.26%	-90.10%	-86.74%
Mean	4.56	-73.37%	-79.47%	-79.01%	-80.90%	-83.09%	-85.65%	-86.35%	-88.22%	-87.95%
Median	5.26	-74.02%	-79.95%	-82.64%	-82.86%	-86.15%	-88.30%	-89.00%	-89.87%	-90.05%
Max	6.47	-70.55%	-76.77%	-56.30%	-66.82%	-61.69%	-63.33%	-63.11%	-76.05%	-70.91%
Min	0.76	-86.46%	-76.78%	-78.62%	-80.73%	-81.52%	-96.74%	-96.76%	-96.63%	-98.74%
Percentile (%10)	2.49	-83.30%	-88.36%	-84.55%	-86.40%	-88.92%	-91.83%	-92.21%	-93.78%	-93.45%
Percentile (%25)	3.86	-82.06%	-82.81%	-83.68%	-85.07%	-86.23%	-88.06%	-89.45%	-89.95%	-90.93%
Percentile (%50)	5.26	-74.02%	-79.95%	-82.64%	-82.86%	-86.15%	-88.30%	-89.00%	-89.87%	-90.05%
Percentile (%75)	5.61	-70.02%	-77.77%	-81.36%	-82.31%	-84.26%	-87.19%	-88.31%	-88.60%	-89.21%
Percentile (%90)	5.75	-69.16%	-75.95%	-76.89%	-80.65%	-82.53%	-86.62%	-87.80%	-87.71%	-86.78%

Table E.121. Percentage Change in Single TC Performances of Best Policies of Groups - Shortage Rates

TC	0 (Baseline)	4	2.4.	32	61	5.9.	6.7.	7.8.	8.4.	2
[TC1]	0.02	-100.00%	-85.09%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%
[TC2]	0.66	-97.18%	-95.24%	-99.12%	-99.21%	-99.45%	-99.60%	-100.00%	-100.00%	-100.00%
[TC3]	1.43	-92.18%	-96.00%	-97.33%	-97.84%	-99.59%	-99.53%	-99.89%	-100.00%	-100.00%
[TC4]	1.18	-88.95%	-94.80%	-97.84%	-98.41%	-98.30%	-98.70%	-98.41%	-99.63%	-99.63%
[TC5]	1.34	-92.80%	-94.28%	-98.24%	-98.14%	-98.20%	-96.71%	-99.64%	-99.11%	-99.37%
[TC6]	1.15	-93.22%	-94.24%	-98.86%	-98.86%	-99.68%	-99.44%	-99.81%	-99.94%	-99.94%
[TC7]	1.29	-91.47%	-91.94%	-98.61%	-99.02%	-98.51%	-99.32%	-99.47%	-99.78%	-100.00%
[TC8]	1.37	-91.68%	-93.72%	-98.27%	-98.72%	-97.85%	-99.26%	-98.56%	-99.70%	-99.85%
[TC9]	1.56	-84.57%	-88.62%	-97.01%	-96.40%	-99.40%	-95.70%	-98.24%	-98.81%	-98.65%
[TC10]	1.33	-92.72%	-90.69%	-99.20%	-98.10%	-96.50%	-98.87%	-98.90%	-99.84%	-99.44%
[TC11]	1.47	-90.59%	-95.29%	-97.96%	-98.85%	-99.20%	-98.87%	-99.72%	-99.94%	-99.94%
[TC12]	1.53	-86.44%	-90.40%	-97.23%	-98.07%	-97.69%	-97.14%	-97.80%	-98.70%	-98.35%
[TC13]	1.47	-84.60%	-91.38%	-97.63%	-96.97%	-97.55%	-95.68%	-97.47%	-97.43%	-97.92%
[TC14]	1.07	-92.22%	-96.27%	-99.17%	-98.52%	-99.78%	-99.94%	-98.39%	-100.00%	-100.00%
[TC15]	1.54	-92.02%	-91.91%	-98.99%	-98.12%	-98.48%	-98.08%	-98.94%	-99.47%	-99.47%
