PRICE DETERMINATION FOR BUNDLED PRODUCTS: APPLICATION FOR A HOUSEHOLD PRODUCT GROUP

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Approval of the Graduate School of Social Sciences

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ABSTRACT

PRICE DETERMINATION FOR BUNDLED PRODUCTS: APPLICATION FOR A HOUSEHOLD PRODUCT GROUP

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The aim of this thesis is to search for the best way to allocate revenues gathered from a group of products in a household supplies company. In so doing, it purports to determine the price which brings customer perception and organizational benefit to equilibrium. To compare alternatives of revenue allocation methods, data obtained for a main product and its variants from a household company will be analyzed in an organized manner. Three ways of product bundling (pure bundling, mixed bundling, unbundling) is discussed as a framework for underlying different detailed aspects. In the end, pricing and promotional policies of the company is critically evaluated and simultaneous strategy changes are suggested.

Keywords: Bundling, Optimization, Pricing

ÖZ

DEMETLİ ÜRÜNLER İÇİN PAKET FİYAT BELİRLENMESİ: EV EŞYALARI ÜRÜN GRUBU İÇİN UYGULAMA

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Bu tez, ev eşyaları grubu demetli ürünlerinden elde edilen gelirin dağıtılmasındaki en iyi yöntemi bulmak amacıyla yazılmıştır. Bu şekilde, müşteri algısı ve şirket menfaatlerini dengeye getirecek fiyatın belirlenmesi de amaçlanmaktadır. Gelir dağılım alternatiflerini karşılaştırmak için söz konusu şirketten alınan çeşitli veri örnekleri düzenli bir şekilde analiz edilecektir. Üç farklı ürün paketleme yöntemi; saf paketleme, karma paketleme ve paketlememe diğer konulara çerçeve olacak şekilde ele alınacaktır. Şirketin fiyatlandırma ve promosyonal politikaları değerlendirilirken, stratejilerde eş zamanlı değişiklikler önerisi getirilmektedir.

Anahtar Kelimeler: Demetli Ürünler, Optimizasyon, Fiyat Belirleme

To My Grandfather

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It took me one and a half years to complete my journey of master's thesis. It was full of distractions, dead ends and reworks. My advisor Can Şımga Muğan was the one who enlightened my road with her load of knowledge and supported me with her happy heart and trust in me.

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I also want to express my gratitude to my parents. Their support is endless; within my changing environment, I could not be able to see the very end of this thesis without their patient help.

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Writing thesis is a journey about aligning dominos, destructing and reconstructing but never giving up. I want to thank all of the people that I couldn't name but who keeps my dominos up.

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1. INTRODUCTION

Looking through the producer's side of view, price is the amount of money that customers have to pay in order to consume or get the service or product in question. But how much money those customers are willing to pay is a question that needs to be answered. However, it is not quite possible to detect an accurate reservation price[1] in a quick changing, highly dependent environment. Studies in this field primarily focused on processes that extract reservation prices without manipulating what is exactly on customer's mind. However, this study focuses on raw demand data taken from a multinational company to determine the optimum bundle and price for a given product and its variants. Real demand data will be analyzed in terms of trends, fluctuations, seasonality and other buying habits of consumers. In other words, customers' willingness to pay will be exposed to find an optimum strategy for the company.

In literature, pricing is a very general concept and has many sub categories attached to it. Another important sub-strategy that given data includes is bundling. Products are not only sold separately but also together in different bundles. This type of strategy is called *mixed bundling*. Selling goods that are only available in a bundle form and cannot be bought separately is called *pure bundling*. Demands can fluctuate in terms of different bundle combinations. Bundles can consist of either same type or different types of products. Product types are more important when they are complementary to each other. Bundles are generally sold with a discounted price to attract more customers because it would not make any sense to buy a package of products if there is no added value or a financial opportunity. An immediate follow up challenge is to determine the optimum discount that attracts customers and maximizes profit at the same time.

[1] Maximum price a customer is willing to pay

To conclude, the aim of this study is to find an optimum and applicable price through analyzing a demand data set taken from a multinational house goods company in terms of pricing and price adjustment strategies. In the process, demand maximization goal of preferably increasing market share or at least keeping the same level is defined and included in the algorithm.

1.1. Outline of the Thesis

The marketing framework of the study will be represented in Chapter 2. Background information about all types of pricing and price adjustment strategies will be explained and important ones that are applicable into the data in question will be underlined. In first half of the Chapter 3 data is be analyzed in detail and . the relevant statistical tests are presented and interpreted. In the last part of Chapter 3, the model is developed and the algorithm of the model is explained step by step. Chapter 3 also reports the result of the algorithm with the appropriate data set and the related interpretation. In the conclusion part, thesis results and suggestions are provided.

2. LITERATURE REVIEW

2.1. Pricing

Pricing is an ongoing, complex problem for both service and manufacturing industries. Although all companies face difficult and everlasting decision periods, some companies make continuous mistakes, get beaten by rivals and lose market share but some of them do not. What makes successful companies' decisions different than others? What it takes to stop being a *price taker* and turn into a *price maker*? While businesses try to find out answers by trial and error, academicians keep developing theories, rules, or paths.

Price of a product in general; is the economic value that is charged to customers in return to the benefits they will get for owning or consuming that product or service. (Kotler, 2004) Price is not the only term used for this type of valuating. For example; price for education is called "tuition", price for living in somebody's house is called "rent". (Zikmund, 1996) Other than that price is not just a number indicating a value; it also shows the quality class and defines the way of customer perception.

In marketing literature pricing is discussed under the *marketing mix concept* framework which is first introduced in 1964 by Neil H. Borden in his article "The Concept of the Marketing Mix". The goal of marketing mix is defined as fulfilling individual and organizational objectives by executing a strategic plan of pricing, promotion, distributing and placement. Thus, it will not be appropriate to separate pricing from marketing mix concept. All 4P elements; price, product, place and promotion support each other in a well-structured marketing strategy. Product determines value from which the price is derived from. Promotion affects the price sensitivity which is directly related to price, and finally distribution channel choice determines the image of the company which complements a product's price. (Indounas, 2006) Price is the most neglected, yet so important issue of the 4P because in fact it involves complex decision variables and uncertainty and that

directly contributes to revenue and profits. Its effect on profitability is incredibly high; even small increases end up with higher margins of improvement on operating profits.

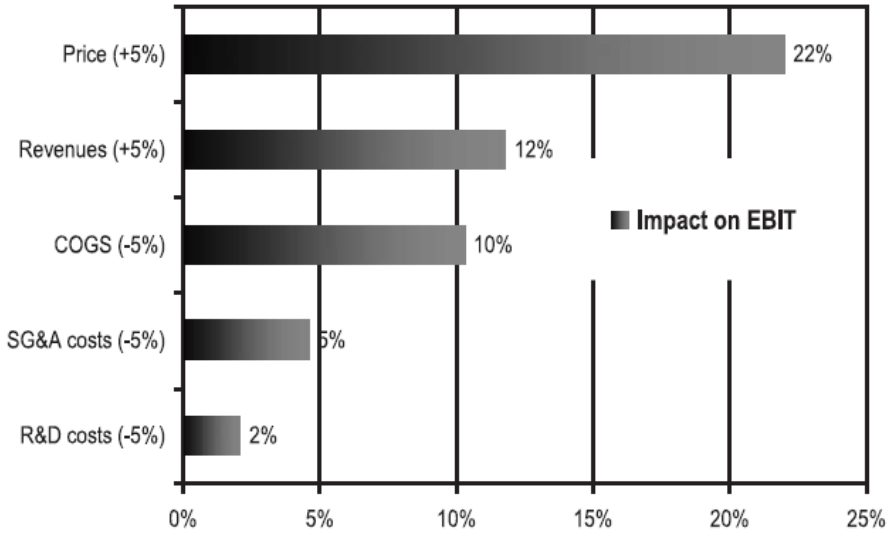

Figure 2.1: The effect of pricing on profitability (Hinterhuber, 2004, pg. 767)

As shown in Figure 2.1 (research among Fortune 500 companies), a 5% increase in average price induces EBIT (earnings before interest and taxes) to increase by 22%. The closest follower, *revenue* (increase by 5%) has only 12% effect on EBIT. However, a common belief is that increasing in prices may lead to low market share and will trigger low profits. It is recommended for companies to lower prices when introducing a new product to the market for a rapid growth but after that stage price can be increased to gather higher short term profit. (Hinterhuber, 2004)

Even if marketers and managers think that customers are very price conscience, tests about prices state that many of the customers do not even remember the prices after shopping and another considerable fact is that many of them buy products without even noticing to the price. (Hinterhuber, 2004) It is also known that consumers' price sensitiveness change according to how much that product adds value to their life, the quality risk they're undertaking and whether the product is critical or not. In some cases customers may prefer higher priced products, especially when health, knowledge based services (e.g. teaching, IT problem solving) or personal taste issues

such as style is involved in factors of choosing that product. Customers are in hope of getting the most value with the high price they pay. (Mandell, 1985)

Pricing as a complex issue of marketing mix; needs to be treated differently for service or manufacturing industries. Service is not a tangible good that can be touched, stored or consumed later. It is also instantly perishable which does not add inventory costs to total costs but makes it harder to promote; no package and no eye-catching design is applicable. Service marketers should find and use other types of human senses in order to attract customers and be less forgettable. For example, creating tangible indicators to prove that service has been taken like education certificates, fancy checks, and memorial photos. Those kinds of tangible proofs make service goods catchier. Also, providing tangible additions to their services give organizations chance to price their service higher than the companies which do not. Even if there is always room to improve prices, costs of service organizations are higher due to government regulations, the need of highly trained personnel and the necessity of being located close to the customer. (Montgomery, 1988)

Pricing is the easiest one to change among the marketing mix elements. But its advantages are commonly lasts shorter than the others because it is easier for rivals to imitate prices than the other marketing mix elements. However price is just a number attached to a product or service and it is so very easy to change that number; the most difficult thing in pricing is finding and establishing the “right” price. It is not quite simple to be sure of the exact “right” price because there are too many factors to be considered in making that decision and many of them are usually unforeseeable. Unexpected weather conditions, rivals’ strategy shifts or instant changes in raw material costs can be given as examples that can ruin a well-planned long term pricing strategy. (Mandell, 1985)

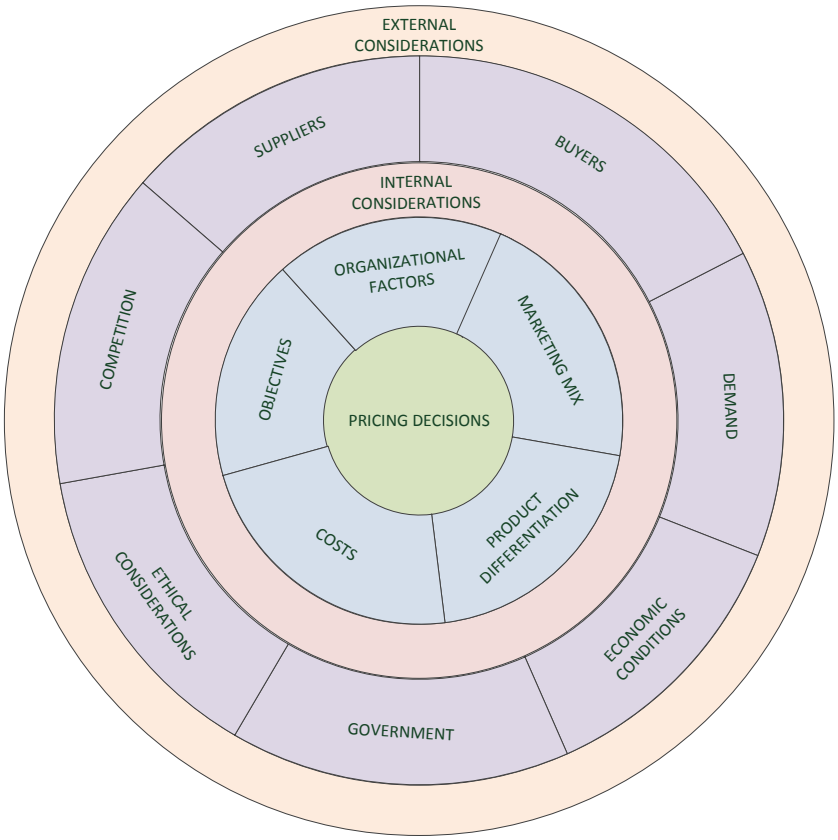

Figure 2.2: Diagram of Factors Effecting on Pricing Decisions (Mandell, 1985, pg. 276)

As shown in the figure above, price is effected by two layers of factors; internal and external. Internal level of factors typically consists of decisions that are made inside the organization. *Organizational factors* reflect company's organizational decision processes whether they are made by either marketing or finance departments effecting directly on pricing decisions. Remaining other 3 elements of *marketing mix* (product, place and promotion) directly affects pricing decisions by rising costs and narrowing profit margins. (Mandell, 1985) Heavy advertising, packaging and distribution costs are directly connected to unit costs leading to higher prices. But if the product is highly *differentiated* from other products in the market, it raises the chance of demanding premium prices for the product. *Total costs* of the product are directly related to the price of the product and vice versa. Price objectives of a company also drive costs by effecting choices of product features, organizational or administrational costs, raw material preference and etc. *Organizational objectives* and missions effect on pricing decisions with the choice of premium pricing or being cost leader. It is almost impossible to think of an organization not affected by the environment they are operating in, so does pricing. Since the operating profit of a

company is directly related to the market *demand*, it influences price levels in order to increase or maintain profit margins. It is also highly recommended for companies to observe their market and act according to the *competition*. Dragging into a price war is not the only choice, differentiation or premium pricing may be the options of surviving heavy competition conditions. *Suppliers* have the power of bargaining if they are few or the product is highly differentiated which also increases costs and revealing a need of reorganizing price issues. Like the supplier side of bargaining, *customers* if there are a few of them, may have strong influences on pricing decisions. *Economic conditions* determine power of buying, inflation, crisis, raw material shortages which directly affects costs and prices. Economic conditions may change from country to country except for the global crisis and international and local companies should establish different pricing strategies in order to survive. It is the *government* that applies anti-trust laws, defines price levels for some services or products and also it is the largest buyer in some industries like defense sector. Largest companies may even get in trouble with governmental regulations. Also, companies cannot operate apart from the society, so *ethical considerations* like adjusting prices for elderly or poor people should not be skipped. (Mandell, 1985)

Price objectives should be consistent with the mission and objectives of the whole organization like the other elements of the marketing mix. Pricing generally has financial or market based objectives. Financial based objectives include profit maximization and target return. In profit maximization objective, it is expected for the firm to set high prices in order to generate higher profits. But this should be analyzed further whether higher prices can compensate the loss of demand or not. In target return objective, firm sets a target profit goal by analyzing costs, future growth needs etc. and tries to reach it by lowering costs and increasing revenues. In market based price objectives, market share is centered and the long term aim is to dominate the market. In practice, these two objectives i.e., financial based and market based objectives conflict with each other. Setting high prices may satisfy the financial based objectives but the lowering effect on market share conflicts with marketing strategy. However, in some research it is suggested that gaining market share is the key to success. (Lusch, 1987) Because while it rises demand with low prices and good marketing mix, accumulating experience of both marketing and production will

lead to reduced costs. Hence, it is not very interesting for the market leaders to be the most profitable firms at the same time.

