NEAR EAST UNIVERSITY FACULTY OF ECONOMICS AND ADMINISTRATIVE SCIENCES DEPARTMENT OF BUSINESS ADMINISTRATION

GRADUATION PROJECT (MAN 400)

DEMAND FORECASTING FOR PEPSI COLA IN TRNC BY USING MULTIPLE REGRESSION METHOD

SUBMITTED BY: ERDEM BAĞCI (20011117) SUBMITTED TO: MR. ALİ MALEK

JULY 2005 LEFKOŞA NEAR EAST UNIVERSITY FACULTY OF ECONOMICS AND ADMINISTRATIVE SCIENCES DEPARTMENT OF BUSINESS ADMINISTRATION

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ABSTRACT

The demand forecasting plays a major role for the survival of companies, firms and enterprises in every sector. Demand forecasts are necessary since the basic operations process, moving from the suppliers' raw materials to finished goods in the customers' hands, takes time. Most firms cannot simply wait for demand to emerge and then react to it. Instead, they must anticipate and plan for future demand so that they can react immediately to customer orders as they occur.

The purpose of the study is to define the demand and its determinants and these determinants are used to do a good demand forecasting of the Ektam Kıbrıs Ltd for Pepsi cola in the last two quarters of 2005, and according the expected demand, is to solve the specific problems of the Ektam Kıbrıs Ltd for Pepsi cola.

Multiple regression method of the demand forecasting, SPSS computer package program and secondary data were used for the purpose of the study. The five predictor variables and forty observations were used in order to obtain a model for demand forecasting of Pepsi cola.

In conclusion, according to results of the study, the demand forecasting of the Ektam Kıbrıs Ltd for Pepsi cola was exceeded the effective production capacity of the firm for the last two quarters of 2005. In this case the firm's managers can follow some strategies (they were showed in section 8) in order to obtain benefits for firm.

Keywords: Demand, Demand Forecasting, TRNC, SPSS, and Multiple Regression

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SECTION 1

STARTING

1.1 Introduction

This section introduces the broad problem area, the actual problem statement, the purpose of this study, aims of this study, and contents of the sections of the study report.

1.2 Broad Problem Area

The demand forecasting plays a major role for the survival of companies and enterprises in the world market by predicted future. Because, the each company must predict the amount of the demand for their products in the future, in order to invest in new area and to produce new products and These forecasts drive a company's production, capacity, and scheduling systems and serve as inputs to financial, marketing and personal planning.

Demand forecasts are necessary since the basic operations process, moving from the suppliers' raw materials to finished goods in the customers' hands, takes time. Most firms cannot simply wait for demand to emerge and then react to it. Instead, they must anticipate and plan for future demand so that they can react immediately to customer orders as they occur. In other words, most manufacturers "make to stock" rather than "make to order" – they plan ahead and then deploy inventories of finished goods into field locations. Thus, once a customer order materializes, it can be fulfilled immediately – since most customers are not willing to wait the time it would take to actually process their order throughout the supply chain and make the product based on their order (httpsupplychain.ittoolbox.combrowse.aspc)

This study is intended to be an applied research project as defined by Sekaran (2003) as the research done with the intension of applying the results of the findings to solve specific problems experienced by organizations.

1.3 Problem Statement

The problem is: the effective production capacity of the Ektam Kıbrıs Ltd for the Pepsi cola is enough or not for the demand of Pepsi cola at the last two quarters of 2005. In order to understand this problem, the demand forecasting is needed. Then it should consider, if firm's effective production capacity is exceeds the demand forecasting of Pepsi cola in the last two quarters of 2005, which variable should be used to increase sales of Pepsi cola? If the demand forecasting of Pepsi cola is exceeds the firm's production capacity, the firm should avoid which costs or how it benefit from the high demand?

The purpose of this project is to define the importance of the demand forecasting and the methods of demand forecasting and is to do a good demand forecasting of Pepsi cola for the last two quarters of 2005 and determine which variable has how many effects on the demand of the Pepsi cola in order to solve the problems of the Ektam Kıbrıs Ltd for the Pepsi cola.

1.4 Purpose of The Study

The purpose of the study is to define the demand and its determinants and these determinants are used to do a good demand forecasting of the firm for Pepsi cola, Ektam Kıbrıs Ltd. and according the expected demand, is to solve the specific problems of the firm for Pepsi cola.

- To explain and define the variables of demand by using literature survey and then to decide which these variables of demand has affect on the sales of Pepsi cola in TRNC.
- To define and identify the demand forecasting and its methods by using literature survey.
- To decide which demand forecasting method should be selected.
- To do a demand forecasting of the Ektam Kıbrıs Ltd. for Pepsi cola by using the variables of the demand and Multiple Linear Regressions Method and SPSS computer package program.
- To decide which predictor variable has how much effect on the sales of Pepsi cola in TRNC.
- To compute the amounts of demand (forecasting) of Pepsi cola for the last two quarters of 2005.
- To reach the effective production capacity of the Ektam Kıbrıs Ltd for the Pepsi cola will be enough or not for the demand of Pepsi cola in the last two quarters of 2005.
- To decide which variable should be used to increase sales of Pepsi cola.
- To determine which strategies can be used by the firm according the results of the demand forecasting.

1.6 The Structure of the Study

After the starting sections, the literature survey is done in the section 2, the theoretical framework was developed and discussed from the literature survey in section 3, introduced to case study, given information about the firm and which variables has affect on the sales of the Pepsi cola that are decided in section 4, the methodology of the

study were described in section 5, the forecasting process is done in section 6, the major findings are found out from the forecasting process and given in section 7, the conclusion reached by the study was discussed in last section 8.

1.7 Conclusion

This section introduced the broad problem area, the problem statement, the purpose of study, aims of this study, and structure of the study

SECTION 2

A LITERATURE REVIEW

2.1 Introduction

This section describes; the demand and its determinants, the demand forecasting and its methods and techniques, the demand forecasting process. The all information is obtained from literature survey.

2.2 Demand and Forecast Concept

A forecast is a prediction of what will occur in the future. Meteorologists forecast the weather, sportscasters and gamblers predict the winners of football games, and managers of business firms attempt to predict how much of their product will be desired in the future. (Robert S. Russell/ Bernard W. Taylor III, 1995)

Demand is willingness and ability of buyer to purchase a given amount of goods or services, over a range of prices, over a given period of time. (Michael Parkin, 1998)

2.2.1 The Determinants of Demand

The determinants of demand cause an increase, the curve shifts to the right, or decrease, the curve shifts to the left, in demand. Many factors can cause demand to change. The most common are listed below with an explanation of each.