[TC16]	1.33	-91.29%	-92.82%	-97.28%	-98.78%	-99.27%	-96.85%	-97.79%	-99.08%	-98.26%
[TC17]	1.57	-86.38%	-89.66%	-97.63%	-96.78%	-98.31%	-97.96%	-98.22%	-99.00%	-98.73%
[TC18]	0.00	-100.00%	99.88%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%
[TC19]	0.05	-100.00%	-96.95%	-100.00%	-98.19%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%
[TC20]	0.25	-99.16%	-95.11%	-99.89%	-100.00%	-99.57%	-100.00%	-99.90%	-100.00%	-100.00%
[TC21]	1.37	-86.20%	-91.01%	-96.45%	-98.37%	-99.09%	-97.26%	-97.77%	-98.57%	-99.80%
[TC22]	1.68	-90.43%	-95.70%	-98.13%	-97.96%	-99.09%	-98.83%	-98.49%	-99.75%	-99.65%
[TC23]	0.82	-97.11%	-96.90%	-99.35%	-99.80%	-99.24%	-100.00%	-99.56%	-100.00%	-100.00%
[TC24]	1.44	-90.35%	-93.69%	-97.44%	-97.69%	-98.93%	-99.07%	-99.83%	-99.94%	-99.88%
[TC25]	1.28	-93.23%	-91.81%	-98.80%	-97.66%	-98.33%	-95.41%	-96.15%	-97.97%	-97.40%
[TC26]	1.43	-86.81%	-88.94%	-96.56%	-96.32%	-96.67%	-97.19%	-97.32%	-98.13%	-98.84%
[TC27]	1.10	-94.50%	-93.42%	-98.21%	-98.27%	-99.79%	-99.30%	-100.00%	-100.00%	-99.89%
[TC28]	1.27	-93.68%	-96.72%	-98.21%	-98.47%	-99.84%	-99.89%	-99.67%	-100.00%	-99.78%
[TC29]	0.24	-97.68%	-98.83%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%
[TC30]	1.62	-88.55%	-92.69%	-96.83%	-95.95%	-98.31%	-97.42%	-98.85%	-99.10%	-99.21%
[TC31]	0.61	-98.01%	-96.83%	-99.46%	-99.46%	-99.39%	-100.00%	-98.98%	-99.92%	-100.00%
[TC32]	0.24	-97.45%	-99.76%	-65.35%	-88.37%	-94.17%	-98.43%	-97.83%	-100.00%	-99.76%
[TC33]	1.29	-91.98%	-97.38%	-76.94%	-90.03%	-94.21%	-92.93%	-93.18%	-99.77%	-99.85%
[TC34]	0.29	-99.24%	-100.00%	-77.99%	-90.91%	-95.22%	-95.45%	-99.06%	-100.00%	-100.00%
[TC35]	1.29	-91.23%	-97.81%	-69.83%	-86.50%	-87.79%	-90.13%	-88.39%	-98.68%	-98.11%
[TC36]	1.23	-86.48%	-93.73%	-59.08%	-87.09%	-80.92%	-85.17%	-71.53%	-95.51%	-96.04%
[TC37]	1.61	-92.57%	-97.18%	-79.10%	-92.72%	-96.20%	-96.07%	-95.67%	-99.38%	-99.00%
[TC38]	0.05	-99.67%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%
[TC39]	0.66	-98.01%	-99.46%	-99.85%	-99.32%	-100.00%	-99.92%	-100.00%	-100.00%	-100.00%
[TC40]	0.27	-97.85%	-99.89%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%
[TC41]	0.29	-99.30%	-100.00%	-99.90%	-100.00%	-100.00%	-99.90%	-100.00%	-100.00%	-100.00%