2.2. Pricing strategies

It is almost impossible to find a strategy that fits with both organization and product mix without knowing the product, its segment, demand and the degree of competition between competitors of market. Some main strategies will be discussed one by one under this topic.

2.2.1. Product Line Pricing

Companies generally create lines of products that are sold at different levels of prices which are called "price points" rather than selling and pricing products individually. This gives customer groups with strict reservation prices, a line of choice. Considering an apparel shop; there may be an economic line of dresses sold at 49^{TL} and an expensive line 199^{TL}. These different price lines are surely attractive to different groups of customers with different purchasing powers. It is important for companies to know their customer segments and their distribution of reservation prices before setting these price points. (Zikmund, 1996)

Products belonging to a product line usually have some common parts, which means they are possessing joint costs differing in only direct costs. That is, manufacturer of food processors line produces same body part for all processors but assembles different containers with increasing level of capacity in the same line. Body part costs are the same joint cost but container direct costs are different from one product classified under a price point to another price point. (Lusch, 1987)

Another aspect of line pricing is the cross elasticity between products or product lines. Cross elasticity is the relationship between Product X's demand and Product Y's price. If cross-elasticity is negative, the products are complements which mean an increase in Y's price causes demand of X to fall. If cross-elasticity is positive, the products are substitutes which mean an increase in Y's price causes demand of X to

rise. (Zikmund, 1996) For example if a laundry machines manufacturer raises the price of its deluxe washing machine line, customers may choose to buy more from the economic line of washing machines. This shows positive cross-elasticity exists between those deluxe and economy lines. But, if an increase in the price of washing machine lowers the demand of dryers, it means this kind of relationship is an indicator of negative cross-elasticity. (Mandell, 1985)

2.2.2. Optional-Product Pricing

Companies set prices low enough to attract customers, but they then charge them for every add-on, accessory or additional service to reach a higher profit margin which they could not make from the main bare product. It is a complex problem which features to list as optional or not. During economic recessions almost every feature becomes optional to make prices seem lower. (Kotler, 2004) Automotive industry is the main user of this strategy but nowadays airline industry is making billions of dollars by utilizing this strategy. They set prices low for seats but then they charge for luggage, seat's position (isle or window), snacks, headphones and more.

2.2.3. Captive-Product Pricing

Gathering higher profit margins not from the main product but from the complementary products is called captive-product pricing. Complementary products' variable cost is so low that even if they sell the main product below cost, firms still continue to earn more profit margins. A common example for this type of strategy is game consoles like PS3 or Xbox360. What makes Sony and Microsoft's captive product pricing strategy profitable in gaming market is that they make money from the games sold, not from the game consoles. (Kotler, 2004) Also mobile application providers like AppStore or Android Market, make profits from their downloadable applications rather than their operating systems or smart phones. They get a predefined percentage of shares from each application downloaded.

2.2.4. By-Product Pricing

By-products are secondary products that are arisen from the manufacturing process or a chemical reaction of the main product and if it is not a complete waste and have any other separate market; they are sold to make the main product cheaper which is called by-product pricing. Zoos' may sell manures to organic manure seller companies which are practically useless for zoos but beneficial for gardeners. Companies are free of disposal of these kinds of secondary products and even more they make money of them. (Kotler, 2004) Cheese producers transform their secondary product whey to whey powder (ingredient of most chocolates, biscuits and etc) and sell them to make the main product cheaper and be the price leader.

2.2.5. Bundle Pricing

Packaging goods together and selling them at a discounted price has become a common way of marketing practice in many service and manufacturing industries. (Fürderer, 1999) Bundling is classified as an alternative technique for price discrimination (Stigler, 1963) and has been analyzed as a tool for profit maximization in goods or service providing industries after since. It has been an effective catalyzer for boosting demand in different sectors and their separately segmented or complementary goods/services. To reduce the confusing and differing definitions in bundling literature Stremersch and Tellis (2002) redefined all the key terms that are mostly used. Their definition for *bundling* is; the sale of two or more separate products in one package. They also defined *separate markets* as products for which separate markets exist, because at least some buyers buy or want to buy products separately. A well-known, up to date example of bundling is Microsoft's Office Package. It contains several products for daily or professional usage. The package ingredients are not available separately which is called "pure bundling strategy". Using bundling as a business strategy, Microsoft cleverly created demand for its less wanted products like PowerPoint and Access by bundling these products with more attractive products like Excel and Word. Microsoft also dominated web-browser market by bundling its Internet Explorer with its market power beholder operating system Windows. (Simon, 1999) However, with the development of

internet age and active players in the web browser market like Google Chrome, Firefox; Microsoft's Internet Explorer is facing a rapid loss of some of its market share.

Another term bundling literature is constructed on is *reservation price*, first introduced by Stigler (1963) is by definition the maximum price a consumer is willing to pay for the product (Stremersch, 1992). Reservation price is directly related to the value consumer gets from that product which will also determine how much he/she will pay for that type of product. If the price of the product is smaller than the reservation price which means there is a positive consumer plus, it is expected for the consumer to buy that product. Otherwise, consumer will not buy the product with a negative consumer surplus and buy nothing or worse switch to another supplier. In literature, there are three ways used to capture the reservation prices of different customer segments. First method is directly asking to customers but it creates unrealistic reservation prices due to high price consciousness. Second way is to make conjoint measurement by asking customers which feature of the product value more to them. However, this way is too complex since each feature is evaluated in dual feature combinations. Last way of measuring the reservation prices is the expert judgment but it may not be realistic or reflect all customer groups' taste preferences. (Simon, 1999)

In the long run, the aim of bundling is to extract more of consumer surplus and gaining more market share with increased profits. But how does bundling do it so?

Table 2.1: Profit Analysis Bundling vs. Unbundling

Customer	**R_1**	**R_2**	**P_1**	**P_2**	**C_1**	**C_2**	**Profit**	**P_B**	**C_B**	**Profit**
A	30	20	30	30	10	10	20	50	20	30
B	20	30					20			30
Total							40			60

R_i = Reservation price for product i

P_i= Price for product i *P_B= Price for bundle*

C_i= Cost for product i *C_B= Cost for bundle, equals to C_1+ C_2*

For the sake of simplicity, in the table above two different segments of customer and two different product types are represented. Reservation prices are defined as A(30,20), B(20,30) and costs are set to 10TL for each product. In the unbundled case; there are only one customer buying each product but in the bundled case both customers A and B are buying the bundled product. So when we compare the total profits resulting from excluding cost from revenue, it is found that total profit is higher in the bundled case (60) than the unbundled case (40).

Also another cost cutting issue in bundling strategy is that the total cost of the bundle may be lower than the sum of the costs for the separate products which is called sub-additivity. Hence, it allows suppliers to discriminate different customer groups with different reservation prices.

The concept of bundling was first introduced by Stigler (1963). He brought the examples of bundles with negatively correlated reservation prices where they were used as a third degree price discrimination tool. At a later research Adams and Yellen (1976) showed that the bundling can be profitable even if motivations like cost savings in production, transactions and complementarity of bundle components do not exist considering three different strategies: unbundling, pure bundling and mixed bundling. These 3 concepts are going to be criticized at a later chapter in this research. McAfee et al. (1989) widened Adams and Yellen's model by finding under what circumstances their strategies are optimal. Before them Schmalensee (1984) proved that bundling can be optimal when the correlation between reservation values among customers is nonnegative by using Gaussian demand function. Salinger (1995) analyzed both cost and demand effect of bundling, found that it tends to be more profitable when demands for the components are highly positively correlated and component costs are high.

2.2.5.1. Product Bundling

Product bundling is often being confused with the terms *bundling* or *price bundling.* To use a clear terminology thorough out the entire thesis; product bundling term will represent the bundles consisting of products integrated to each other and creating

value together. Some basic examples in the literature for this concept are mostly in computer and/or high technology products like internal hard disk, CD/DVDRom drivers integrated inside of a computer instead of external hard disk or CD/DVDRom player bundles. Supplier may or may not want a premium price for these kinds of bundles because ingredients of the bundle create more value together than they are sold separately. Product bundling as its natural design needs research, revised manufacturing systems and also in service industry it needs redesign of the existing interfaces, customer touch points or rebuilt delivery processes which ends up with a lot of investment and struggle on companies' shoulders. Thus, this makes product bundling a long term differentiation strategy or a new product development process rather than a short term pricing decision. (Stremersch, 1992)

2.2.5.2. Price Bundling

Price bundling mainly consists of several products, services or products and services brought and sold together which are may or may not be complementary to each other with a price discount to make sure that customers will not make their own bundles themselves if those products are being sold separately simultaneously. If bundled products are not sold separately a price discount will not be necessary, hence it will not be meaningful to talk about a price contrast if there is not any negligible separate prices. This kind of strategy will be named with the term "pure bundling".

2.2.5.3. Unbundling

Unbundling as a pricing strategy means selling and pricing products separately. What differs this from other strategies is any kind of bundle should not exist in each of the product's separate markets. Also this is a widely used common strategy not named necessarily but in the bundling literature the term "unbundling" is used to differ it from other strategies.

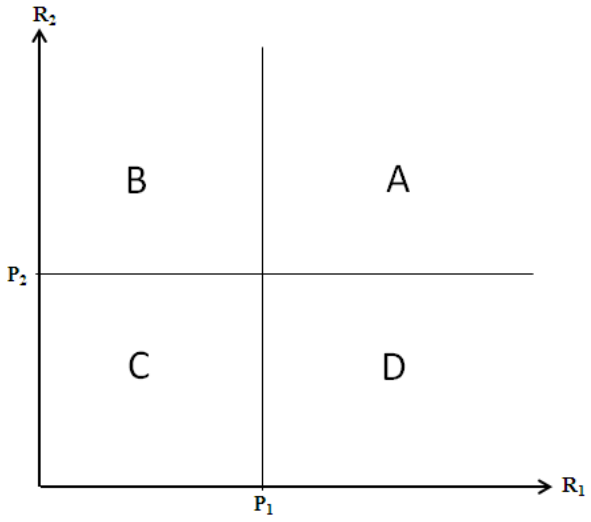

Figure 2.3: Graphical Illustration of Unbundling (Adams, 1976, pg. 478)

This figure above represents separate markets without any existing bundle. Area C consists of customers with reservation prices lower than the actual prices of the products. Under the fact that if the price of the product is higher than the reservation price for the customer, customer does not buy the product; C type of customers buy nothing. Customers in Area B buy only product 2, customers in Area D buy only product 1 because their reservation price exceeds only one type of product's price.

2.2.5.4. Pure Bundling

Pure bundling is selling products only within a bundle. To call a strategy pure bundling none of the products must be sold separately. Considering a bundle with 2 products; if a customer wants to buy only one of the products in the bundle, there is no way rather than buying the bundle. Hence, this is what makes this "pure price bundling" strategy illegal for market power beholder companies. (Stremersch, 1992) Windows and Internet Explorer or Windows Media Player pure bundling cases can be given as examples for dealing with these kinds of anti-trust issues. (Simon, 1999)

Another aspect of pure bundling is depoliferation which is the reduction of complexity. It lowers the product combinations and limits the decision variety not just for the supplier but also for the customer. It reduces the product variety which is not eligible for mixed bundling. (Eckalbar,2005)

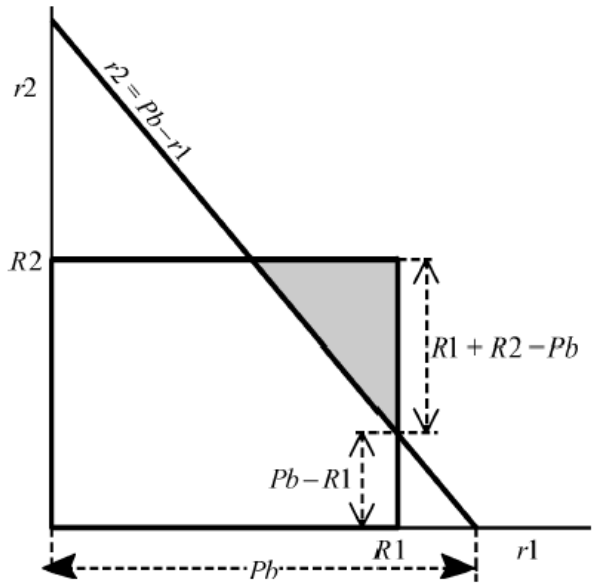

Figure 2.4: Graphical Illustration of Pure Bundling (Eckalbar,2005, pg. 73)

In Figure 1.2 shaded area represents the bundle buyers. Since this is a pure bundling strategy, if customers do not buy the bundle they do not have any other choice so they do not buy anything.

2.2.5.5. Mixed Bundling

This strategy is to sell both bundle and at least one of the ingredients of the bundle separately. Customer should make a decision whether to buy the bundle or just the product alone.