 The price of the good: when the price of a good rises, other things remaining the same, its relative price-its opportunity cost-rises. As the opportunity cost of a good rises, people buy less of that good and more of its substitutes. (Michael Parkın, 1998)

- 2. The prices of the related goods: A substitute is a good that can be used in place of another good. For example, a bus ride is a substitute for a train ride and a compact disc is substitute for a tape. If the price of a substitute for a tape increases, people buy less of the substitute and more tapes. (Michael Parkın, 1998)
- 3. Income: another influence on demand is consumer income. When income increases, consumers buy more of most goods, and when income decreases, they buy less of most goods. Although an increase in income leads to an increase in the demand for all goods. (Michael Parkın, 1998)
- 4. Population: Though not mentioned in the lesson, the number of buyers will affect demand particularly with today's mobility. With more people in the market, demand will increase. On the other hand, if people are leaving a market, demand will decrease. Demand dropped significantly in this county with the oil crash of 1987 as people left the area (demand for U-haul trucks increased though and they had to hire drivers to return their trucks to be rented again). (www.brazosport.cc.tx.us,2005)
- 5. Preferences:
 - Advertising; how we feel about a product will determine how much we buy at what price. I buy more of the things I like best and I'm willing to pay higher prices for it. The whole purpose of advertising is to get you to change your tastes and preferences, therefore increasing your demand. (www.brazosport.cc.tx.us,2005)

- 6. Expected future prices: if the price of a good is expected to rise in the future and good can be stored, the opportunity cost of obtaining the good for future use is lower now than it will be when the price has increased. So people retime their purchase – they substitute over time. They buy more of the good now before its price is expected to rise (and less after), so current demand for the good increases. (Michael Parkın, 1998)
- 7. Other (government, weather and seasonality): Many other factors can affect our demand. Three are listed here, but there are more. Laws can make it easier or harder to buy items. A gulf storm can clean the shelves of batteries and bottled water. A cold front will raise the demand for sweaters and coats. In 1997, a heavy invasion of mosquitoes led to a shortage of spray (as well as many complaints).

(www.brazosport.cc.tx.us,2005)

2.2.2 Demand Characteristics

Before a discussion of popular forecasting methods, it is important to be familiar with the five major characteristics of demand:

1. Average: Demand tends to cluster around a specific level.

2. Trend: Demand consistently increases or decreases over time.

3. Seasonality: Demand shows peaks and valleys at consistent intervals. These intervals can be hours, days, weeks, months, years, or seasons.

4. Cyclical: Demand gradually increases and decreases over an extended period of time, such as years. Business cycles (recession and expansion) and product life cycles influence this component of demand.

5. Random Error: Variations that cannot be explained or predicted.

(httpsupplychain.ittoolbox.combrowse.aspc, 2005)

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2.3 Types of Forecast

There are three types of forecasting methods:

- Economic Forecasting: address business predicting, inflation rates, money supplies, housing starts, macro forecasting,
- Technological Forecasting: rates of technology which create new products.
- **Demand Forecasting**: projection of demand for a company's product or service. These forecasts drive a company's production, capacity, and scheduling systems and serve as inputs to financial, marketing and personal planning.(www.snc.edu,2005)

2.4 Definition of Demand Forecasting

A forecast is an estimate of future demand. It can be determined by mathematical means using historical data; it can be created subjectively by using estimates from informal sources, or it can represent a combination of both techniques. (www.gis.net, 2005)

2.4.1 Components of Demand Forecasting

The type of forecasting method to use depends on several factors including the time frame of the forecast (i.e., how far in the future is being forecasted), the behaviour of demand, and the possible existence of patterns (trends, seasonality, etc.), and the causes of demand behaviour (Roberta S. Russell/ Bernard W. Taylor III, 1995)

2.4.1.1 Time Frame

Indicates how far into the future one is forecasting.

In general, forecasts can be classified according to three **time frames:** short-range, medium-range, and long-range.

Short-range forecasts typically encompass the immediate future. They are concerned with the daily operations of a company, dictated by daily or weekly demand such as production scheduling and resource requirements. A shortage-range forecast rarely goes beyond a couple of months into the future.

A medium-range forecast typical encompasses anywhere from 1 or 2 months to two years. A forecast of this length is normally used by management to develop such things as an annual production plan or an annual budget or the development of a project or program, such as the development of a new production line or the implementation of a quality circle program.

A long-range forecast usually spans a period longer than 2 years. This type of forecast is normally used by management for strategic planning. It might include planning new products for changing markets, entry into new markets, the development of new production facilities, or the long-term implementation of a new program, such as a quality management program. In general, the further into the future management seeks to predict, the more difficult forecasting becomes. (Roberta S. Russell/ Bernard W. Taylor III, 1995)

2.4.1.2 Demand Behaviour

Demand sometimes behaves in a random, irregular fashion, with no apparent patterns. However, it often exhibits predictable behaviour, reflected by trends or repetitive patterns in which it is hoped the forecast will reflect. The three primary types of demand movement are trends, cycles, and seasonal patterns. A trend is a gradual, long-term up or down movement of demand. For example, the demand for personal computers has generally followed an upward trend during the last few decades, without any sustained downward movement in the market. Trends are the easiest patterns of demand behaviour to detect and are often the starting points for developing forecasts.

Random variations are movements that are not predictable and follow no pattern (and thus are virtually unpredictable).

A cycle is an undulating movement in demand, up and down that repeats itself over a lengthy time span (i.e., more than one year). For example, new housing starts and, thus, construction-related products tend to follow cycles in the economy. Automobile sales tend to follow cycles in the same fashion. The demand for winter sports equipment increases every four years before and after the winter Olympics.

A seasonal pattern is an oscillating movement in demand that occurs periodically (in the short run) and is repetitive. Seasonality is often whether related. For example, every winter the demand for snow blowers and skis increases dramatically, and retail sales in general increases during the holiday season. However, a seasonal pattern can occur on a daily or weekly basis. For example, some restaurants are busier at lunch than at dinner, and shopping mall stores and theatres tend to have higher demand on weekends. (Roberta S. Russell/ Bernard W. Taylor III, 1995)

2.5 Demand Forecasting Methods and Techniques

There are three types of forecasting methods available to predict demand:

(1)Judgment (qualitative) methods

(2) Time series analysis,

(3) Causal methods.

Each of these methods is described below with the techniques used to apply the method.

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Figure 2.5





2.5.1 Judgment (qualitative) Methods

These methods utilize opinions to develop forecasts and are generally used, when historical data is not available. The basis for judgement methods is that the decision maker(s) possess sufficient experience to establish forecasts. In general, they are low cost and have a rapid development time. However, they are not consistently accurate and are subject to bias by the group creating the forecast. There are some techniques of judgement:

- Sales Force Estimates
- Executive Opinion
- Delphi Method

(httpsupplychain.ittoolbox.combrowse.aspc, 2005)

2.5.2 Time Series Methods

Time series methods are statistical techniques that make use of historical data accumulated over a period of time. Time series methods assume that what has occurred in the past will continue to occur in the future. As the name time series suggests, these methods relate the forecast to only one factor-time. They tend to be most useful for short-range forecasting, although they can be used for longer-range forecasting. They are also some of the most popular and widely used forecasting techniques. (Roberta S. Russell/ Bernard W. Taylor III, 1995)

2.5.2.1 Naive

The naïve technique is simply the forecast for the next period is equal to the demand for the current period. This is a simple, low-cost method that only takes trend into account. However, if demand is variable, this is a poor method to use.

(httpsupplychain.ittoolbox.combrowse.aspc, 2005)

2.5.2.2 Moving Average

A time series forecast can be as simple as using demand in the current period to predict demand in the next period. For example, if demand is 100 units this week, the forecast for next week's demand would be 100 units; if demand turned out to be 90 units instead, then the following week's demand would be 90 units, and so on. However, this type of forecasting method does not take into account any type of historical demand *behaviour*; it relies only on demand in the current period. As such, it reacts directly to the normal, random and down movements in demand.

Moving averages are computed for specific periods, such as three months or five months, depending on how much the forecaster desires to "smooth" the demand data. The longer the moving average period, the smoother it will be. The formula for computing the simple moving average is as follows:

Moving average:
$$MA_n = \frac{\sum_{i=1}^{n} Di}{n}$$

 $MA_n = \underline{\sum (Demand in previous n period)}$

Where

n: Number of periods in the moving average

D: Demand in period i.