[TC42]	1.54	-89.24%	-97.45%	-96.83%	-97.75%	-98.25%	-96.81%	-99.14%	-97.84%	-99.10%
[TC43]	1.69	-90.96%	-97.05%	-96.71%	-97.87%	-99.26%	-97.15%	-98.75%	-98.95%	-99.43%
[TC44]	1.47	-92.65%	-98.24%	-97.86%	-98.63%	-97.95%	-99.11%	-98.97%	-99.35%	-99.49%
[TC45]	1.66	-86.92%	-96.95%	-96.93%	-96.71%	-99.29%	-97.34%	-98.89%	-99.43%	-99.42%
[TC46]	1.61	-86.48%	-98.04%	-96.21%	-96.50%	-98.19%	-97.04%	-99.02%	-99.27%	-99.08%
[TC47]	1.70	-92.43%	-98.56%	-98.54%	-98.03%	-98.66%	-99.01%	-99.60%	-99.94%	-99.48%
[TC48]	0.12	-99.46%	-100.00%	-100.00%	-99.82%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%
[TC49]	1.52	-90.55%	-97.47%	-97.53%	-97.18%	-98.53%	-96.21%	-99.20%	-99.40%	-99.10%
Mean	1.08	-90.75%	-94.63%	-94.94%	-96.97%	-97.78%	-97.39%	-97.72%	-99.23%	-99.25%
Median	1.29	-91.52%	-96.50%	-98.03%	-98.07%	-98.94%	-98.84%	-99.06%	-99.78%	-99.79%
Max	1.70	-85.86%	-89.57%	-70.43%	-89.75%	-86.22%	-89.28%	-79.43%	-96.75%	-97.14%
Min	0.00	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%
Percentile (%10)	0.22	-99.20%	-99.76%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%	-100.00%
Percentile (%25)	0.66	-98.01%	-97.06%	-99.11%	-99.20%	-99.63%	-99.91%	-99.75%	-100.00%	-100.00%
Percentile (%50)	1.29	-91.52%	-96.50%	-98.03%	-98.07%	-98.94%	-98.84%	-99.06%	-99.78%	-99.79%
Percentile (%75)	1.52	-89.97%	-94.04%	-96.80%	-97.64%	-98.23%	-97.10%	-98.33%	-99.19%	-99.10%
Percentile (%90)	1.61	-87.04%	-92.25%	-95.81%	-96.39%	-97.10%	-96.08%	-97.49%	-98.68%	-98.55%

Table E.122. Percentage Change in Single TC Performances of Best Policies of Groups - Selection Criterion Values Rates

TC	0 (Baseline)	4	2.4.	32	61	5.9.	6.7.	7.8.	8.4.	2
[TC1]	15.47	-15.79%	-96.28%	-98.25%	-98.50%	-98.55%	-99.05%	-99.00%	-99.13%	-99.48%
[TC2]	31.36	-15.19%	-87.65%	-96.51%	-96.74%	-96.31%	-97.58%	-97.81%	-97.79%	-98.00%
[TC3]	38.46	-16.94%	-83.12%	-94.56%	-94.68%	-94.89%	-96.82%	-96.93%	-96.87%	-97.15%
[TC4]	41.48	-13.53%	-78.34%	-93.04%	-93.09%	-93.14%	-96.12%	-96.19%	-96.16%	-96.09%
[TC5]	41.96	-14.45%	-77.90%	-92.59%	-92.36%	-92.18%	-95.65%	-95.86%	-95.90%	-95.69%
[TC6]	35.90	-17.56%	-84.99%	-95.50%	-95.14%	-95.41%	-97.12%	-96.98%	-97.07%	-97.24%