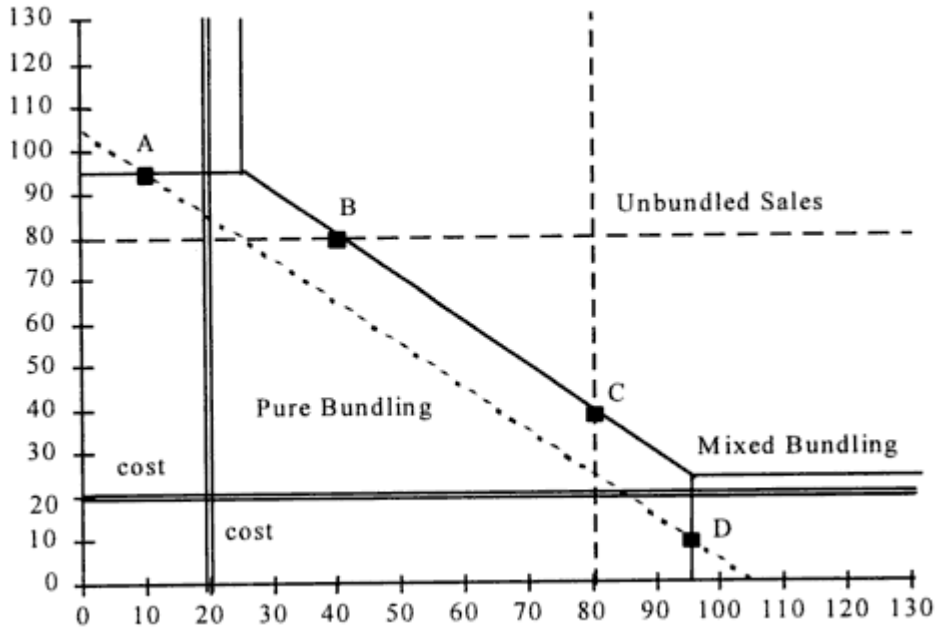

Figure 2.5: Graphical Comparison of Mixed Bundling, Pure Bundling and Unbundling
(Fürderer, 1999, pg. 91)

To illustrate graphically, 4 types of customers are generated with negatively correlated reservation prices; A (10, 95), B (40, 80), C (80, 40), D (95, 10) and costs are set to 20 for each separate product and 40 for the bundle. According to the Figure1.3 the following results are obtained.

Table 2.2: Comparison of Pricing Strategies (Fürderer, 1999)

Pricing Strategy	P_1	P_2	P_B	Revenue	Costs	Profit
Unbundling	80	80	-	320	80	240
Pure Bundling	-	-	105	420	160	260
Mixed Bundling	95	95	120	430	120	310

Mixed bundling seems to be an optimal pricing strategy for the markets including customers with both “balanced” and “extreme” preferences. (Simon, 1999)

Under different types of correlations between reservation prices results may vary but it is argued that mixed bundling weakly gives better results than pure bundling

(Salinger, 1995). Also it is suggested by Bakos et al. (2000) that mixed bundling dominates pure bundling with or without the existence of marginal costs.

2.2.5.6. Complementarity

Complementary products are by definition; products that can function together or product groups that are dependent to each other. These products can be sold either in bundle or separately. In unbundling or in mixed bundling case, complementary products' demands fluctuate attached to each other because customers need to buy both products to get value from each product. (e.g., shaving cream and razor, printers and ink cartridges) Once one of the complementary product's price decreased and its demand increased, demand of the other product increases even if its price doesn't change or increases.

Researchers have tried to understand the effect of complementarity on many issues like customer perception, firm profitability or mental accounting. In a recent research Leszczyc and Häubl (2010) argued that bundle auctions with (moderate or more) complementarity is %50 more profitable than auctions with no complementarity as a result of three different field studies. (Popkowski, 2010) Sheng and Parker (2007) carried out a research to understand how customers value bundle components after a price discount; they found that complementarity weakens the negative effect of price cuts. (Sheng, 2007)

2.3. Price Adjustment Strategies

An accurate understanding of customer needs, perceptions and reservation prices is crucial for establishing a price for a new or an existing product. Even if all factors are analyzed accurately and an approximately "right" price is given, a need of adjustment may exist. Thus, some adjustment strategies are analyzed below.

2.3.1. Discount and Allowance Pricing

Adjusting prices in order to attract more customers is a common method in different industries. There are various ways of discount and allowance pricing supporting early payment, high volume selling or off-season buying. It can be made by either a price adjustment the list price of that product or paying a service (such as maintaining, transporting) for that product on behalf of the customers. (Zikmund, 1996)

Cash discount is the most common type of discounting, used to reward buyers who make their payments promptly. They are generally shown in bills like "2/10, net 30" meaning payment is due to 30 days but if the customers pay in 10 days, they can pay %2 of the price less. After 10^{th} day, the full amount of payment is expected. Cash discounts help industries to improve their bad debts ratio and credit collection costs. (Kotler, 2004) With the developing environment of marketing, it is also being common for companies to offer cash discount coupons of other companies to their subscribers. For example, if you are a customer of X Communication Company, you get %25 cash discount from an apparel shop Y for a limited time. And also cash discounts are legal if made equally to all customers.

Trade discounts are available for companies operating in the same trade channels. They are generally given to wholesalers, retail dealers, transporter or storing companies dealing in the same industry.

Quantity discount is to reduce the price of a product or service according to the amount purchased by customers. This type of discount lowers the inventory costs while increasing the advantages of economies of scale. Quantity discounts may be cumulative or non-cumulative. Non-cumulative quantity discounts are valid for a one-time purchase. Past purchases are not taken into consideration. Cumulative price discounts are extended version of non-cumulative price discounts for a given amount of time. (Zikmund, 1996) For example, if a small quantity but frequent purchaser fulfills the total amount to be purchased in a year, it earns a discount for the next purchase(s). Also this type of discount may be done due to an agreement covering a large amount promised to be purchased until the end of a given period. (Mandell,

1985) Another way of doing cumulative quantity discount is to increase the amount discounted incrementally for the upcoming purchases. The purpose of the cumulative quantity discounts is to keep the consumer locked in. (Zikmund, 1996)
Seasonal discount is to support purchases out of season. Clothing (e.g. winter or summer), ice cream, gardening products are examples of seasonal discounted products. It helps companies to surrender out of season and keep producing at a low level. (Kotler, 2004)

Allowances can be done in two ways trade-in or promotional. Trade-in allowance exists generally in durable goods industry because discount is made in return of the old product such as refrigerators or vehicles. Promotional allowance can be made if the purchaser participates in and advertising or a supporting program. Thus it can be said that allowances are always made in return of valuable contribution from the customer. (Kotler, 2004)

2.3.2. Segmented Pricing

Segmenting customers in order to extract different levels of consumer surplus by setting different prices for different segments is called *segmented pricing*. In segmented pricing, the product itself or its cost does not change heavily but the price each segment has to pay changes according to the features of each segment. (Kotler, 2004) To apply an effective segmented pricing strategy, market must be segmentable, each segment should be paying according to their own demand curve, price differences between segments should not be so high that any of the lower priced segments have the will to resell the product to an upper segment member. (Mandell, 1985)

In *customer-segment pricing*, product or service does not change from customer to customer but price changes respectively. A common example for customer segmentation is the price policies travelling companies establish. Students and elder people pay less while middle-aged customers pay more while the service which is in this case transportation from one place to another stays exactly the same. This example can be widening to entertainment sector such as cinemas, theatres or

concerts whereas the ticket price differs according to the age of customers. (Kotler, 2004)

Product-form pricing occurs when a slightly different version of a product is sold much higher than the original product even if the cost stays the same or increases barely between the versions. (Mandell, 1985) Updated versions of lecture books double their prices while the total pages and total costs stay the same

The location pricing can be defined as different prices for different places offered whereas the cost of offering stays the same. Same hotel rooms' prices may differ due to the scene viewed from the windows such as sea or street. (Mandell, 1985)

Time pricing is used to benefit more from the less preferred hours of service by setting low prices but gaining more customers. Generally, prices are lower for using phones, flying during week days than the weekends. Theatre tickets are lower for matinees than evening or weekend performances (Mandell, 1985)

2.3.3. Psychological Pricing

As mentioned before price is not just a number indicating costs and profits attached to a product. Customer perception is far too different from this simple logic. Price is also an indicator of quality. If the product is going to be bought for the first time, the most eligible data customers have is the product's price before deciding over a range of products. Customers usually buy higher priced products in hope of higher quality. If it is not the first time, then they can use their judgments accumulated from their past usages. Companies also influence the price - quality matches in customers' minds by arranging places of products offered to indicate higher priced product area brings higher quality. (Kotler, 2004) Prestige pricing is also used for products whose price is directly related to its percept quality, such as high priced perfumes, luxury cars. (Lusch, 1987)

Odd/even pricing is a common method being used by marketers. Pricing a stereo 299^{TL} instead of 300^{TL} results with more psychological effect compared to the little

decrease in price. (Kotler, 2004) Researches show that approximately 60% of prices end with"9", 30% of prices end with digit "5" and totally 97% of prices end in three digits which are "9,5,0". (Holdershaw, 1997) Even if there is no strong evidence of the clear effect on consumers, it is suggested that it creates a kink effect on demand curve. (Gendall, 1997)

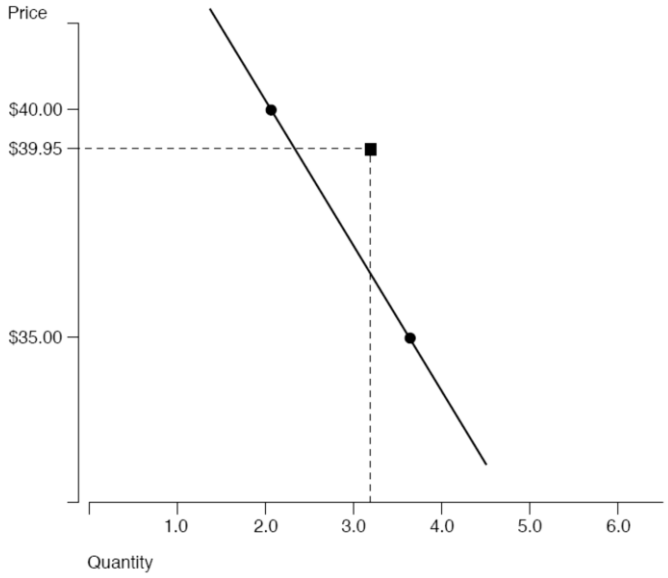

Figure 2.6: A kinked Demand Curve (Holdershaw, 1997, pg. 55)

The reasons of creating a kinked curve as represented in Figure 2.6. are suggested as price illusions, convincing the customer that it is the lowest price among rivals' products. (Holdershaw, 1997)

2.3.4. Promotional Pricing

In order to create additional demand and the physiological effect of urgency, companies establish promotional prices which are below list prices for a particular time period. Retailing sector promotions are often organized to attract customers into the market and hope to sell more form the other normal mark-up priced products. This is called *leader pricing* because the product in promotional discount is often the most preferred product in that store or chain of stores. The cons of this strategy is that customer may not buy any of the normally priced products, firm sacrifices some

of its profit and earns nothing and the worse is that the customer may resist to buy that product from its normal price. (Mandell, 1985) Also seasonal discounts mentioned before is another example of promotional pricing. They are made to create additional demand and they are valid for limited time. (Kotler, 2004) But promotional sales create both end addiction; each time a company gets in trouble creates a promotional discount and also customers wait for the promotional discount to buy a product of that company. Also price promotions are easy to copy by rivals; once it is copied the advantage of promotion disappears. Another important risk of promotional pricing is that if it is made too often, it creates "price wars" which threatens the profitability of the market. (Kotler, 2004)

2.3.5. Geographical Pricing

Some organizations' customers may have been distributed among the country or maybe even farther, worldwide. In order to cope with transportation costs changing from customer to customer and not get excluded from the competition among rivalries because of the escalating prices, some different strategies and policies are developed.

FOB Origin, meaning free on board is a strategy in which the buyer pays the transportation cost from factory to the destination. The costs increase with distance where the products are transported. Though it is a fair way of distributing transportation costs since every buyer is charged with the same unit transportation cost multiplied with their distance from the origin of the factory, it makes the good provider a high cost company according to the farthest buyers. (Kotler, 2004) But if all sellers in use FOB origin pricing strategy, then there will be no choice for the buyers but to buy from the nearest provider. To help buyer reduce the total cost (unit cost plus transportation cost), seller may reduce its product price to make it somehow equal to the nearest providers offering in the perspective of the buyer. (Lusch, 1987)

Uniform delivered pricing is a strategy that every buyer pays the same price regardless of the distance they are located from the factory. Under this strategy, buyers located the farthest from the manufacturer gets the biggest price

discrimination. (Lusch, 1987) It is a better way to capture the customers that are distant than the FOB origin pricing establisher companies. This strategy is also easier to administer because all prices are the same, and it gives chance to companies announce their prices nationally. (Kotler, 2004)

Zone pricing is a combination of both uniform delivered and FOB origin pricing strategies. While it gives the same price to all customers in a given zone, that price changes according to the distance of those predefined zones. Zone pricing reduces the administrative paperwork of thousands of buyers to the number of regions defined.