The major disadvantage of the moving average method is that does not react well to variations that occur for a reason, such as trends and seasonal effects (although this method does reflect trends to a moderate extent). Those factors that cause changes are generally ignored. It is basically a "mechanical" method, which reflects historical data in a consistent fashion. However, the moving average method does have the advantage of being easy to use, quick, and relatively inexpensive, although moving averages for a substantial number of periods for a lot of different items can result in the accumulation and storage of a large amount of data. In general, this method can provide a good forecast for the short run, but no attempt should be made to push the forecast too far into the distant future. (Roberta S. Russell/ Bernard W. Taylor III, 1995)

2.5.2.3 Weighted Moving Average

The moving average method can be adjusted to more closely reflect fluctuations in the data. This adjusted method is referred to as a **weighted moving average** method. In this method, weights are assigned to the most recent data according to the following formula:

$$WMA_n = \sum_{i=1}^n W_i D_i$$

Where

W_i: The weight for period i, between 0 and 100 percent

 $\sum W_i = 1.00$

Determining the precise weights to use for each period of data more frequently requires some trial-and-error experimentation, as does determining the exact number of periods to include in the moving average. If the most recent periods are weighted too heavily, the forecast might overreact to a random fluctuation in demand. If they are weighted too lightly, the forecast might under react to actual changes in demand behaviour. (Roberta S. Russell/ Bernard W. Taylor III, 1995)

2.5.2.4 Exponential Smoothing

The exponential smoothing forecasting technique is also an averaging method that weight the most recent past data more strongly. As such, the forecast will react more to immediate changes in the data. This is very useful if recent changes in the data are the results of an actual change (e.g., a seasonal pattern) instead of just random fluctuations (for which a simple moving average forecast would suffice).

Exponential smoothing is one of the more popular and frequently used forecasting techniques, for a variety of reasons. Unlike moving averages, which can require a large amount of historical data, exponential smoothing requires data. Only the forecast for the current, the actual demand for the current period, and a weighting factor called a smoothing constant are necessary. Manual computation is simple, and the mathematics of the technique is easy to understand by management. However, virtually all POM and forecasting computer software packages include modules for exponential smoothing. Most importantly smoothing has a good tract record of success. It has been employed over the years by many companies that have found it to be an accurate method of forecasting.

The exponential smoothing forecast is computed using the formula:

$$\mathbf{F}_{t+1} = \Box \mathbf{D}_t + (1 - \Box) \mathbf{F}_t$$

Where

 F_{t+1} the forecast for the next period D_{t} actual demand in the present period F_{t} the previously determined forecast for the present period \Box =a weighting factor referred to as the smoothing constant The smoothing constant, □, is between 0.0 and 1.0. it reflects the weight given to the most recent demand data. (Roberta S. Russell/ Bernard W. Taylor III, 1995)

2.5.3 Causal Methods

Causal methods create forecasts by determining a cause-effect relationship between independent variables and the demand for the product. Two examples where causal methods could be used to create forecasts will help to illustrate, this:

- Forecasting snow blowers: Long range forecasts for winter snowfall can be used to forecast snow blower consumption.
- Promotion planning: If the consumer price of a product is reduced by

\$1.50 per unit, how will it affect demand?

One of the benefits is that causal methods provide good long-term forecast accuracy. For instance, if a weatherman predicts that it will be a cold winter, then the demand for heavy jackets will be greater.

Perhaps their most beneficial aspect is that causal methods support "What if?" analyses. However, the forecasts are only as good as the independent variables identified and the model created. They require careful thought and insight into the variables that effect demand. (httpsupplychain.ittoolbox.combrowse.aspc,2005)

2.5.3.1 Simple Linear Regression

To generates a forecast by linking one independent variable to the demand for a product. For example, sales of ice cream may be dependent on the price that is charged for the product. A model would be developed which described this relationship. Given a specific price, a demand forecast for ice cream will be generated.

2.5.3.2 Multiple Linear Regressions;

To generates a forecast by linking two or more independent variables to the demand for a product. For example, sales of ice cream may be dependent on the price that is charged for the product, the temperature, and the number of hours of daylight. A model would be developed which described this relationship. Given a specific price, a temperature, and a number of daylight hours, a demand forecast for ice cream will be generated.(httpsupplychain.ittoolbox.combrowse.aspc)

When the dependent variable that we seek to explain is hypothesized to dependent on more than one independent or explanatory variable, we have multiple or multivariate regression analysis. For example, the firm's sales revenue may be postulated to depend not only on the firm's advertising expenditures but also on its expenditures on quality control. The regression model can then be written as; $y = a + b_1 x_{1+} b_2 x_2$

Where y is the dependent variable referring to the firm's advertising expenditures, and x_2 to its expenditures on quality control. The coefficients *a*, b_1 and b_2 are the parameters to be estimated.

The *a* coefficient is the constant or vertical intercept and gives the value of y when both x_1 and x_2 are equal to zero. On the other hand, b_1 and b_2 are the slope coefficients. They measure the change in y per unit change of x_1 and x_2 , respectively. Specifically, b_1 measures the change in sales (y) per unit change in advertising expenditures (x_1), while holding quality control expenditures (x_2) constant. Similarly, b_2 measures the change in x_2 while holding x_1 constant. That is, $b_1 = \Delta y / \Delta x_1$, while $b_2 = \Delta y / \Delta x_2$. In our sales-advertising and quality-control problem we postulate that both b_1 and b_2 are positive, or that the firm can increase its sales by increasing its expenditures for adverting and quality control.

The model can also be generalized to any number of independent (predictor) or explanatory variables (k'), as indicated in following equation:

$Y_{=}a_{+}b_{1}x_{1+}b_{2}x_{2+}\ldots\ldots\ldots+b_{k}x_{k'}$

The process of estimating the parameters or coefficients of a multiple regression equation is in principle the same as in simple or multiple regression analysis, but the since calculations are much more complex and time- consuming, they are invariably done with computers. The computer also provides routinely the standard error of the estimates, the *t* statistics, the coefficient of multiple determination, and several other important statistics that are used to conduct other statistics test of the results (to be estimated later). All that is required is to be able to set up the regression analysis, feed the data into the computer and be able to interpret the results. (Dominic Salvatore, 1989)

2.6 Elements of A Good Demand Forecasting

A properly prepared forecast should meet the following requirements:

- The forecast should be *accurate* and the degree of accuracy should be stated. This will enable users to plan for possible errors and will provide a basis for comparing alternative forecasts.
- The forecast should be *timely*. Usually, a certain amount of time is needed to respond to the information contained in a forecast. For example, capacity cannot be expanded over night, nor can inventory leaves be changed immediately. Hence, the forecasting horizon must cover the time necessary to implement possible changes.
- The forecast should be *reliable*. It should work consistently. A technique that sometimes provides a good forecast and sometimes a poor one will leave users with the uneasy feeling that they may get burned every time a new forecast is issued.

- The forecasting technique should be *simple to understand and use*. Users often lack confidence in forecast based on sophisticated techniques; they do not understand either the circumstances in which techniques are appropriate or the limitations of the techniques. Misuse of techniques is obvious consequence. Not surprisingly, fairly crude forecasting techniques enjoy widespread popularity because users are more comfortable working with them.
- The forecast should be expressed in *meaningful units*. Financial planners need to know how many *dollars* will be needed, production planners need to know how many units will be needed, and schedulers need to know what *machines* and *skills* will be required. The choice of units depends on user needs.
- The forecast should be *in writing*. Although this will not guarantee that all concerned are using the same information, it will at least increase likelihood of it. In addition, a written forecast will permit an objective basis for evaluating the forecast ones actual results are in.