[TC7]	40.19	-13.73%	-79.58%	-93.84%	-93.89%	-93.81%	-96.44%	-96.69%	-96.72%	-96.84%
[TC8]	39.79	-14.83%	-79.60%	-93.15%	-93.00%	-93.35%	-96.23%	-96.03%	-96.26%	-96.29%
[TC9]	43.39	-13.38%	-76.07%	-91.58%	-91.31%	-91.45%	-94.98%	-95.27%	-95.25%	-95.25%
[TC10]	40.82	-15.18%	-78.74%	-93.39%	-93.25%	-92.95%	-96.10%	-96.05%	-96.34%	-96.41%
[TC11]	38.21	-16.78%	-82.49%	-94.72%	-94.43%	-94.56%	-96.84%	-96.89%	-96.91%	-96.89%
[TC12]	44.23	-13.41%	-75.26%	-91.14%	-91.10%	-90.51%	-95.09%	-95.07%	-95.12%	-95.20%
[TC13]	43.91	-12.80%	-75.81%	-91.74%	-91.31%	-91.12%	-95.02%	-95.22%	-95.31%	-95.34%
[TC14]	33.21	-16.48%	-86.08%	-96.33%	-96.09%	-96.37%	-97.30%	-97.56%	-97.67%	-97.76%
[TC15]	40.38	-16.72%	-80.53%	-93.25%	-93.28%	-92.92%	-96.16%	-96.10%	-96.16%	-96.44%
[TC16]	43.32	-13.84%	-77.19%	-92.79%	-92.06%	-92.08%	-95.43%	-95.95%	-96.05%	-95.67%
[TC17]	44.23	-15.68%	-76.84%	-91.59%	-91.42%	-91.54%	-95.38%	-95.56%	-95.72%	-95.63%
[TC18]	10.88	-15.62%	-97.34%	-98.50%	-98.65%	-98.70%	-99.73%	-99.75%	-99.73%	-99.87%
[TC19]	17.61	-16.68%	-95.17%	-97.62%	-97.92%	-98.28%	-98.94%	-98.93%	-99.12%	-99.30%
[TC20]	22.81	-18.26%	-93.04%	-97.46%	-97.65%	-97.84%	-98.41%	-98.47%	-98.72%	-98.94%
[TC21]	44.00	-12.13%	-74.94%	-91.23%	-90.97%	-91.10%	-95.12%	-95.14%	-95.26%	-95.30%
[TC22]	37.91	-15.23%	-82.28%	-94.75%	-94.26%	-94.24%	-96.78%	-96.92%	-96.99%	-96.97%
[TC23]	30.91	-17.07%	-88.25%	-96.46%	-96.54%	-96.34%	-97.55%	-97.72%	-97.91%	-97.78%
[TC24]	38.27	-15.97%	-82.43%	-94.52%	-94.37%	-94.69%	-96.60%	-96.80%	-96.87%	-96.78%
[TC25]	41.63	-13.61%	-77.20%	-92.55%	-92.32%	-92.21%	-95.37%	-95.83%	-95.87%	-95.75%
[TC26]	45.65	-11.61%	-73.47%	-90.83%	-90.71%	-90.37%	-94.93%	-95.13%	-94.88%	-94.88%
[TC27]	33.18	-18.04%	-86.14%	-96.00%	-96.09%	-96.37%	-97.24%	-97.38%	-97.53%	-97.50%
[TC28]	34.76	-18.79%	-85.14%	-95.44%	-95.43%	-95.51%	-97.11%	-97.28%	-97.24%	-97.34%
[TC29]	23.12	-15.63%	-92.94%	-97.47%	-97.55%	-97.68%	-98.22%	-98.57%	-98.60%	-98.95%
[TC30]	44.49	-13.24%	-74.35%	-90.99%	-90.64%	-90.84%	-94.99%	-95.17%	-95.08%	-94.90%
[TC31]	29.16	-15.81%	-88.81%	-96.70%	-96.88%	-96.83%	-97.72%	-97.91%	-97.99%	-97.94%
[TC32]	23.08	-18.99%	-85.21%	-93.06%	-94.45%	-95.10%	-96.75%	-96.73%	-97.28%	-96.85%