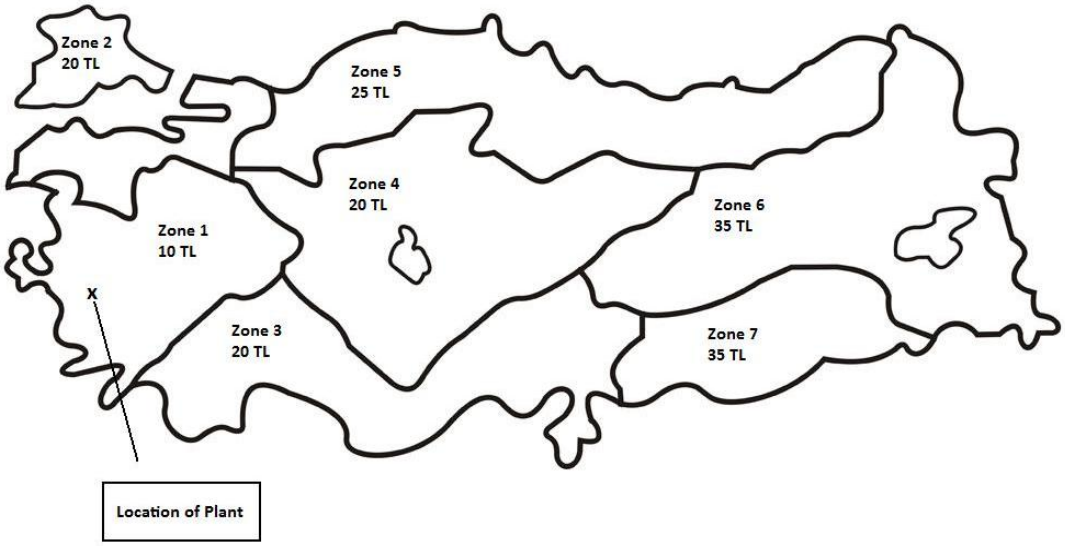

Figure 2.7: Illustration of Zone Pricing

Basing point pricing is to define base points regardless of the location of the factory and charge every customer not from the distance from the origin of the factory but from the base point. This strategy is a lot like the FOB origin strategy. Thus it gives farther buyers to pay less and closer buyers to pay more, compared to what they will pay when the reference point is set as the factory not the base point. Also, basing points can be multiple so buyers choose the nearest reference point to pay less cost. (Kotler, 2004)

And last, *freight absorption pricing* is to not bill all or part of the transportation cost to the customer in order to compete with closely located rivals. For the seller it may

be financially better to pay the transportation cost itself and not to lose the customer than to produce less and increase the average unit cost. This strategy is common in markets with high competition levels and allows establishing market penetration strategy. (Kotler, 2004)

2.3.6. International Pricing

In order to reflect and adapt to the market conditions of countries they are operating in, companies mostly adjust their pricing policies accordingly. International organizations decide upon economic conditions, transportation costs, competition and rivalry, marketing intermediaries, laws and regulations and form their pricing strategy considering each element. (Kotler, 2004) Local marketing objectives often conflict with the global managers' price decisions. International level management may be seeking universal prices but tariffs and competitiveness in some countries' markets may not let local managers to set higher prices and vice versa. The changing environment also causes different variable costs to increase which directly adds up on price in a cost-plus pricing strategy and does not let companies to compete with local companies in a fair condition. (Montgomery, 1988) For example; while exporting overseas; shipping, port and insurance charges adds up incrementally on costs and cause a price escalation. In order to be effected less by those costs, it is suggested for companies to build their facilities where lower freight and duty charges exist and also closer to their existing or potential markets. With the help of low labor, transportation and costs, market dominance can be gathered internationally.

3. DATA AND METHODOLOGY

3.1. Introduction

In this chapter, the data gathered from a multinational company will be analyzed in detail using statistical and normalization approaches. Afterwards, the problem will be defined and using an optimization approach optimum price will be gathered for changing coefficients of pre-determined goals. In the last part of this chapter, results will be interpreted and suggestions about product lines and prices will be provided.

3.2. Defining Products and Data

As a result of detailed investigation of several companies operating in different industries, we decided to collaborate with a multinational fast moving consumer goods company which produces household products among other things. Fast changing environment and quick response to price fluctuations made FMCG the most appropriate industry to observe and apply bundling strategies. After contacting with the company, explaining our needs of bundle and willingness to analyze their pricing strategies upon changing demands of customers, they decided to give us demand data of 4 different bundles of 2 different complementary household products. Because of privacy issues, we will hide name of the company and product.

First product will be mentioned as “Bottle” and second product will be mentioned as “Machine”. In this type of complementarity the bottle cannot be used without a machine integrated onto it. While machine is a lifetime good, bottle can be consumed in a month or so. Machine is not sold alone while the bottle is sold solely or in different types of bundles. As mentioned before, the firm’s strategy is a type of mixed bundling where only one product of the bundle is sold alone but the only way to get the other product is to buy it in a bundle.

Product and bundle types are as follows;

B1 consists of a machine and a bottle,

B12 consists of a machine and 2 bottles,

B222 consists of 3 bottles,

B2 consists of only 1 bottle

The raw demand data which will be analyzed in further sections is given in Appendix A. This weekly time series data starts from 04.01.2010 and ends in week of 14.03.2011 consisting of 63 weeks for 4 different types of bundles and also shown graphically in Figure 3.1.

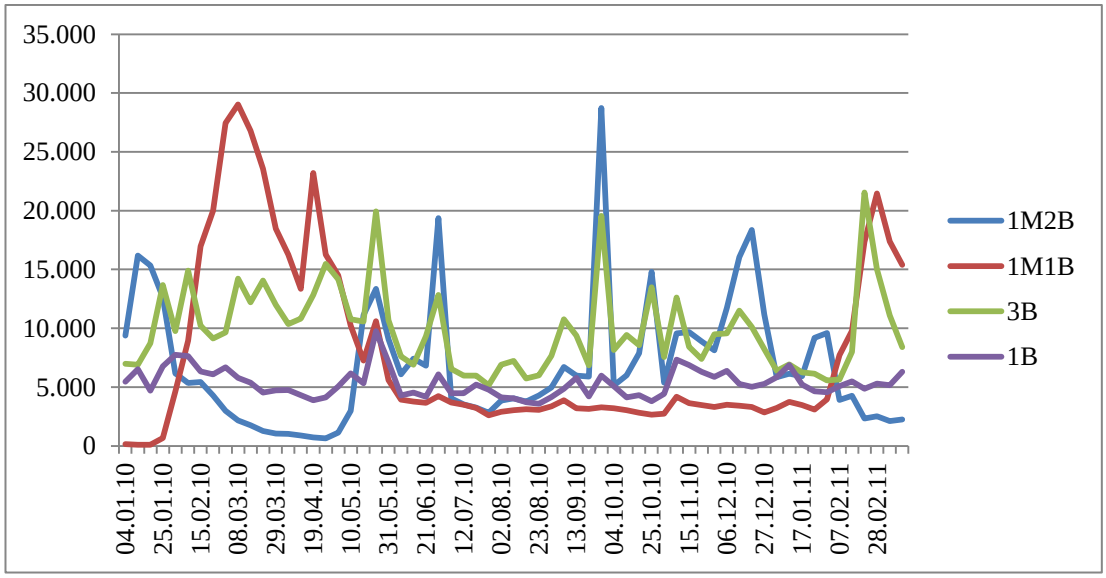

Figure 3.1: A Graphical Demonstration of Data Given In Appendix A

As seen from the figure above there is a reverse relationship and a cannibalization effect between bundles 1M2B and 1M1B while bundles that consist of different number of bottles are fluctuating relatively steady. This is a result of company's promotional strategy. Company starts a promotional pricing period generally starting at the end of January and ending at the end of April. In this period, company packages 1M1B instead of packaging 1M2B and sells this promotional bundle with a discounted price. While not being packaged as a 1M2B and having an inside the brand rival, the demand of 1M2B starts to fall rapidly. Promotional effect continues

till the inventory stocks of distributers and/or markets vanished. This period is repeated every year cyclically causing 1M1B demand to boom and 1M2B demand to hit the bottom.

Lastly, in Table 3.1 prices and total sales for 63 weeks of each bundle are shown but those prices are not valid throughout whole period. In other words, company made price changes in two of the bundles; 1M2B and 3B. Those changes occurred on 05.07.2010 week as 9% price increase in both bundles. Also in 3B bundle one more change occurred on 03.01.2011 as 16% price increase. The price of promotional bundle (1M1B) and the separate product (1B) stayed constant during the whole time period of the data. Effects of these changes are analyzed in following sections.

Table 3.1: Final Prices and Total Sales Table

	Price (TL)	**Total Sales (63 weeks)**
1Machine + 2Bottle	17,99	433335
1Machine + 1Bottle	9,99	500408
3Bottles	21	624036
1Bottle	8,99	336724

Prices presented in Table 3.1, can be classified as psychological and odd pricing strategy. Main reason for the company to set odd prices is to make customers believe that these are the lowest price for this type of consumer goods and expect a kinked effect on their demand data.

3.3. Data Analysis

First thing that has done in this part is to find out factors that affect demand of the products. Promotional effect is a known and obvious effect that is directly related to 1M2B and 1M1B bundle demands. Hence, first question we search an answer is directly related to the effect of promotion on remaining bundle demands. The main reason for the company to sell promotional bundle at a discounted price is to make customers buy the machine and continue to consume other higher priced non-

machine bundles such as 3B or 1B which is also called captive pricing strategy in literature. Once the customer buys the machine of a particular brand, they have to continue using that brand's complementary products. If not, machine will not function and the money spent will be sunk cost. However, a benchmark among company's rivals shows that they are using an opposite strategy. During a visit to the stores where both products are sold it is discovered that the rival companies' bottled products or bundles can be used with any machine, meaning that they are taking advantage of customers who are willing to switch between different brands. The effect of this strategy cannot be analyzed because of non-existing rival demand data.

Table 3.2: Promotional Pricing Effect

	Promotional Period (14 weeks)				**Regular Period (38 weeks)**			
	Sum	**Average**	**Median**	**S. Deviation**	**Sum**	**Average**	**Median**	**S. Deviation**
1M2B	46360	3311,43	1955,5	3316,12	332910	8760,79	5973	5441,74
1M1B	245572	17540,86	27913	8490,74	148300	3902,63	3208	2437,87
3B	169311	12093,64	13212	2134,07	353761	9309,49	9388	3392,08
1B	78792	5628	5576	1288,36	198646	5227,53	5788	1241,38

The basic effects of promotion can be seen from Table 3.2. Promotional period has a direct effect on bundles 1M2B and 1M1B, resulting with a peak on 1M1B and a rapid fall on 1M2B. It also affects bundle 3B and product 1B causing 3B's demand to increase relatively less.

Another effect that is mostly observed in time series data is the seasonality factor. In order to gather accurate results in further applications the effect of seasons is analyzed. *Main effects plot* is used as a statistical tool for analyzing those 2 types of effects for each bundle. Minitab 13.0 is used to draw main effects plots for existing demand conditions covering 63 weeks. Minitab finds out each season's and promotion's mean in data, season and promotion pairs. The resulting plots are shown and interpreted below.