(William J. Stevenson, 1999)

2.7 Forecasting Principles

Regardless of the techniques, forecasting models, software, participants, data amount of support, or hardware platform, there are time-tested principles that apply to any firm using a forecast to drive their manufacturing and / or procurement activities. You could call it the 'Top Nine List.'

- Clearly define what is being forecast
- The forecast is always wrong
- Measure and report the forecast error
- For the forecast to be unbiased, it must have a 50% chance of being too high or too low

- The forecast and annual sales budget is not the same thing.
- Document and publish any forecast assumptions.
- Remember the primary purpose of the forecast
- New product forecasts require sales and marketing input
- Decide how to use customer data

(William J. Stevenson, 1999)

2.8 The Forecasting Process

Forecasting is not simply identifying and using a quantitative method to compute a numerical estimate of what demand will be in the future. Instead, it is a continuing process that requires constant monitoring and adjustment. The general steps in this process are illustrated in figure 2.8

Thus, one of the first steps in the forecasting process is to plot the available historical demand data and, by visually looking at it, attempt to determine the forecasting method that best seems to fit the patterns the data exhibits. Historical demand data often is simply past sales data; true product demand is usually not available. Once a method has been identified, there are several measures available for comparing the historical data with the forecast to see how accurate the forecast is. If the forecast does not seem to be particularly accurate, another method can be tried until an accurate forecast method is identified. After the forecast is made over the desired planning horizon, it may be possible for the operations manager or analyst to use judgment, experience, knowledge of the market, or even intuition to adjust the forecast to enhance further its accuracy. Finally, as demand actually occurs over the planning period, it must be monitored and compared with the forecast in order to assess the performance of the forecast method. If

it is not accurate, then consideration must be given to selecting a new model or adjusting the existing one. As we proceed through the various forecasting methods and measures of accuracy in the following sections, it will be beneficial to keep this continuing process, as illustrated in figure 1.7





2.9 Conclusion

This section completed a literature review on demand and demand forecasting. The demand and demand forecasting were defined in detail. The determinants of demand, the demand forecasting methods, and types of demand forecasting were identified and explained. The demand forecasting process were also explained and showed in a figure in detail. The main variables affecting the demand are further discussed in the next section.

SECTION 3

THEORETICAL FRAMEWORK

3.1 Introduction

This section set up a theoretical framework of the problem situation using the variables as identified in section 2.

3.2 Theoretical Frameworks for Demand

Figure: 3.1 Theoretical Frameworks for Demand



At the above, illustrated a theoretical framework for the demand, and the theoretical framework includes seven independent variable, and one dependent variable. Now, if we want to describe the above figure, we should consider the independent variable, and dependent variable. The independent variable is one that influences the dependent variable in either a positive or negative way. The variance in the dependent variable is accounted for by the independent variable. (uma sekaran,2003).

Advertising; how we feel about a product will determine how much we buy at what price. I buy more of the things I like best and I'm willing to pay higher prices for it. The whole purpose of advertising is to get you to change your tastes and preferences, therefore increasing your demand. Thus, the preferences are related with the advertisement.

When income increases, consumers buy more of most goods, and when income decreases, they buy less of most goods. Although an increase in income leads to an increase in the demand for all goods.

A substitute is a good that can be used in place of another good. For example, the coca cola is substitute for Pepsi cola. If the price of coca cola increases, people buy less of the coca cola and more Pepsi cola.

When the price of a good raises, other things remaining the same, it's relative price-its opportunity cost-rises. As the opportunity cost of a good rises, people buy less of that good and more of its substitutes.

The daily mean temperature is related seasonally factor and either affect the demand for good, namely, the daily mean temperature is highest in the summer and this effect directly the demand for soft drink. Namely, if the daily mean temperature rises, the demand for the soft drink increases.

3.3 Conclusion

In this section, the variables of demand as determining in section 2 were identified, and then the theoretical framework for demand were illustrated and defined. The relationships between the independent variables and dependent variables are measured by multiple linear regressions methods and spss computer package program under case study in the next sections.
SECTION 4

CASE STUDY OF EKTAM KIBRIS LTD IN TRNC

4.1 Introduction

This section consists of the historical background of the TRNC & the Ektam Kıbrıs Ltd. it includes also the variables affecting the Ektam Kıbrıs Ltd's sales for Pepsi cola, which were obtained from the sales manager of Ektam and the literature.

4.2 About TRNC

TRNC (Turkish republic of northern Cyprus) is a small island state situated in the Eastern Mediterranean. The economy is lead by tourism, education and is also characterised with many small to medium enterprises.

4.3 About the Ektam Kıbrıs Ltd.

In 1981 the Pepsi cola company was established under the "Ektam Kıbrıs Ltd." In a partnership with one of the biggest production companies in Turkey which is called "Tamek Holding A.Ş." with local partner's Şemsi Kazım.

Main establishment of Ektam is conveniently situated near the Nicosia Industrial Zone, on the main road of Dr. Küçük Bulvarı. This location contains the administration offices. It also contains a warehouse and a distribution spot. The place is almost in the centre of TRNC and from this point they can distribute to Whole Island. The Ektam also have production facilities in Karpaz and a regional warehouse-distribution centre in Güzelyurt.

At the beginning the company started to produce 25 ml bottle, this bottle was return bottle. By the year 1985 the company started to use new technology. In continuing two years the company has made an investment of around \$20,000,000 for its new technology to build and improve its production.

In 1996 the company begun to use new technology system called "reverse osmosis". In the year 2000 a pet bottles are available and appeared in market, such as 2.5 ltr, 1 ltr, 600 ml, 330ml, 7up, yedigün, pepsi light, soda water, fruko.

Pepsi-Cola is one of the major production units of soft drinks in TRNC. Pepsi is bottled by the first, and one of the oldest bottling companies in TRNC, Ektam Ltd. They enjoyed a monopoly for many years. In addition there are many other brands which are imported. Pepsi is still well distributed all over TRNC. There are people who believe this is their nostalgic traditional drink and there is some regretting that they had to drink only this for many years, and now consumes the other brands.

Products of Ektam are the soft drinks. Although the organization makes lemonade type drinks, which are concentrated, the main product is the soft drinks. These are in cola, orange and gaseous form. The products are shaped in many different ways. There are different alternatives for different consumption purposes. There are large bottles for the family and parties. There are small bottles ready for consumption and there are the canned cokes. These come in different shape and different prices.

The coke business is a seasonally effected business. There are pick seasons when the consumption is high and there are low seasons when there is hardly any consumption at all. Company has the task of producing the appropriate product in appropriate quantity in accord with the seasonal variations.

The taste and ingredients of the soft drinks hardly ever change. Especially in case of Pepsi which is well known in TRNC, the management is especially careful about the taste, since there are many consumers who are found of the taste and will not drink any other brand. In addition to normal pricing theory the organization has to take into consideration the seasonality problem of the product. Normally organizations have to take a few points into consideration in respect of pricing. First consideration is the market situation. Along with many other similar products there are also alternative products the consumers can choose. These are beer, fruit juice etc. The second consideration is the cost. Company has to make profit so that they can carry on with their operations. A special aspect has to be also considered in TRNC in respect of pricing, and that is the inflation and devaluation of Turkish Lira. Due to high inflation the prices must be frequently adjusted. Since there is a raw material imports involved in production the currency variations must also be closely dealt with.

Seasonality aspect of the business is also important factor in pricing. Unlike other ordinary business products of Pepsi are usually sold in summer and the sales are very low in winter. But the costs of the company still go on. There are fixed costs to take care of and also minimum amount of labour which has to be kept to have them when they are needed.