[TC33]	39.01	-15.54%	-69.34%	-88.47%	-90.29%	-90.33%	-93.22%	-92.85%	-94.45%	-93.62%
[TC34]	21.74	-18.69%	-86.38%	-92.68%	-94.62%	-94.75%	-96.50%	-96.85%	-97.20%	-96.84%
[TC35]	41.76	-14.46%	-65.25%	-86.84%	-88.45%	-88.48%	-91.98%	-91.60%	-93.33%	-93.13%
[TC36]	45.64	-11.73%	-61.31%	-84.58%	-86.97%	-85.88%	-91.13%	-91.22%	-92.13%	-91.44%
[TC37]	36.80	-17.97%	-72.45%	-88.55%	-90.55%	-90.85%	-93.06%	-92.58%	-94.47%	-93.87%
[TC38]	19.64	-13.46%	-82.50%	-98.60%	-98.73%	-98.77%	-99.18%	-99.30%	-99.38%	-99.05%
[TC39]	32.86	-16.11%	-67.14%	-96.79%	-96.94%	-96.95%	-97.95%	-97.98%	-98.05%	-98.12%
[TC40]	25.74	-14.90%	-75.00%	-97.72%	-97.93%	-98.15%	-98.62%	-98.67%	-98.82%	-98.58%
[TC41]	25.63	-13.12%	-74.54%	-98.06%	-98.06%	-98.09%	-98.29%	-98.41%	-98.62%	-98.32%
[TC42]	48.82	-11.53%	-49.61%	-90.62%	-90.74%	-90.78%	-94.97%	-95.41%	-95.31%	-95.40%
[TC43]	48.04	-13.08%	-51.59%	-91.66%	-91.37%	-91.79%	-95.71%	-95.51%	-95.46%	-95.79%
[TC44]	43.77	-14.16%	-55.42%	-93.37%	-93.43%	-93.44%	-96.42%	-96.42%	-96.67%	-96.52%
[TC45]	47.02	-13.32%	-53.05%	-91.96%	-91.60%	-92.11%	-95.70%	-95.55%	-96.05%	-95.43%
[TC46]	48.18	-13.67%	-52.32%	-91.02%	-90.73%	-91.09%	-95.24%	-95.47%	-95.64%	-95.33%
[TC47]	42.26	-15.53%	-58.87%	-93.91%	-93.81%	-94.00%	-96.35%	-96.45%	-96.73%	-96.50%
[TC48]	22.29	-15.36%	-79.86%	-98.25%	-98.36%	-98.64%	-99.09%	-99.10%	-99.14%	-98.99%
[TC49]	48.50	-11.33%	-50.38%	-90.68%	-91.06%	-90.91%	-95.28%	-95.70%	-95.46%	-95.24%
Mean	36.15	-14.75%	-74.29%	-93.06%	-93.20%	-93.24%	-95.99%	-96.09%	-96.30%	-96.21%
Median	39.29	-16.07%	-79.35%	-93.60%	-93.61%	-93.89%	-96.44%	-96.47%	-96.63%	-96.62%
Max	50.14	-13.22%	-49.24%	-85.97%	-87.82%	-87.12%	-91.64%	-91.40%	-92.73%	-92.21%
Min	10.88	-15.62%	-97.46%	-98.50%	-98.65%	-98.70%	-99.73%	-99.75%	-99.73%	-99.87%
Percentile (%10)	22.30	-17.93%	-89.36%	-97.86%	-98.06%	-98.28%	-98.71%	-98.82%	-98.91%	-98.98%
Percentile (%25)	30.55	-16.33%	-86.06%	-96.45%	-96.54%	-96.40%	-97.53%	-97.79%	-97.73%	-97.98%
Percentile (%50)	39.29	-16.07%	-79.35%	-93.60%	-93.61%	-93.89%	-96.44%	-96.47%	-96.63%	-96.62%
Percentile (%75)	43.37	-13.77%	-74.16%	-91.61%	-91.59%	-91.49%	-95.32%	-95.47%	-95.61%	-95.62%
Percentile (%90)	46.36	-12.43%	-55.16%	-90.48%	-90.52%	-90.65%	-94.98%	-95.18%	-95.17%	-94.97%