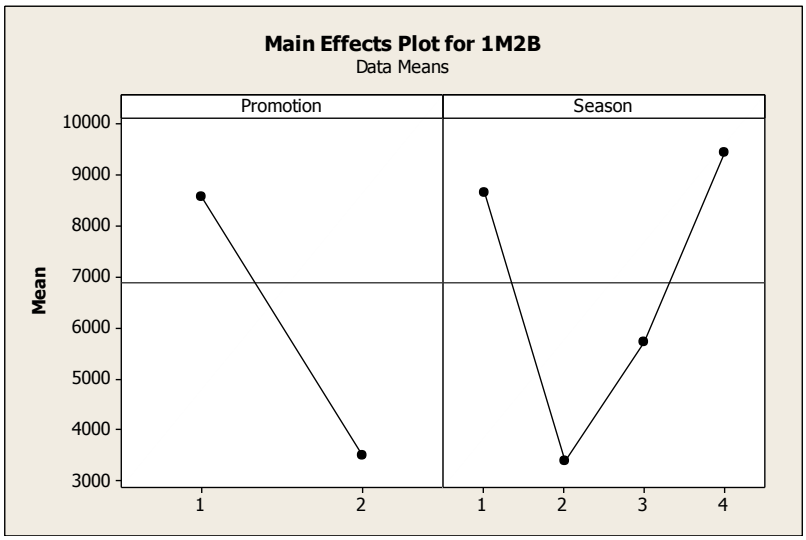

Figure 3.2: Main Effects Plot for 1M2B

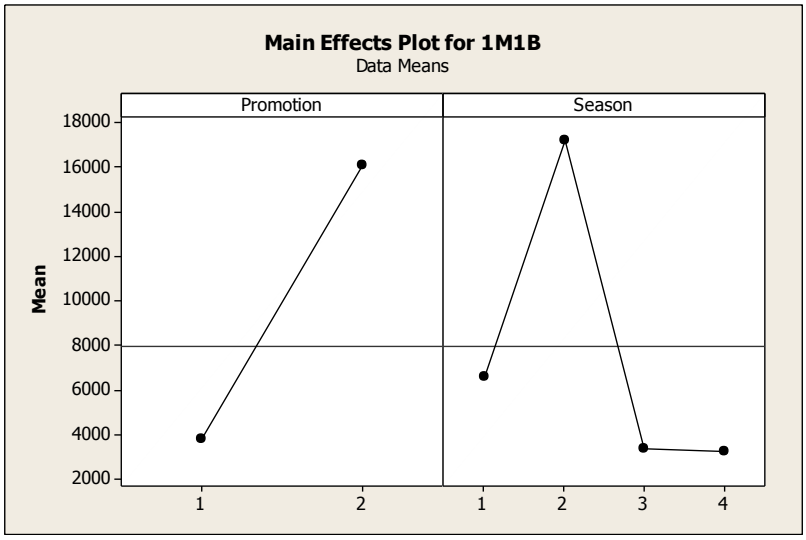

Figure 3.3: Main Effects Plot for 1M1B

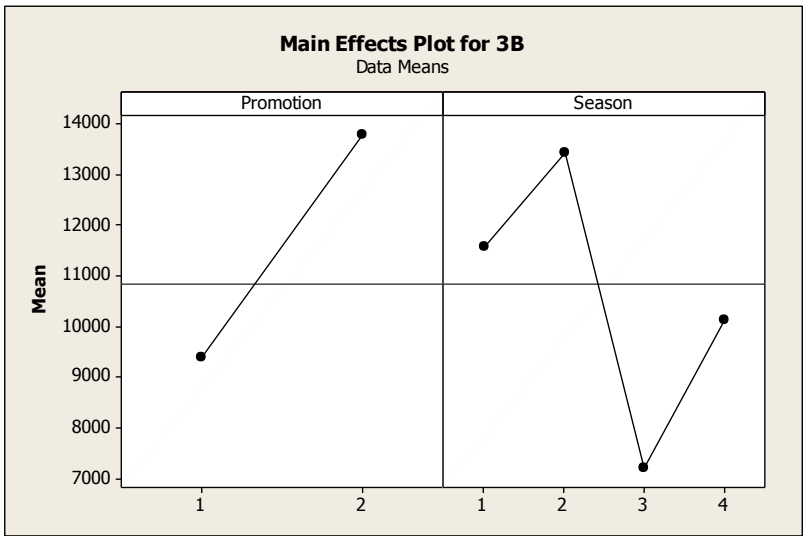

Figure 3.4: Main Effects Plot for 3B

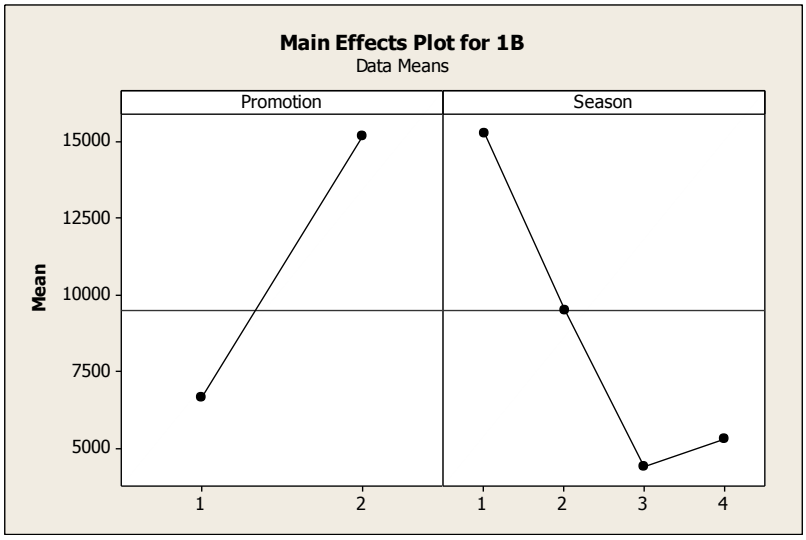

Figure 3.5: Main Effects Plot for 1B

In the promotional side of plots given in figures above, number 2 refers to promotional period and number 1 refers to its opposite; no-promotion. Promotional effect has a significant increasing effect for all types of bundles except for the 1M2B bundle. This is because of firm's natural cycle of promotional and non promotional periods. 1M1B is far less priced than 1M2B and while 1M1B is pushed to the stores, 1M2B is not packaged until the end of promotion. Other remarkable effect that can be caught through the plots is that even there is no promotion or discount in *non-machine* bundles, there is a significant positive effect on their demands. Consumers tend to buy more bottles in order to use with the machine they bought since there is

only one bottle sold in the promotional package. Main effects plot is usually used for comparing effects. In our plots none of the dots are close to the general mean line so it is not possible to say which effect mainly drives the data. Both promotion and season have close and significant effect on data.

In the seasonal side of plots given in figures above, numbers 1 to 4 refers to seasons; winter to autumn respectively. Plots can be misleading due to the fact that promotion is made only in 5 weeks from winter and 9 weeks from spring. Spring and winter (partially) will not be included in the analysis due to this reason. When remaining seasons are checked, it can be seen that summer is the season that customers are least likely to buy the bundles or product. Autumn is the season that can partially recover the negative effects of summer. Although, winter has promotional weeks in it, it can be said that the reason of high levels of sales in this specific season is not only promotion but also weather conditions. Overall, bundle demand is reversely correlated with the temperature of weather.

Analysis part continues with interaction plots. Those types of plots help comparing importance of main effects and analyzing interactions in concern. **(Sematech, 2012)** The results are given in Figures 3.6 to 3.11.

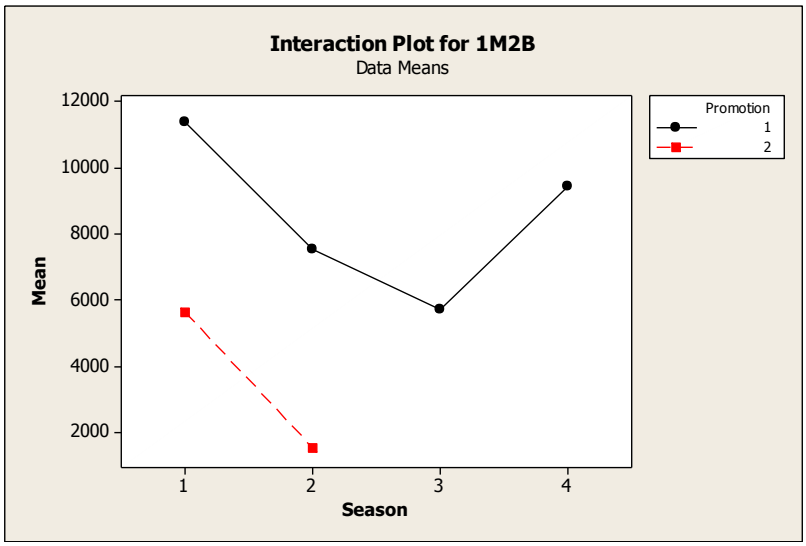

Figure 3.6: Interaction Plot for 1M2B; Promotion and Season

Figure 3.7: Interaction Plot for 1M1B; Promotion and Season

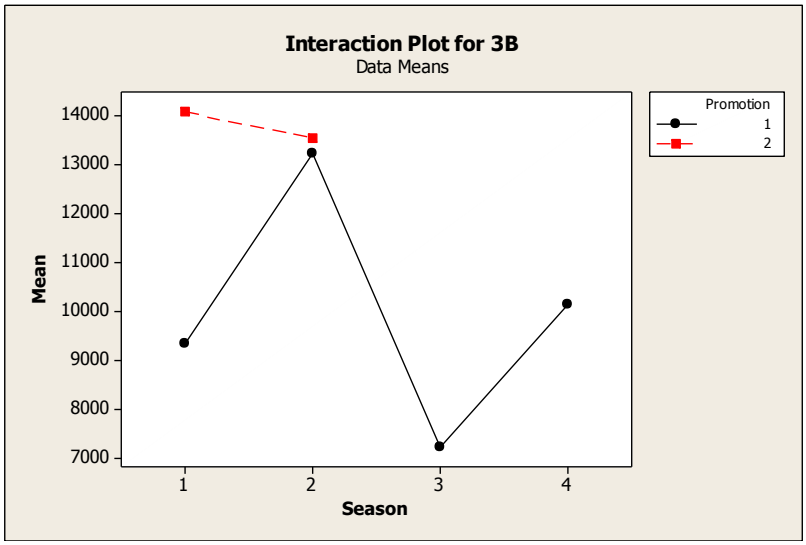

Figure 3.8: Interaction Plot for 3B; Promotion and Season

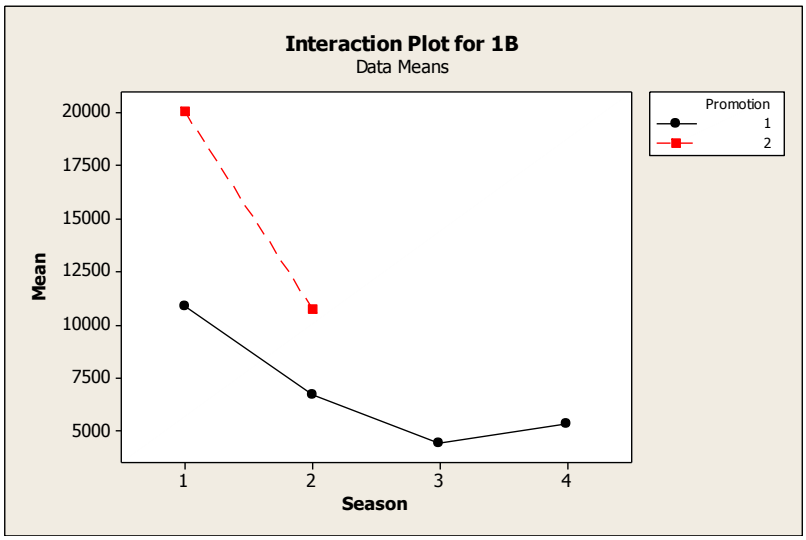

Figure 3.9: Interaction Plot for 1B; Promotion and Season

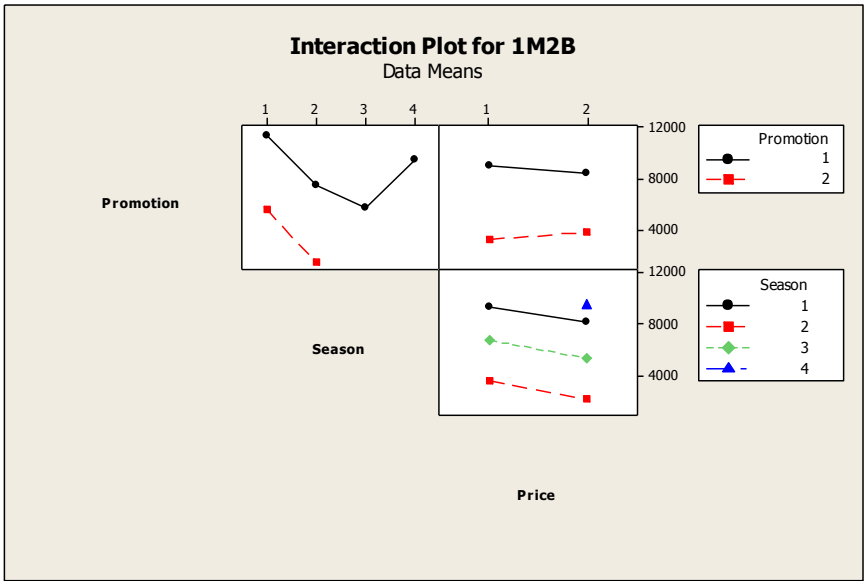

Figure 3.10: Interaction Plot for 1M2B; Promotion, Season and Price Change

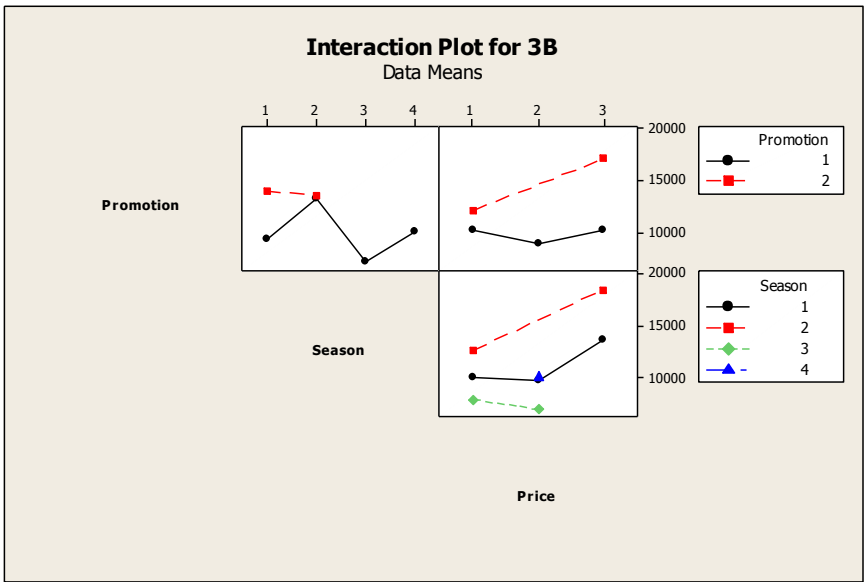

Figure 3.11: Interaction Plot for 3B; Promotion, Season and Price Change

Parallelism between curves in interaction plots means there exists no or slight relationship between main effects defined. Triple interaction plots can only be made for bundles 1M2B and 3B because they are the only bundles that have price changes during the time interval. In none of the plots a conflicting curve exists so it can be said that there is no significant cross over effect between promotion, season and price effects. So it can be said that the effects of promotion and price stay the same or change slightly in whichever season the bundles are sold. Main reason for analyzing interaction plots is that in the algorithm part the information of if promotion effect change according to the season is needed. The promotion coefficient will be taken constant in the algorithm during the seasons because of non-existing cross over interaction between promotion, season and pricing issues. If it existed, the coefficient of promotion would have been different for 4 seasons.

In the final part of analysis section, correlation table for all bundle demands is built using MS Excel. Results are shown in Table 3.3.

Table 3.3: Correlation among Bundles

	1M2B	1M1B	3B	1B
1M2B	1			
1M1B	-0,52	1		
3B	0,17	0,47	1	
1B	0,28	0,07	0,32	1

For the amount of data used 63 weeks, it is not that healthy to make a comment about the relationship between bundles. But the correlation table gives us hints about the nature of target segment consumers. The negative relationship between bundles 1M2B and 1M1B is expected due to the reasons that both of them are not being produced at the same time period. But what is interesting on the table is relationship between 1M1B and 3B bundles. Once customer buys the machine for a discounted price, they buy simultaneously or afterwards bottle bundle. Hence, 1M1B is not only a self-promoting product, it also makes other higher profit bundle demands to increase working as a seed.

3.4. Problem Definition

Interpreting graphics drawn in section 3.2, it wouldn't be accurate to ignore declining trend in demand curves. This could be a result of actions that is made to boost profit, rival brand initiatives, a general shrink in market demand, decreasing buying power of target segment, increasing number of new entrants into the market. Firms should be able to keep their market share while maximizing their profits. Profit maximization is essential in both short and long term decisions. However, losing market share in long term can be dangerous and may harm companies' profitability and even worse if the company runs on only one type of product, they may even face bankruptcy.

In line with those effects of profitability and market share issues, the first issue to wonder about the company in question is if the pricing structure of the company harms market share or profitability. Prices of the bundles may not have been set according to maximizing profit and keeping or increasing market share aims. The previous part of the thesis shows that, nearly all bundle demands affect each other. A

correct re-pricing of even one bundle may create a bigger influence on both market share and profitability. Within the limitations of the data given, it is appropriate to investigate profit, market shares and pricing policies of the company.

Apart from those market share and profitability issues, company has issued seeding/harvesting periods of bundles (machine including) which brings out new questions such as if those periods are long enough, and if they are positioned in the calendar accurately.

To sum up, the research questions that the algorithm structure will be built on are as follows;

- Is the pricing structure of the company right?
- Is it possible to improve profit without harming market share?
- What should the price of each product or bundle be?
- Is promotional period necessary? If so, is it positioned right in the calendar?
- How long should the promotional period last?