Objective organization is to distribute their products to the remotest corner of the country. They use two channels of distribution. One is for a far place where they use 15 big Lorries. These Lorries visit the customers every two days they going around the distribution area and distribute the product. Another channel is the distribution to the nearer places with smaller vehicles. There are 5 small "VAN" type cars for the city center and same places which are near the city. They also visit the customers in every two days. The control of these distribution is made by sales chief and those chief always control the sales person they go to the right place in right time or not and give good service to the customers and solve the problem face to face.(fatih, sales manager of Ektam Kıbrıs Ltd)

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4.4 The variables Affecting Ektam Kıbrıs Ltd's sales for Pepsi cola

- Mean air temperatures
- GNP per capita for TRNC
- The price of the Pepsi cola
- Population of TRNC
- The advertisement of Ektam Kıbrıs ltd for Pepsi cola

4.5 Conclusion

In this section, the EKTAM KIBRIS LTD and TRNC was introduced, and the variables affecting the sales of the Ektam Kıbrıs Ltd for Pepsi cola were derived from the literature survey(in section 2 and 3) and the sales manager of the Ektam Kıbrıs Ltd. These variables are used in order to predict the sales of the Ektam Kıbrıs Ltd for Pepsi cola, which are explained in the section 5(methodology).

SECTION 5

METHODOLOGY

5.1 Introduction

In this section the methodology of the study is explained. The purpose of this study is causal study (hypothesis testing- analytical and predictive). Hypothesis testing is undertaken to explain the variance in the dependent variable or to predict organizational outcomes. (Uma Sekaran, 2003) The method section consists of which data are used, these data sources, how data are obtained and collected and evaluation of data.

5.2 Which Data are used?

The last ten years data are used (quarterly) which are sales of the Pepsi cola, the quarterly mean air temperature, price of the Pepsi cola per litre, population of TRNC, the GNP per capita for TRNC, and the advertising expenditure for sales of Pepsi cola.

5.3 The Sources of Data

In this study the secondary data are used. According Uma Sekaran (1993) secondary data can be used, among other things, for forecasting sales by constructing models based on based sales figures, and through extrapolation. There are several sources of secondary data, including books and periodicals, government publications of economic indicators, census data, statistical, data bases the media etc...

The sales of the Pepsi cola, price of the Pepsi cola per litre and the advertising expenditure for sales of Pepsi cola are obtained from the Ektam Kıbrıs Ltd. The quarterly mean air temperature is obtained from the KKTC Meteoroloji Genel

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Müdürlüğü. Population of TRNC and the GNP per capita for TRNC are obtained from the state planning organization statistics and research department of TRNC.

5.4 Evaluation of Data

When the dependent variable that we seek to explain is hypothesized to dependent on more than one independent or explanatory variable, we have multiple or multivariate regression analysis. (Dominic Salvatore, 1989).

Multiple regression method and SPSS computer package program were used in order to evaluate data and reach the aims of the study. Because, the dependent variable (sales of Pepsi Cola) was explained by more than one independent variable and, also there was forty observation which means that the evaluation of data was more complex, therefore the SPSS computer package program was used, if it was not used, the data will not be evaluate and can not reach the aims of the study.

5.5 Conclusion

In this section, the methodology of the study was explained. The sources of data were explained. It explained which data that were obtained from where. These data are used in the section 6 in order to do demand forecasting for sales of Pepsi cola by using Multiple Linear Regression Model and SPSS computer package program.

SECTION 6

FORECASTING PROCESS

6.1 Introduction

In this section the demand forecasting process is done step by step. The causal method and its multiple regression technique are used. The SPSS computer package program is also used with the historical data of the predictor variables $(X_1, X_2, X_3, X_4, \text{ and } X_5)$ and dependent variable (Y).At the end of all, expectations and projected data of the predictor variables are used in order to compute the demand of Ektam Kıbrıs Ltd for Pepsi cola for the last two quarters of 2005. The 1st quarter represent the first 3 months of the year (January, February and March). The 2nd quarter represent the second 3 months of the year (April, May and June). The 3rd quarter represent the third 3 months of the year (July, August and September). The 4th quarter represent the last 3 months of the year (October, November and December).

6.2 Identify the Purpose of Forecast

The purpose of the forecast is to predict the sales of Ektam Kıbrıs Ltd for the Pepsi cola in TRNC by using the historical data of the variables affecting of the sales of Ektam Kıbrıs Ltd for the Pepsi cola in TRNC. These variables are;

The advertising expenditures of ektam ltd for the sales of Pepsi cola, Mean air temperatures in TRNC, The price of the Pepsi cola, GNP per capita for TRNC, Population of TRNC. These variables are obtained from literature (in section 2) and the sales manager of the Ektam Kıbrıs Ltd.

6.3 Collect Historical Data

The historical data are obtained in quarterly because the forecast is done as quarterly.

Table 6.3.1

"The historical sales of the Ektam Kıbrıs ltd. for pepsi cola (liters)"

Years Quarters	1995	1996	1997	1998	1999
1	1,225,566	1,316,009	1,307,911	1,838,723	1,689,918
2	2,585,158	2,724,833	3,071,141	2,867,877	3,438,691
3	2,544,644	2,895,070	3,325,920	4,130,392	3,828,362
4	1,452,357	1,798,501	2,009,909	2,725,685	1,976,236

Years Quarters	2000	2001	2002	2003	2004	
1	1,812,826	2,233,197	1,843,567	2,049,430	2,257,985	
2	3,148,131	2,317,499	2,974,801	3,315,113	3,913,588	
3	3,604,786	3,318,793	4,048,828	4,702,387	4,968,131	
4	1,751,459	2,028,614	2,541,093	2,865,593	3,321,667	

(Fatih Taşkan)

"The historical advertising expenditures of the Ektam Kıbrıs ltd for sales of Pepsi cola (in ytl)"

Years Quarters	1995	1996	1997	1998	1999
1	98,7	202,9	670	1720	3450
2	284,1	608,7	2010	3160	10350
3	378,8	811,6	2680	6880	13800
4	189,4	405,8	1340	3440	6900

Years Quarters	2000	2001	2002	2003	2004
1	4649	9468	6844	5339	19363
2	13947	28406	20533	16019	58089
3	18596	37874	27378	21358	77452
4	9298	18937	13689	10679	38726

(Fatih Taşkan)

"Quarterly mean air temperatures at TRNC (in °C)"

Years Quarters	1995	1996	1997	1998	1999	- 19
1	17.7	15.3	15.4	16	17.3	
2	27	26.8	25.6	26.7	27.5	
3	32.7	32.9	31.8	34	33.1	
4	20.5	21.9	21.2	22.8	22.6	

Years Quarters	2000	2001	2002	2003	2004	
1	10.7	13.1	12.4	11.4	11,9	22644
2	21.6	21.5	20.8	21.9	21,1	
3	27.9	27.3	27.4	28.1	27,4	
4	16.9	16.8	17	17.3	15,9	1,8626

(Fehmi Oktay)

"The historical prices of the Ektam Kıbrıs ltd for the Pepsi cola (per litters)"

Years Quarters	1995	1996	1997	1998	1999
1	0,0392	0,0681	0,0962	0,1578	0,2810
2	0,0453	0,0780	0,1257	0,2046	0,3247
3	0,0562	0,0780	0,1257	0,2348	0,4761
4	0,0562	0,0780	0,1578	0,2421	0,5904