Answers of these questions will be given and interpreted in results section.

3.4.1. Optimization Algorithm

In order to solve problems and answer questions defined in Section 3.3, an optimization algorithm is developed using Lingo 11.0 optimization software. In this part, firstly data preparation process will be shown and then model developed will be explained step by step. Besides, a screen shot of codes written can be found in Appendix B.

Although pricing and promotional decisions cannot be made for short periods, data supplied from the company is weekly. So in order to manage an applicable solution, data will be purified to be a base data which does not include any existing pricing and promotional policies. Afterwards, it will be converted from weekly into monthly periods. All effects that are determined in data will be extracted except for the

seasonality. The basic reason for not extracting seasonality is that, it is not possible to make any changes on it. Floating demand through seasons is in the nature of products that are in question. Also, seasonality does not have any interaction with pricing and promotion strategies according to the plots drawn in data analysis part 3.3. Promotional periods cannot be accurately placed without the seasonality effect remaining in data. So it is not accurate to extract seasonal effect from data.

To derive a base data that has no pricing and promotional effects in it, method of normalizing data means is used. First step for preparing data is to slightly shifting usable time period 3 weeks from the start. This step was done to get rid of inconsistent weeks at the beginning of the data. Instead of using first 3 weeks from 2010, first 3 weeks from 2011 will be used during preparation and also in the model. Model developed will be using 52 week data starting from 25.01.10 and ending in 17.01.11. Next step will be neutralizing promotional weeks' mean and non-promotional week's mean given in Table 3.4.

In addition to promotional and non-promotional effects, there is a significant difference in means of 5 weeks after promotion so they will be neutralized separately. It takes 5 weeks to pass until 1M1B reaches to its own non-promotional mean (3339,18).

Table 3.4: Demand Data

	Means of Periods			
Bundles	**Promotional**	**After Pro.**	**Non-Pro.**	**Full data Mean**
1M2B	3311,43	7525,20	8251,48	6851,63
1M1B	17540,86	9640,80	3339,18	7768,63
3B	12093,64	13222,60	8623,98	10000,29
1B	5628,00	6681,80	5044,94	5359,31

Neutralization is done by calculating coefficients to multiply each week to acquire stabilized means in each period. Coefficients for each bundle in Table 3.5 is found by dividing each period mean to total mean.

Table 3.5: Coefficients for Different Promotional Conditions

	Coefficients		
Bundles	**Promotional**	**After Pro.**	**Non-Pro.**
1M2B	2,07	0,91	0,83
1M1B	0,44	0,81	2,33
3B	0,83	0,76	1,16
1B	0,95	0,80	1,06

Weekly data that is multiplied by each coefficient is given in Appendix C. Also outlier demand data on 27.09.10 that is inconsistent with its previous and next week is neutralized by using averages of 2 weeks nearby the outliers. These outliers may be a result of a week-lasting promotion that is made by distributers themselves. Outliers occurred in the same week of the year so this supports the idea of one week discount. After securing consistency of data, next step done is to purify effects of pricing policies. It has been done in the same way as promotional effect done.

Table 3.6: Demand under different Price Levels

	Means		
Bundles	**Before Price Inc.**	**After Price Inc.**	**Total Mean**
1M2B	7093,77	6001,39	6851,63
1M1B	7995,24	7588,91	7768,63
3B	10110,21	9468,98	10000,29
1B	5309,71	5398,64	5359,31

Price increase is done in 1M2B and 3B bundles at the same week (05.07.10). Means of the period before and after that week are given in Table 3.6. Main reason for doing this step after promotional effect purifying step is not to blow up pricing effect that starts at the second half of the year because of promotional week's effect placed at the beginning of the year. Coefficients gathered by dividing each mean to total mean is given in Table 3.7.

Table 3.7: Coefficients for Different Price Levels

	Coefficients	
Bundles	**Before Price Inc.**	**After Price Inc.**
1M2B	0,97	1,14
1M1B	0,97	1,02
3B	0,99	1,06
1B	1,01	0,99

For the sake of simplicity, price change that is only made in 3B bundle is not taken into calculation. New set of data calculated by multiplying each coefficient to its affiliated week is given in Appendix D.

Last step is to bring each week together to create a monthly basis data. Set of monthly data used in optimization algorithm is given in Table 3.8.

Table 3.8: Monthly Data Prepared for Algorithm

	Months						
Bundles	1	2	3	4	5	6	
1M2B	42267	42419	18434	6519	33089	31850	
1M1B	25130	21747	53915	29724	37742	35258	
3B	35144	36008	50812	40475	49458	42067	
1B	25401	26742	26063	16418	27047	20486	
	Months						
	7	8	9	10	11	12	Total
	12963	19836	23042	32061	39476	54328	356285
	30968	36858	32235	27941	41309	31142	403969
	28986	41075	43445	48528	55726	48289	520015
	19980	20702	21966	18263	32477	23139	278684

Since it is an optimization problem, first step is building the algorithm to define the objective function. As mentioned in Section 3.3, there are two conflicting goals that need to be maximized. To maximize more than one goal in one problem, it is appropriate to use goal modeling. In order to show how goals change under different levels of weights, model will be run several times with changing weights.

$$MAX = W * GOAL1P + (1 - W) * GOAL2P$$

$$\text{GOAL1P} = \Big(\big((\text{P1} - 3) * \text{D1} + (\text{P12} - 4) * \text{D12} + (\text{P222} - 4) * \text{D222} + (\text{P2} - 2) * \text{D2}\big) - 18901174\Big)/18901174$$

$$\text{GOAL2P} = \big((\text{D1} + \text{D12} + \text{D222} + \text{D2}) - 1573652\big)/1573652 \qquad (3.1)$$

Objective function for undefined weighted goals is given in Equation 3.1.

GOAL1P is the percentage profit change using the new price, demand and extracting existing profit. Total theoretical profit gathered selling 4 different bundles in year 2010 is 18.901.174 TL.

GOAL2P is the percentage demand change from the existing total demand. While maximizing profit by increasing price, the firm should be protecting its current position in the market. This goal helps providing this type of aim.

$$P1 > 3$$
$$P12 > 4$$
$$P222 > 4$$
$$P2 > 2$$

(3.2)

Equation 3.2 is written to claim that price of any bundle cannot be less than its cost. Costs used are not real because of privacy issues but they are approximately adapted from real costs. Each unit in bundle is taken as 1TL and 1TL as packaging costs are added afterwards. For example, price of 1M2B is a sum of 1TL machine cost, 2TL bottle cost and 1TL packaging cost.

$$P1 \leq P12 * 0{,}6$$
$$P2 \leq P1 * 0{,}8$$

(3.3)

To protect company's pricing policy at least partially, constraints for rational relationship between bundle prices is included into the model. In existing price structure, price of 1M1B is 60% of price of 1M2B and 1B price is 80% of 1M1B price. To sum up, 1M1B price changes depends on the price of 1M2B and 1B price changes depends on the price of 1M1B. Price of 3B is left alone to float itself.

In the optimization model, Equations from 3.4 to 3.7 is written in a loop to use set of monthly data and assign promotional month(s) into binary variables. Loop format of equations can be found in Appendix B.

$$D12 = \sum_{i=1}^{12} (1 - PRO_i) * \left(\left(\frac{B12_i}{0.83} \right) - (P12 - 18) * 2188 \right) + \left(PRO_i * \left(\left(\frac{B12_i}{2.069} \right) - (P12 - 18) * 2188 \right) \right) \quad (3.4)$$

$$D1 = \sum_{i=1}^{12} (1 - PRO_i) * \left(\left(\frac{B1_i}{2.326} \right) - (P1 - 10) * 2188 \right) + \left(PRO_i * \left(\left(\frac{B1_i}{0.4428} \right) - (P1 - 10) * 2188 \right) \right) \quad (3.5)$$

$$D222 = \sum_{i=1}^{12} (1 - PRO_i) * \left(\left(\frac{B222_i}{1.159} \right) - (P222 - 21) * 2188 \right) + \left(PRO_i * \left(\left(\frac{B222_i}{0.827} \right) - (P222 - 21) * 2188 \right) \right) \quad (3.6)$$

$$D2 = \sum_{i=1}^{12} (1 - PRO_i) * \left(\left(\frac{B2_i}{1.062} \right) - (P2 - 9) * 2188 \right) + \left(PRO_i * \left(\left(\frac{B2_i}{0.952} \right) - (P2 - 9) * 2188 \right) \right) \quad (3.7)$$

In the equations above, PRO_i is a binary variable which gets 1 as a value when it is optimum to make promotion on that month, gets 0 when it is not feasible to make promotion. Data sets of 12 months calculated earlier in this section are used as set of values for variables $B12_i$, $B1_i$, $B222_i$ and $B2_i$ in the algorithm of the model.

Equations from 3.4 to 3.7 are the main body of the algorithm written. They are built to change demand for different promotional and pricing conditions. At first glance, they consist of two parts; during promotion period price; and no promotion price. To actualize the total demand equation depending on the price conditions, how much demand changes for 1 unit of increase/decrease in price is found. Demand reflection

to the price change is found from the real data set by using basic ratios. The normalized average difference between higher priced months and lower priced months is 3566 for average price change of 1,63. So, 1 unit distinction in price causes demand to decrease/increase 2188 units. In algorithm, the program cumulatively sums demands of each month and ends up with total demand to use in objective function.

3.5. Results

To gather results, percentage weights are used for W in Equation 3.1. In literature, many studies have done to search for relationship between market share and profitability. In years according to the Table 3.9, results change from strongly positive to no or weakly positive relationship. Fraering and Minor (1994) also resulted with a too weak relationship in their comparative study of company ROAs (return on asset) and market shares. In order for an entity to sustain its existence, it must be profitable; except for the charities and non-profit organizations. Thus, weights are chosen in a scale that is closer to the profitability goal. Goals starts from 50% to 50%, additively 10% increases in each step and finally reaches to 100% to %0.

Equations explained in the previous section are turned into language of Lingo optimization program and run for different levels of goal weights. A screenshot of codes and a sample solution sheet for 50% weights is given in Appendix E. Results for different levels of weights are given in Table 3.10. In addition to that, existing conditions are shown in Table 3.11 to compare before and after optimization.

Table 3.9: Studies of Market Share and Profitability Relationship (Fraering, 1994)

Study	Year	MS/Profitability relationship
Buzzel,Gale and Sultan	1975	Strongly Positive
MacMillan,Hambrick and Day	1982	Strongly Positive
Newton	1983	Weakly Positive
Hergert	1984	Positive but insignificant
Smirlock	1985	Strongly Positive
Wernerfelt	1986	Positive only in introduction/growth stages
Bourantas and Mandes	1987	Spurious relationship
Markell,Neeley and Strickland	1988	Significant only in plastics sector
Jacobson	1988	No relationship
Shanklin	1988	Weakly Positive
Schwalbach	1991	No relationship

Table 3.10: Results for Different Weights of Profit and Demand Goals

	50%	60%	70%
Profit Max. Goal	18.703.070,00	20.745.520,00	21.704.220,00
Demand Max. Goal	2.312.384,00	2.108.327,00	1.962.571,00
1Y1M Price	8,30	9,71	10,72
2Y1M Price	13,83	16,18	17,87
3Y Price	18,17	20,17	21,60
1Y Price	5,07	7,07	8,50
	80%	**90%**	**100%**
Profit Max. Goal	22.134.860,00	22.311.550,00	22.355.040,00
Demand Max. Goal	1.857.063,00	1.775.587,00	1.710.407,00
1Y1M Price	11,55	12,20	12,73
2Y1M Price	19,25	20,34	21,21
3Y Price	22,67	23,50	24,17
1Y Price	9,24	9,76	10,18

Table 3.11: Existing Conditions for Bundles

	Existing C.
Profit Max. Goal	18.901.174,00
Demand Max. Goal	1.573.652,00
1Y1M Price	9,99
2Y1M Price	17,99
3Y Price	20,99
1Y Price	8,99

Results are given in Table 3.10 are graphically visualized in Figure 3.12. Profit increases faster at the beginning of the model runs where the goal weights are closer to each other. But closer to the last runs, profit stays relatively steady. This is because of the negative effects of price increase. Consumers stop buying or buy less frequent when the price of the product is higher than their reservation prices. As the model increases prices, demand falls but it needs high demand and high price to maximize the profit goal defined. Thus, it stabilizes the increase of profit.

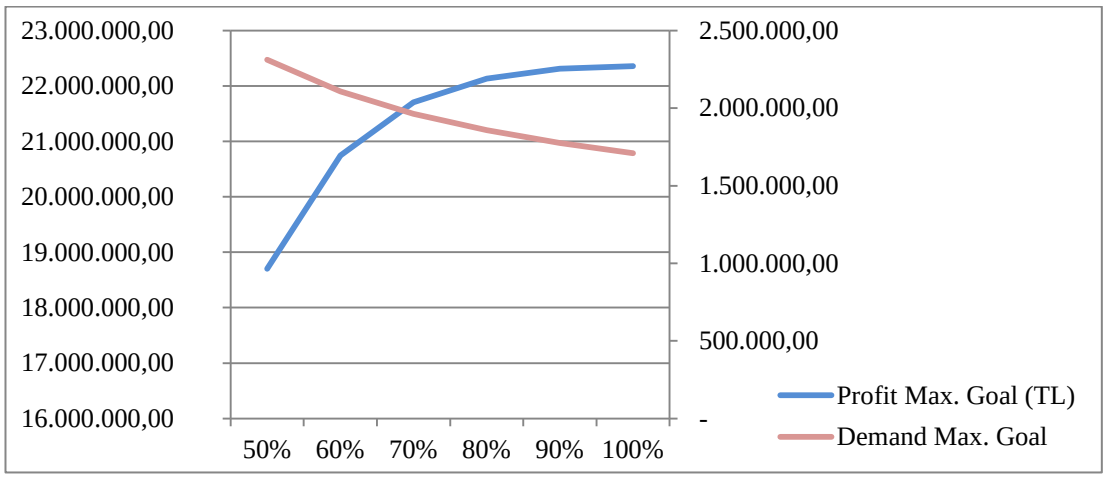

Figure 3.12: Graphic of Profit and Demand Goals

Prices and demands are not the only results of the algorithm written. There was another important variable to analyze carefully; promotional months. Promotional month results for all goal weights are the same and equal to 1, meaning promotion should be continuous and deployed into all year. Promotional month is not just a type of discount period, it brings out a new bundle which is only available in that months. When promotion is spread to whole year, it means bringing promotional 1M1B bundle package as a normal product that is packaged continuously.