Years Quarters	2000	2001	2002	2003	2004
1	0,6742	0,8141	1,3919	1,6230	1,8626
2	0,7417	1,1957	1,4875	1,8760	1,8626
3	0,7417	1,1957	1,6230	1,6812	1,8626
4	0,8141	1,3919	1,6230	1,8626	1,8626

(Fatih Taşkan)

"GNP per capita for TRNC (in YTL)"

Years Quarters	1995	1996	1997	1998	1999
1	49	79,25	145	285	493
2	49	79,25	145	285	493
3	49	79,25	145	285	493
4	49	79,25	145	285	493

Years quarters	2000	2001	2002	2003	2004
1	775	1260	1653	2198	2708
2	775	1260	1653	2198	2708
3	775	1260	1653	2198	2708
4	775	1260	1653	2198	2708

(Erhan Özkan)



"Population of TRNC"

Years Quarters	1995	1996	1997	1998	1999
1	181363	200586	203046	205398	206562
2	181363	200586	203046	205398	206562
3	181363	200586	203046	205398	206562
4	181363	200586	203046	205398	206562

Years Quarters	2000	2001	2002	2003	2004
1	210047	212342	214646	216940	218066
2	210047	212342	214646	216940	218066
3	210047	212342	214646	216940	218066
4	210047	212342	214646	216940	218066

NUMBER OF

(Erhan Özkan)

6.4 Plot Data and Identify Patterns

The graph 6.4.1

"The relationships between the advertising expenditures for Pepsi cola and sales of Pepsi cola"



There is a positive relationship between the sales of Pepsi cola and advertising expenditures for the sales of the Pepsi cola.

"The relationships between the GNP per capita for TRNC (in YTL) and sales of Pepsi cola"



There is a positive relationship between the sales of Pepsi cola and the GNP per capita for TRNC.

"The relationships between the price for the Pepsi cola (per litters) and sales of Pepsi cola"



There is a negative relationship between the sales of Pepsi cola and the price for the Pepsi cola. This relationship is shown in the graph, when the price raises the amount of sales decrease.

"The relationships between the Quarterly mean air temperatures at TRNC (in °C) and sales of Pepsi cola"



There is a positive relationship between the sales of Pepsi cola and the mean air temperatures.

"The relationships between the Population of TRNC and sales of Pepsi cola"



There is a positive relationship between the sales of Pepsi cola and the Population.

6.5 Select a forecast model that seems appropriate for data

The causal model and its multiple linear regression technique are selected, because there are five variables that affect the sales of the Ektam Kıbrıs Ltd for Pepsi cola. In other word, there are more than one variable that affect the sales of the Ektam Kıbrıs Ltd for Pepsi cola. When the dependent variable that we seek to explain is hypothesized to dependent on more than one independent or explanatory variable, we have multiple or multivariate regression analysis. (Dominic Salvatore, 1989)

6.6 Develop/compute forecast for period of historical data

In this step, the SPSS package program of computer is used in order to do the forecast for Pepsi cola by using the period of historical data, because of the sample are forty and variables are five, it means that another way is more complex. In this process, the 5 percent level of probability is used, namely, the SPSS program has 95 percent confident

The following variables are used for the regression;

Predicted (dependent) variable: Y = Sales

Predictor (independent) variables:

 X_1 =Quarterly mean air temperature in the TRNC

 X_2 = Income (GNP per capita) for the TRNC

 $X_3 =$ Price of the Pepsi cola

X₄=Population of the TRNC

 X_5 = Advertisement expenditures for the sales of Pepsi cola.

6.6.1 The Output of the SPSS Program for the Multiple Linear Regressions

In this step the output of the spss package program of the multiple regression for the estimated and predicted of the sales of Pepsi cola are showed. And the each result is discussed.

In the table 6.6.1.1, the variables are evaluated and decided which are entered or removed that by SPSS package program.

Table 6.6.1.1 Variables Entered or Removed

Model	Variables Entered	Variables Removed	Method
1	X5, X1, X4, X3, X2	•	Enter

a. All requested variables entered.

b. Dependent Variable: Y

We can see in the Table 6.6.1.2, the all variables are entered which means that the all variables are meaningful for the regression.

Table 6.6.1.2 Model Summary

				Std. Error
			Adjusted	ofthe
Model	R	R Square	R Square	Estimate
1	,953 ^a	,909	,895	303083,0

a. Predictors: (Constant), X5, X1, X4, X3, X2

In the model summary, the multiple R shows a substantial correlation between the **five predictor variables** and the dependent variable **sales**, (R=, 953). The R -square value indicates that about, 909 of the variance in sales are explained by the five predictor variables.

Table 6.6.1.3 Anova^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3,1E+13	5	6,2E+12	67,775	,000 ^a
	Residual	3,1E+12	34	9,2E+10		
	Total	3,4E+13	39			

a. Predictors: (Constant), X5, X1, X4, X3, X2

b. Dependent Variable: Y

To conduct *f* test or analysis of variance, the regression value of the *f* statistic with a critical value from the table of the *f* distribution. Two tables of the *f* distribution are presented in appendix. One is for the 5 percent level of significance and other is for the 1 percent level. The *f* distribution for each level of significance is defined in terms of 5 df. These are k-1 (where k is numbers of parameters) for the numerator and n - k for the denominator (n is the numbers of the observation). In this case, df = 6-1= 5 for the numerator and 40 -6 = 34 for the denominator. The critical value of the *f* distribution is found in table for the 5 percent level of significance is approximately 2,50. Since, the regression value of the *f* statistic is 67,775 which means the regression value of the *f* statistic are accepted.

Table 6.6.1.4 Coefficients

		Unstanı Coeffi	fardized cients	Standardi zed Coefficien ts		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	-6235452	1578464		-3,950	,000
	X1	122319,8	9012,699	,859	13,572	000,
	X2	922,070	267,002	,899	3,453	,002
	Х3	-691457	328164,2	-,519	-2,107	,043
	X4	28,233	7,810	,310	3,615	,001
	X5	5,008	5,065	,088	,989	,330

The β values indicate the relative influence of the entered variables, that is, GNP per capita for TRNC (X₂) has the greatest influence on sales ($\beta =$, 899); followed by quarterly mean air temperature (X₁), ($\beta =$, 859); then, followed by price of the Pepsi cola (X₃), ($\beta =$, -519); then, followed by population of the TRNC (X₄), ($\beta =$, 310); and last followed by advertisement expenditures for the sales of Pepsi cola. (X₅), ($\beta =$, 088).

The direction of influence for quarterly mean air temperature in the TRNC (X_1) , income (GNP per capita) for the TRNC (X_2) , population of the TRNC (X_4) , and advertisement expenditures for the sales of Pepsi cola. (X_5) are positive but, the direction of influence for price of the Pepsi cola (X_3) is negative.

To perform t tests for statistical significance of the estimated parameters or coefficients, the critical value of the t are needed to determine from the table of the t distribution (in appendix).

At the 0, 05 level of significance for n-k = 40-6= 34 df (where k is the numbers of estimated parameters, including the constant term and n is the numbers of observation), in this case, the critical value of the *t* is approximately 1,690 and its obtained by going down the column headed 0,05 in table *t* distribution until to reach 34 df.

Since, the value of the calculated t statistic exceed the critical t value of 1,690, the variables are concluded that variables are statistically different from zero at the 0,05 level of significance.

Namely, the *t* value of the predictor variables should be; t > 1,690 and -t < -1,690. In this case, the

 X_1 , X_2 , X_3 and X_4 are statistically different from zero but X_5 is not. However, its t value is ignored in this study.

The Regression Equation for the Sales of Pepsi Cola;

It can be written by using the coefficients (in table 6.6.1.4):

 $Y_{=}a_{+}b_{1}x_{1+}b_{2}x_{2+}\dots\dots + b_{k}x_{k}$ (it is discussed in section 2)

 $Y = (-6235452) + 122319,8*X_1 + 922,070*X_2 + (-691457*X_3) + 28,233*X_4 + 5,008*X_5$

The above results indicate that for each °C raise in quarterly mean air temperature(X_1) the sales of Pepsi cola increase by 122319,8 litres, for each ytl increase in income (GNP per capita) (X_2) the sales of Pepsi cola increase by 922070 litres, for each ytl increase in the price of Pepsi cola (X_3) the sales of Pepsi cola fall by 5,008 litres, for each person increase in population (X_4) the sales of Pepsi cola increase by 28233 litres, and for each ytl increase in expenditures on advertisement(X_5) the sales of Pepsi cola increase by 5,008 litres

6.7 Check Forecast Accuracy with one or more Measures

The results of the regression is evaluated by t test and f test and decided the accuracy of forecast are accepted.

6.8 Is accuracy of Forecast Acceptable?

Yes, accuracy is acceptable because, the results are evaluated by the t test and f test. (It is discussed in step 6.6.1, in detail)

6.9 Forecast over planning horizon

In this step, the results of the 6.6th step are applied in order to compute the firm's demand over planning horizon (last two quarters of the 2005) by using the expectations and projected data of the predictor variables.

6.9.1 The expectations and projected data of the predictor variables.

• The planning of the Ektam Kıbrıs Ltd

The sales manager said that in the last two quarters of the 2005, price for Pepsi cola is not change and advertisement expenditures for sales of the Pepsi cola will be 80000 YTL at the 3rd Quarter and will be 40000 YTL at 4th Quarter. (Fatih Taşkan)

• The expected mean air temperature in TRNC

The general manager of meteorology said that we forecast that the mean air temperature will be 35 $^{\circ}$ C at 3rd Quarter and will be 23 $^{\circ}$ C at 4th Quarter at 2005. (Fehmi Oktay)

• The projected population of TRNC and GNP per capita for TRNC

According the Erhan Özkan (official in state planning organization statistics and research department of TRNC), the projected population of TRNC is 220289 and the projected quarterly GNP per capita for TRNC is 2867 ytl for the last two quarters of 2005.

6.9.2 Demand forecast of the Ektam Kıbrıs Ltd for the Pepsi cola

 $Y = (-6235452) + 122319,8*X_1 + 922,070*X_2 + (-691457*X_3) + 28,233*X_4 + 5,008*X_5$

Predicted (dependent) variable: Y = Sales = ?

Predictor (independent) variables:

3rd Quarter at 2005

 $X_1 = 35^{\circ}C$

23°C

4th Quarter at 2005

 $X_2 = 2867 \text{ ytl.}$ 2867 ytl

- $X_3 = 1,8626$ ytl per liter 1,8626 ytl per liter
- $X_4 = 220289$ 220289
- $X_5 = 80000 \text{ ytl}$ 40000 ytl

6.9.2.1 Demand forecasting of Pepsi cola at 3rd Quarter at 2005

Y = (-6235452) + 122319,8*35 + 922,070*2867 + (-691457*1, 8626) + 28,233*220289 + 5,008*80000 = 6021467

The approximate 95 percent confidence interval estimate or forecast of sales of Pepsi cola at 3rd Quarter at 2005 for is then given by;

 $6021467 - 2^*$ (standard error of the estimate) and $6021467 + 2^*$ (standard error of the estimate)

6021467 - 2*(303083) and 6021467 + 2*(303083)

6021467-606166 and 6021467+606166

5415301 and 6627633

That is, 95 percent confident are that the true value of Y will lie between 5415301 and 6627633 for 3rd Quarter for 2005.

6.9.2.2 Demand Forecasting of Pepsi Cola at 4th Quarter at 2005

Y = (-6235452) + 122319,8*23 +922,070*2867 + (-691457*1,8626) + 28,233*220289 + 5,008*40000 = 4353309

The approximate 95 percent confidence interval estimate or forecast of sales of Pepsi cola at 4th Quarter at 2005 for is then given by;

 $4353309 - 2^*(\text{standard error of the estimate})$ and $4353309 + 2^*(\text{standard error of the estimate})$

4353309 - 2*(303083) and 4353309 + 2*(303083)

4353309 - 606166 and 4353309 + 606166

3747143 and 4959475

That is, 95 percent confident are that the true value of Y will lie between 3747143 and 4959475 at 4th Quarter at 2005.

6.10 Adjust Forecast Based on Additional Qualitative Information and Insight

Any adjust is not needed for this process because the multiple regression technique is more effectively than others. And the historical data of this regression is strongly such as; the numbers of observation is forty.

6.11 Monitor Results and Measure Forecast Accuracy

The monitor results and measuring of forecast accuracy are discussed in step 6.9 and the following results are decided.

The true value of Y will lie between 3747143 and 4959475 at 4th Quarter at 2005.

The true value of Y will lie between 5415301 and 6627633 at 3rd Quarter at 2005.

6.12 Conclusion

In this section the demand forecasting process was done step by step. The causal method and its multiple regression technique were used. The SPSS computer package program was also used with the historical data of the predictor variables (X_1 , X_2 , X_3 , X_4 , and X_5) and dependent variable (Y). At the end of all, the demand of Ektam Kıbrıs Ltd for Pepsi cola at the last two quarters of 2005 were computed by using the expectations and projected data of the predictor variables and the demand forecasting for sales of Pepsi cola at the last two quarters of 2005 period of time.

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SECTION 7

FINDINGS

7.1 Introduction

This section consists of the findings from the results of the demand forecasting process. It also includes the quarterly production capacity of the Ektam Kıbrıs Ltd for the Pepsi cola.

7.2 The Findings from the Results of the Demand Forecasting Process

The result of the Multiple Linear Regression indicate that for each 1°C raise in quarterly mean air temperature(X_1) the sales of Pepsi cola increase by 122319,8 litres, for each 1ytl increase in income (GNP per capita) (X_2) the sales of Pepsi cola increase by 922070 litres, for each 1ytl increase in the price of Pepsi cola (X_3) the sales of Pepsi cola fall by (-691457)litres, for each person increase in population (X_4) the sales of Pepsi cola increase by 28233 litres, and for each ytl increase in expenditures on advertisement(X_5) the sales of Pepsi cola increase by 5,008 litres

• Demand forecasting of Pepsi cola at 3rd Quarter at 2005

The true value of Y will lie between 5415301 and 6627633 at 3rd Quarter at 2005.

• Demand forecasting of Pepsi cola at 4th Quarter at 2005

The true value of Y will lie between 3747143 and 4959475 at 3rd Quarter at 2005.

7.3 The Quarterly Production Capacity of the Ektam Kıbrıs Ltd for the Pepsi Cola

The sales manager of the Ektam Kıbrıs Ltd said that the quarterly production capacity of the Ektam Kıbrıs Ltd for the Pepsi cola is 3960000 litres. (Fatih Taşkan)

7.4 Conclusion

In this section, the major findings were found out from the results of the demand forecasting process (in section 6) and were also showed; which predictor variable has how many effects on the sales? This section was also included the quarterly production capacity of the Ektam Kıbrıs Ltd for the Pepsi cola that were obtained from the sales manager of the Ektam Kıbrıs Ltd. The information of this section is used to solve the problem statement and to reach the objectives of the study in the conclusion section.