To show the effect of profit and market share changes, Table 3.12 is drawn. Percentage increases got closer to each other around 80% - 20% weight distribution model.

Table 3.12: Comparison of Results and Existing Conditions

	Percentage Change					
Weights	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
Profit	-1%	10%	15%	17%	18%	18%
Demand	47%	34%	25%	18%	13%	9%
Total	23%	19%	18%	17%	18%	18%

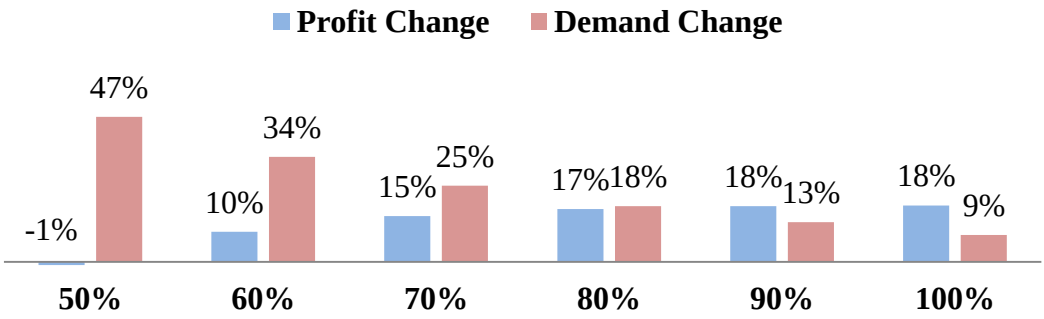

Figure 3.13: Comparison Chart

According to the results of the algorithm utilized, the existing strategy of the firm is not right and should be changed. In line with the research questions defined in Problem Definition section, we suggest that the 80% weighted result is the most appropriate price structure for the company. It improves both profit and market share with more balanced change ratios (17% Profit Increase and 18% Market Share Increase).

Table 3.13: Comparison Table of Proposed vs. Existing Pricing Structures

	Existing C.	Proposed	Change %
Profit	18.901.174,00	22.134.860,00	17,1%
Demand	1.573.652,00	1.857.063,00	18,0%
1M1B Price	9,99	11,55	15,6%
1M2B Price	17,99	19,25	7,0%
3B Price	20,99	22,67	8,0%
1B Price	8,99	9,24	2,8%

Generally there exists a price increase between new and old prices. But, according to Table 3.13, those changes do not exceed company's price increase strategy that has been done before as 9% and 16% price increases. While proposed pricing structure does not exceed company's framework of price increase, it improves both profit and demand simultaneously.

Apart from pricing results of algorithm, promotional results show that there is no need of any promotional period or promotional product. Instead the "promotional product1M1B" bundle should be added to the product portfolio and sold all year long based on the existing demand conditions. Thus, company should package 1M2B and 1M1B simultaneously.

To sum up, results given in this section support that; it is possible to both increase profit and demand by making promotional product available all year and making small adjustments to the existing pricing strategies. While promotion boosts demand for most of the bundles and increases profit accordingly, slightly higher prices will not make big differences in company's position in the market, instead they will help increase profits.

3.6. Conclusion

Bundling, one of the common application of selling practices, has been analyzed for over many years. Packaging products together and selling them as a bundle is done for increasing sales volume and decreasing uncertainty, like many marketing strategies are intended to do. But sales volume is not the only multiplier in sales revenue; price is another strong player in both marketing and financial analysis. To co-operate with those two difficult revenue drivers was what this thesis aimed to

achieve. It has always needed a hard work to maximize both profit and sales volume. Profit generally depends on high prices while demand is in a reverse relationship with price. As a matter of fact, an optimization model was developed to maximize profits by using accurate price allocation constraints while taking advantage of bundling as a volume increaser inhibitor. The aim of optimizing simultaneously to conflicting goals is achieved. A new strategy of canceling promotional periods and selling them as a regular product is achieved. New prices for existing bundles and products are defined. With the help of new strategy and new prices demand is improved 18% and profit increase by 17%.

Bundling was usually investigated by making assumptions, applying survey methods about non-existing products. Results were usually dependent to theoretical approaches, judgmental data that is likely to differ from research to research. Considering bundles that do not even exist was not sufficient in order to develop right strategies for right bundles in right prices. In that manner, the most important role of this research was to work with real bundle demand data without getting lost in approaches or assumptions. Optimization was the most appropriate method that is likely to solve chaos of conflicting goals, price and demand constraints, and maximization issues in the demand data that is given by the company. It is full of surprises, unexpected errors to work with real demand data. Mixed bundling demand data was laying untouched at the beginning of this research but after many attempts, creating, disposing, recreating many models a solution was gathered. Initial models were mainly focused on building a regression equation that consists of every impact, making each demand curve float through time. Lingo 11.0 is used as a tool to find an optimum solution for the models developed. Infinite loops, inapplicable too high prices were the main problems of the initial models. Those problems were solved with a lean model that accepts only two effects as main demand drivers and ignores others because they are in the nature of the products/bundles. Results were acceptable and we achieved our aim of maximizing two conflicting profit and demand goals. In addition, a new promotional strategy is suggested.

Scarce amount of data was our limitations. With the help of longer data periods, recursive promotional periods results can be improved. Also, some effects are ignored because of absence of rival companies', substitute product data. More

reflective results can be gathered by including more data and more effects into the model developed. Working with a real company, observing real customer reactions to changes in strategies gives encouraging and motivational aim to achieve but it also brings some difficulties indeed.

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APPENDICES

APPENDIX A: Raw Demand Data

	Dates	04.01.10	11.01.10	18.01.10	25.01.10	01.02.10	08.02.10
Bundles	1M2B	9392	16171	15345	12648	6164	5339
	1M1B	141	107	84	680	4614	8951
	3B	6988	6909	8722	13677	9750	14902
	1B	5463	6510	4696	6771	7754	7647
	Dates	**15.02.10**	**22.02.10**	**01.03.10**	**08.03.10**	**15.03.10**	**22.03.10**
Bundles	1M2B	5426	4297	2980	2153	1758	1274
	1M1B	16964	20006	27441	29039	26787	23553
	3B	10231	9141	9645	14214	12210	14067
	1B	6324	6098	6690	5773	5379	4541
	Dates	**29.03.10**	**05.04.10**	**12.04.10**	**19.04.10**	**26.04.10**	**03.05.10**
Bundles	1M2B	1059	1016	885	729	632	1126
	1M1B	18465	16263	13343	23200	16266	14507
	3B	11988	10359	10811	12827	15489	14171
	1B	4733	4749	4325	3878	4130	5042
	Dates	**10.05.10**	**17.05.10**	**24.05.10**	**31.05.10**	**07.06.10**	**14.06.10**
Bundles	1M2B	2970	11118	13344	9068	6099	7430
	1M1B	10220	7259	10610	5608	3942	3783
	3B	10761	10567	19929	10685	7616	6896
	1B	6162	5330	9753	7122	4296	4545
	Dates	**21.06.10**	**28.06.10**	**05.07.10**	**12.07.10**	**19.07.10**	**26.07.10**
Bundles	1M2B	6812	19372	4051	3535	3257	2831
	1M1B	3650	4222	3696	3487	3221	2599
	3B	9325	12839	6559	5974	5976	5160
	1B	4182	6083	4485	4475	5219	4767
	Dates	**02.08.10**	**09.08.10**	**16.08.10**	**23.08.10**	**30.08.10**	**06.09.10**
Bundles	1M2B	3852	4036	3771	4291	4974	6704
	1M1B	2901	3027	3121	3067	3360	3888
	3B	6895	7226	5743	6001	7675	10779
	1B	4132	4047	3720	3570	4162	4857

APPENDIX A: CONT'D

	Dates	**13.09.10**	**20.09.10**	**27.09.10**	**04.10.10**	**11.10.10**	**18.10.10**
Bundles	1M2B	5973	5884	28733	5120	6004	7895
	1M1B	3208	3158	3281	3200	3050	2824
	3B	9388	6853	19563	8154	9427	8563
	1B	5788	4200	5984	5091	4123	4304
	Dates	**25.10.10**	**01.11.10**	**08.11.10**	**15.11.10**	**22.11.10**	**29.11.10**
Bundles	1M2B	14801	5381	9576	9665	8890	8130
	1M1B	2658	2744	4179	3624	3480	3318
	3B	13483	7563	12627	8431	7396	9487
	1B	3800	4423	7335	6874	6309	5855
	Dates	**06.12.10**	**13.12.10**	**20.12.10**	**27.12.10**	**03.01.11**	**10.01.11**
Bundles	1M2B	11731	16035	18371	11172	5854	6143
	1M1B	3494	3421	3318	2843	3219	3747
	3B	9567	11506	10117	8241	6372	6931
	1B	6394	5271	5016	5261	5832	6862
	Dates	**17.01.11**	**24.01.11**	**31.01.11**	**07.02.11**	**14.02.11**	**21.02.11**
Bundles	1M2B	5926	9.191	9.587	3.899	4.256	2.339
	1M1B	3463	3.085	3.950	7.705	9.784	17.361
	3B	6260	12276	13537	11604	14040	19700
	1B	5221	4654	4552	5073	5486	4869

	Dates	**28.02.11**	**07.03.11**	**14.03.11**	**Avr.**	**Sum**	**Profit / Unit**	**Total Profit**
Bundles	1M2B	2.526	2.107	2.237	6851,6	356285	14	4987990
	1M1B	21.451	17.368	15.403	7768,6	403969	7	2827783
	3B	23977	19475	17640	10000,3	520015,3	17	8840261
	1B	5300	5147	6290	5359,3	278684	7	1950788
					Total Demand	1558953	**Total Profit**	18606822

Notes:

Red colored area is not used in one year calculations. Instead, yellow colored area is used.

Blue colored area represents promotional periods.

Green colored area shows after promotional period.

Red lines indicate the dates of price increases.

APPENDIX B: Screenshot of Codes

```
MAX= 0.5*GOAL1P+0.5*GOAL2P;
GOAL1P=(((P1-3)*D1+(P12-4)*D12+(P222-4)*D222+(P2-2)*D2)-18606821.67)/18606821.67;
GOAL2P=((D1+D12+D222+D2)-1558953)/1558953;
GOAL1=(P1-3)*D1+(P12-4)*D12+(P222-4)*D222+(P2-2)*D2;
GOAL2=D1+D12+D222+D2;
P1>3;
P12>4;
P222>4;
P2>2;
P1<=P12*0.6;
P2<=P1*0.8;
Sets:
Bundle: MD12, B12, MD1, B1, MD222, B222, MD2, B2,PRO;
ENDSETS
DATA:
Bundle= JAN..DEC;
B12= 40588.09 42419.33 18433.8 6518.979 33088.8 31850.16 11681.65 17875.3 20764.74 28892.31 35574.61
      48958.88;
B1=25130.4 21746.99 53914.54 29724.11 37742.24 35258.08 30968.02 36857.73 32235.04 27941 41308.96
      31141.88;
B222=34070.81 36007.91 50812.18 40475.36 49457.88 42066.83 27687.73 39234.71 41498.74 46354.05
      53229.67 46125.94;
B2=25400.65 26742.14 26062.61 16418.4 27046.83 20486.14 19979.96 20702.34 21965.72 18263.11 32476.65
      23139.46;
ENDDATA
@FOR(
Bundle(I):MD12(I)= (1-PRO(I))*((B12(I)/0.83)-(P12-18)*2188)+(PRO(I)*((B12(I)/2.069)-
      (P12-18)*2188));
@BIN(PRO(I));
);
D12=@SUM(Bundle(I):MD12(I));
@FOR(Bundle(I):MD1(I)= (1-PRO(I))*((B1(I)/2.326)-(P1-10)*2188)+(PRO(I)*((B1(I)/0.4428)-
      (P1-10)*2188)));
D1=@SUM(Bundle(I):MD1(I));
@FOR(Bundle(I):MD222(I)= (1-PRO(I))*((B222(I)/1.159)-(P222-
      21)*2188)+(PRO(I)*((B222(I)/0.827)-(P222-21)*2188)));
D222=@SUM(Bundle(I):MD222(I));
@FOR(Bundle(I):MD2(I)= (1-PRO(I))*((B2(I)/1.062)-(P2-9)*2188)+(PRO(I)*((B2(I)/0.952)-
      (P2-9)*2188)));
D2=@SUM(Bundle(I):MD2(I));
```

APPENDIX C: Demand Data Multiplied by Promotional Coefficients

	Dates	**25.01.10**	**01.02.10**	**08.02.10**	**15.02.10**	**22.02.10**	**01.03.10**
Bundles	1M2B	26169,82	12753,85	11046,86	11226,87	8890,868	6165,88
	1M1B	301,1638	2043,485	3964,29	7513,152	8860,417	12153,29
	3B	11309,58	8062,325	12322,54	8460,066	7558,739	7975,5
	1B	6447,739	7383,808	7281,916	6022,079	5806,869	6370,606
	Dates	**08.03.10**	**15.03.10**	**22.03.10**	**29.03.10**	**05.04.10**	**12.04.10**
Bundles	1M2B	4454,745	3637,455	2636,017	2191,163	2102,193	1831,142
	1M1B	12861,02	11863,64	10431,34	8177,926	7202,687	5909,454
	3B	11753,63	10096,51	11632,07	9912,938	8565,91	8939,671
	1B	5497,385	5122,195	4324,203	4507,037	4522,273	4118,516
	Dates	**19.04.10**	**26.04.10**	**03.05.10**	**10.05.10**	**17.05.10**	**24.05.10**
Bundles	1M2B	1508,365	1307,663	1025,214	2704,161	10122,85	12149,61
	1M1B	10275	7204,016	11689,86	8235,359	5849,361	8549,624
	3B	10606,71	12807,93	10717,57	8138,579	7991,856	15072,37
	1B	3692,856	3932,825	4044,064	4942,389	4275,062	7822,642
	Dates	**31.05.10**	**07.06.10**	**14.06.10**	**21.06.10**	**28.06.10**	**05.07.10**
Bundles	1M2B	8256,342	5064,315	6169,513	5656,356	16085,57	3363,755
	1M1B	4518,972	9171,096	8801,181	8491,756	9822,519	8598,775
	3B	8081,1	8831,45	7996,544	10813,19	14888	7605,762
	1B	5712,381	4563,699	4828,215	4442,595	6462,054	4764,476
	Dates	**12.07.10**	**19.07.10**	**26.07.10**	**02.08.10**	**09.08.10**	**16.08.10**
Bundles	1M2B	2935,293	2704,456	2350,726	3198,515	3351,3	3131,256
	1M1B	8112,535	7493,684	6046,595	6749,201	7042,341	7261,033
	3B	6927,4	6929,72	5983,493	7995,384	8379,209	6659,535
	1B	4753,853	5544,215	5064,049	4389,48	4299,183	3951,807

APPENDIX C CONT'D

	Dates	**23.08.10**	**30.08.10**	**06.09.10**	**13.09.10**	**20.09.10**	**27.09.10**
Bundles	1M2B	3563,039	4130,169	5566,678	4959,691	4885,79	4770,578
	1M1B	7135,401	7817,068	9045,465	7463,439	7347,114	7633,274
	3B	6958,709	8899,866	12499,24	10886,25	7946,682	9804,83
	1B	3792,46	4421,349	5159,657	6148,671	4461,717	6356,885
	Dates	**04.10.10**	**11.10.10**	**18.10.10**	**25.10.10**	**01.11.10**	**08.11.10**
Bundles	1M2B	4251,401	4985,432	6555,627	12290,04	4468,123	7951,448
	1M1B	7444,827	7095,851	6570,06	6183,859	6383,939	9722,479
	3B	9455,31	10931,08	9929,197	15634,39	8769,605	14642,16
	1B	5408,239	4379,919	4572,198	4036,792	4698,613	7792,07
	Dates	**15.11.10**	**22.11.10**	**29.11.10**	**06.12.10**	**13.12.10**	**20.12.10**
Bundles	1M2B	8025,349	7381,827	6750,759	9740,856	13314,69	15254,39
	1M1B	8431,267	8096,249	7719,355	8128,82	7958,985	7719,355
	3B	9776,904	8576,34	11000,66	11094,2	13342,26	11731,59
	1B	7302,344	6702,136	6219,846	6792,433	5599,455	5328,565
	Dates	**27.12.10**	**03.01.11**	**10.01.11**	**17.01.11**	**Avr.**	**Sum**
Bundles	1M2B	9276,689	4860,879	5100,851	4920,664	6484,559	337197,1
	1M1B	6614,263	7489,031	8717,427	8056,699	7768,635	403969
	3B	9555,808	7388,531	8036,743	7259,43	9752,598	507135,1
	1B	5588,832	6195,413	7289,596	5546,339	5359,308	278684

Notes:

Blue colored area represents promotional periods.

Green colored area shows after promotional period.

Non-colored area shows the non-promotional area.

APPENDIX D: Demand Data Multiplied by Pricing Coefficients

	Dates	**25.01.10**	**01.02.10**	**08.02.10**	**15.02.10**	**22.02.10**	**01.03.10**
Bundles	1M2B	25276,53	12318,51	10669,78	10843,65	8587,386	5955,413
	1M1B	292,6279	1985,567	3851,93	7300,206	8609,286	11808,83
	3B	11186,63	7974,675	12188,58	8368,092	7476,565	7888,794
	1B	6507,962	7452,775	7349,932	6078,327	5861,107	6430,109
	Dates	**08.03.10**	**15.03.10**	**22.03.10**	**29.03.10**	**05.04.10**	**12.04.10**
Bundles	1M2B	4302,686	3513,294	2546,039	2116,37	2030,436	1768,638
	1M1B	12496,5	11527,39	10135,68	7946,139	6998,541	5741,962
	3B	11625,85	9986,747	11505,62	9805,17	8472,786	8842,483
	1B	5548,732	5170,038	4364,593	4549,134	4564,512	4156,984
	Dates	**19.04.10**	**26.04.10**	**03.05.10**	**10.05.10**	**17.05.10**	**24.05.10**
Bundles	1M2B	1456,878	1263,027	990,2192	2611,857	9777,315	11734,89
	1M1B	9983,776	6999,832	11358,53	8001,944	5683,572	8307,302
	3B	10491,4	12668,69	10601,06	8050,1	7904,973	14908,51
	1B	3727,349	3969,559	4081,837	4988,552	4314,992	7895,707
	Dates	**31.05.10**	**07.06.10**	**14.06.10**	**21.06.10**	**28.06.10**	**05.07.10**
Bundles	1M2B	7974,519	4891,449	5958,922	5463,281	15536,51	3840,314
	1M1B	4390,89	8911,16	8551,729	8251,074	9544,119	8802,416
	3B	7993,246	8735,439	7909,609	10695,64	14726,14	8032,533
	1B	5765,737	4606,325	4873,312	4484,091	6522,411	4729,763
	Dates	**12.07.10**	**19.07.10**	**26.07.10**	**02.08.10**	**09.08.10**	**16.08.10**
Bundles	1M2B	3351,151	3087,609	2683,765	3651,664	3826,095	3574,877
	1M1B	8304,66	7671,153	6189,794	6909,039	7209,121	7432,992
	3B	7316,108	7318,557	6319,236	8444,018	8849,38	7033,212
	1B	4719,218	5503,821	5027,153	4357,499	4267,86	3923,015

APPENDIX D CONT'D

	Dates	**23.08.10**	**30.08.10**	**06.09.10**	**13.09.10**	**20.09.10**	**27.09.10**
Bundles	1M2B	4067,832	4715,311	6355,336	5662,354	5577,983	5446,449
	1M1B	7304,386	8002,196	9259,684	7640,192	7521,112	7814,049
	3B	7349,174	9399,252	13200,59	11497,09	8392,583	10355
	1B	3764,828	4389,136	5122,065	6103,873	4429,21	6310,57
	Dates	**04.10.10**	**11.10.10**	**18.10.10**	**25.10.10**	**01.11.10**	**08.11.10**
Bundles	1M2B	4853,718	5691,742	7484,395	14031,23	5101,143	9077,969
	1M1B	7621,139	7263,898	6725,655	6330,309	6535,127	9952,732
	3B	9985,863	11544,44	10486,34	16511,66	9261,682	15463,76
	1B	5368,835	4348,008	4538,886	4007,38	4664,38	7735,299
	Dates	**15.11.10**	**22.11.10**	**29.11.10**	**06.12.10**	**13.12.10**	**20.12.10**
Bundles	1M2B	9162,34	8427,646	7707,173	11120,89	15201,05	17415,56
	1M1B	8630,94	8287,989	7902,169	8321,331	8147,474	7902,169
	3B	10325,5	9057,572	11617,92	11716,71	14090,92	12389,87
	1B	7249,14	6653,306	6174,53	6742,945	5558,659	5289,742
	Dates	**27.12.10**	**03.01.11**	**10.01.11**	**17.01.11**	**Avr.**	**Sum**
Bundles	1M2B	10590,96	5549,543	5823,513	5617,799	6851,635	356285
	1M1B	6770,906	7666,39	8923,878	8247,502	7768,635	403969
	3B	10092	7803,114	8487,698	7666,769	10000,29	520015,3
	1B	5548,113	6150,274	7236,485	5505,93	5359,308	278684

Notes:

Framed cells are normalized using the two cells around them.

Each color shows a different price period.

APPENDIX E: Solution Sheet for 50% to 50% Weights

Local optimal solution found.

Objective value:	0.2442367
Objective bound:	0.2442367
Infeasibilities:	0.3725290E-08
Extended solver steps:	0
Total solver iterations:	96

Variable	Value	Reduced Cost
GOAL1P	0.7650910E-02	0.000000
GOAL2P	0.4808226	0.000000
P1	8.326821	0.000000
D1	956236.7	0.000000
P12	13.87804	0.000000
D12	270936.1	0.000000
P222	18.20742	0.000000
D222	686407.5	0.000000
P2	5.106906	0.000000
D2	394952.4	0.000000
GOAL1	0.1874918E+08	0.000000
GOAL2	2308533.	0.000000
MD12(JAN)	28636.11	0.000000
MD12(FEB)	29521.19	0.000000
MD12(MAR)	17928.38	0.000000
MD12(APR)	12169.65	0.000000
MD12(MAY)	25011.51	0.000000
MD12(JUN)	24412.85	0.000000
MD12(JUL)	14664.90	0.000000
MD12(AUG)	17658.44	0.000000
MD12(SEP)	19054.98	0.000000
MD12(OCT)	22983.24	0.000000
MD12(NOV)	26212.97	0.000000
MD12(DEC)	32681.92	0.000000
B12(JAN)	40588.09	0.000000
B12(FEB)	42419.33	0.000000
B12(MAR)	18433.80	0.000000
B12(APR)	6518.979	0.000000
B12(MAY)	33088.80	0.000000
B12(JUN)	31850.16	0.000000
B12(JUL)	11681.65	0.000000
B12(AUG)	17875.30	0.000000
B12(SEP)	20764.74	0.000000
B12(OCT)	28892.31	0.000000
B12(NOV)	35574.61	0.000000
B12(DEC)	48958.88	0.000000
MD1(JAN)	60414.30	0.000000
MD1(FEB)	52773.36	0.000000
MD1(MAR)	125419.1	0.000000
MD1(APR)	70788.53	0.000000
MD1(MAY)	88896.33	0.000000
MD1(JUN)	83286.21	0.000000
MD1(JUL)	73597.73	0.000000
MD1(AUG)	86898.79	0.000000

APPENDIX E CONT'D

MD1(SEP)	76459.11	0.000000
MD1(OCT)	66761.64	0.000000
MD1(NOV)	96951.25	0.000000
MD1(DEC)	73990.36	0.000000
B1(JAN)	25130.40	0.000000
B1(FEB)	21746.99	0.000000
B1(MAR)	53914.54	0.000000
B1(APR)	29724.11	0.000000
B1(MAY)	37742.24	0.000000
B1(JUN)	35258.08	0.000000
B1(JUL)	30968.02	0.000000
B1(AUG)	36857.73	0.000000
B1(SEP)	32235.04	0.000000
B1(OCT)	27941.00	0.000000
B1(NOV)	41308.96	0.000000
B1(DEC)	31141.88	0.000000
MD222(JAN)	47308.24	0.000000
MD222(FEB)	49650.56	0.000000
MD222(MAR)	67551.73	0.000000
MD222(APR)	55052.55	0.000000
MD222(MAY)	65914.13	0.000000
MD222(JUN)	56976.94	0.000000
MD222(JUL)	39589.88	0.000000
MD222(AUG)	53552.37	0.000000
MD222(SEP)	56290.01	0.000000
MD222(OCT)	62161.01	0.000000
MD222(NOV)	70474.94	0.000000
MD222(DEC)	61885.18	0.000000
B222(JAN)	34070.81	0.000000
B222(FEB)	36007.91	0.000000
B222(MAR)	50812.18	0.000000
B222(APR)	40475.36	0.000000
B222(MAY)	49457.88	0.000000
B222(JUN)	42066.83	0.000000
B222(JUL)	27687.73	0.000000
B222(AUG)	39234.71	0.000000
B222(SEP)	41498.74	0.000000
B222(OCT)	46354.05	0.000000
B222(NOV)	53229.67	0.000000
B222(DEC)	46125.94	0.000000
MD2(JAN)	35199.44	0.000000
MD2(FEB)	36608.57	0.000000
MD2(MAR)	35894.78	0.000000
MD2(APR)	25764.31	0.000000
MD2(MAY)	36928.63	0.000000
MD2(JUN)	30037.14	0.000000
MD2(JUL)	29505.44	0.000000
MD2(AUG)	30264.24	0.000000
MD2(SEP)	31591.32	0.000000
MD2(OCT)	27702.03	0.000000
MD2(NOV)	42632.22	0.000000
MD2(DEC)	32824.24	0.000000
B2(JAN)	25400.65	0.000000
B2(FEB)	26742.14	0.000000
B2(MAR)	26062.61	0.000000

APPENDIX E CONT'D

B2(APR)	16418.40	0.000000
B2(MAY)	27046.83	0.000000
B2(JUN)	20486.14	0.000000
B2(JUL)	19979.96	0.000000
B2(AUG)	20702.34	0.000000
B2(SEP)	21965.72	0.000000
B2(OCT)	18263.11	0.000000
B2(NOV)	32476.65	0.000000
B2(DEC)	23139.46	0.000000
PRO(JAN)	1.000000	-0.1355669E
PRO(FEB)	1.000000	-0.1044292E
PRO(MAR)	1.000000	-0.5144237E
PRO(APR)	1.000000	-0.3302470E
PRO(MAY)	1.000000	-0.3124164E
PRO(JUN)	1.000000	-0.2757151E
PRO(JUL)	1.000000	-0.2894133E
PRO(AUG)	1.000000	-0.3415884E
PRO(SEP)	1.000000	-0.2962256E
PRO(OCT)	1.000000	-0.2356187E
PRO(NOV)	1.000000	-0.3437207E
PRO(DEC)	1.000000	-0.1794916E

APPENDIX F: Tez Fotokopi İzin Formu

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ☒

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı : Ersöz

Adı : Keriman Hande

Bölümü : İşletme Bölümü

TEZİN ADI (İngilizce) : Price Determination For Bundled Products: Applicatıon For A Household Product Group

TEZİN TÜRÜ : Yüksek Lisans ☒ Doktora ☐

1. Tezimin tamamı dünya çapında erişime açılsın ve kaynak gösterilmek şartıyla tezimin bir kısmı veya tamamının fotokopisi alınsın. ☒

2. Tezimin tamamı yalnızca Orta Doğu Teknik Üniversitesi kullancılarının erişimine açılsın. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

3. Tezim bir (1) yıl süreyle erişime kapalı olsun. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

Yazarın imzası ..... Tarih …….