SECTION 8

CONCLUSIONS

8.1 Overview of the Study

The following information consists of the major findings (it was discussed in section 7, in detail) and the quarterly production capacity of Ektam Kıbrıs Ltd for Pepsi cola

8.1.1 Major Findings The Findings from the Results of the Demand Forecasting Process

The result of the Multiple Linear Regression indicate that for each 1°C raise in quarterly mean air temperature(X_1) the sales of Pepsi cola increase by 122319,8 litres, for each 1ytl increase in income (GNP per capita) (X_2) the sales of Pepsi cola increase by 922070 litres, for each 1ytl increase in the price of Pepsi cola (X_3) the sales of Pepsi cola fall by (-691457)litres, for each person increase in population (X_4) the sales of Pepsi cola increase by 28233 litres, and for each ytl increase in expenditures on advertisement(X_5) the sales of Pepsi cola increase by 5,008 litres

The demand forecast for sales of Pepsi cola at the last two quarters of the 2005;

- 3rd Quarter at 2005: the true value of Y will lie between 5415301 and 6627633.
- 4th Quarter at 2005: the true value of Y will lie between 3747143 and 4959475

8.1.2 The Effective Production Capacity of the Ektam Kıbrıs Ltd for the Pepsi Cola

The firm can produce 3960000 litres for Pepsi cola as quarterly.

8.2 The Conclusion of the Study

When the demand forecast for sales of Pepsi cola at the 3rd Quarter at 2005 and the quarterly production capacity of the Ektam Kıbrıs Ltd for the Pepsi cola are compared, the production capacity of the Ektam Kıbrıs Ltd for the Pepsi cola is not enough in order to satisfy the demand for sales of Pepsi cola at the 3rd Quarter at 2005. The firm can solve this problem by stocks before this quarter.

When the demand forecast for sales of Pepsi cola for the 4th Quarter at 2005 and the quarterly production capacity of the Ektam Kıbrıs Ltd for the Pepsi cola are compared, the production capacity of the Ektam Kıbrıs Ltd for the Pepsi cola will be enough in order to satisfy the demand for sales of Pepsi cola at the 4th Quarter at 2005. However, also the approximately 1000000 litters Pepsi cola can be needed.

In this case, the firm can not invest in short run, but the following strategies can be followed.

- The firm can avoid the advertising expenditures
- The firm can stock Pepsi cola in the winter season
- The firm can rise its prices

8.3 Limitation of the study

- The lack of experienced of researcher about the firm
- Time
- Literature sources
- The data about competitor firms

8.4 Recommendations of the Study

This study aiming is to perform a demand forecast and to learn which problems can be solved by the demand forecasting. This study includes a case study of the Pepsi cola, all same firms can be benefit from this study. However, there are some limitations of the study, and these can be eliminated such as if this study is to do by personnel of companies, the study will be more effective. And, if this is used by any firm, they should consider the effect of the competitors. (bixi cola, cola turka, coca cola, etc...). Another, an important point about this project, the changes in data between quarters of the years, which means that the population can be change due to tourism inside or outside and also foreign or domestic students. This point of the study should be considered by the users.

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References

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1	David R. Anderson / Dennis J. Sweeney /Thomas A. Williams (1986), Production and Operation Management, West Publishing Co. Third Edition, pp:185230
2	Dominick Salvatore(1989), Managerial Economics, McGraw-Hill Inc. International Edition, pp: 113-149
3	Erhan Özkan, official in state planning organization statistics and research department of TRNC
4	Fatih Taşkan The Sales Manager of Ektam Kıbrıs Ltd
5	Fehmi Oktay, KKTC Meteoroloji Dairesi Müdürü
6	httpsupplychain.ittoolbox.combrowse.aspc.(April, 2005)

7	http://www.snc.edu/socsci/chair/333/facts.htm.(April, 2005)
	2:201 -
8	http://www.brazosport.cc.tx.us~econ/arch/.(April, 2005)
9	Michael Parkin (1998) Economics, Addision Wesley Publishing Co. 4 th Edition pp: 68-85
10	Uma Sekaran (1993) Research Methods for Business, John Wiley &Sons.4 th Edition
11	Roberta S. Russell/ Bernard W. Taylor III (1995), Production and Operation Management, Prentice- Hall, Inc pp: 484-493
12	William J. Stevenson,(1999),Production Operations Management, Mc Graw-Hill Inc. pp: 90-125
13	www.gis.net~jmastersforecast.htm.(April, 2005)

APPENDIX A.

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APPENDIX B

Table II Upper Fercentage Points of the t Distribution 0 Q = 0.4 0.25 0.1 0.001 0.000 v Q = 0.4 0.2 0.11 0.002 0.01 0.000 1 0.325 1.000 3.078 6.314 12.706 31.821 63.657 318.33 2 289 0.816 1.882 2.776 3.747 4604 7.15 3 2.777 7.765 1.638 2.33 3.747 4604 7.17 5 0.267 0.727 1.476 2.132 2.776 3.365 4.002 2.866 3.355 3.457 3.457 3.458 2.262 <t< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th>The second secon</th><th></th><th>2</th></t<>							The second secon		2
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12 $.259$ $.695$ 1.356 1.762 $2.11.7$ 2.160 2.650 3.012 3.8 13 $.259$ $.694$ 1.350 1.771 2.160 2.650 3.012 3.8 14 $.258$ $.692$ 1.345 1.761 2.145 2.624 2.977 3.7 15 0.258 0.691 1.341 1.753 2.131 2.602 2.947 3.7 16 $.256$ $.690$ 1.337 1.746 2.120 2.583 2.921 3.66 17 $.257$ $.689$ 1.333 1.740 2.110 2.567 2.898 3.66 18 $.257$ $.688$ 1.330 1.734 2.101 2.552 2.878 3.66 19 $.257$ $.688$ 1.328 1.729 2.093 2.539 2.861 3.57 20 0.257 0.687 1.325 1.725 2.086 2.528 2.845 3.57 21 $.257$ $.686$ 1.323 1.721 2.080 2.518 2.831 3.57 22 $.256$ $.686$ 1.321 1.717 2.074 2.508 2.819 3.51 23 $.256$ $.685$ 1.319 1.714 2.069 2.500 2.807 3.44 24 $.256$ $.685$ 1.316 1.708 2.060 2.485 2.787 3.44 25 0.256 0.684 1.316 1.703 2.052 2.477 <	11	.260	.097	1.303	1.790	7170	2 681	3.055	3.930
13.259.6941.500 1.771 2.1050 2.050 3.012 3.74 14.258.692 1.345 1.761 2.145 2.624 2.977 3.74 150.2580.691 1.341 1.753 2.131 2.602 2.947 3.74 16.258.690 1.337 1.746 2.120 2.583 2.921 3.61 17.257.689 1.333 1.740 2.110 2.567 2.898 3.66 18.257.688 1.330 1.734 2.101 2.552 2.878 3.66 19.257.688 1.328 1.729 2.093 2.539 2.861 3.57 200.2570.687 1.325 1.725 2.086 2.528 2.845 3.57 21.257.686 1.323 1.721 2.080 2.518 2.831 3.57 22.256.686 1.321 1.717 2.074 2.508 2.819 3.512 23.256.685 1.319 1.714 2.069 2.500 2.807 3.44 24.256.685 1.316 1.708 2.060 2.485 2.787 3.44 250.2560.684 1.316 1.708 2.060 2.485 2.779 3.44 250.256.683 1.311 1.699 2.045 2.467 2.779 3.44 26.683 1.311 1.701 <	12	.259	.695	1.370	1.702	2160	2,650	3 012	3.852
14 $.256$ $.692$ 1.345 1.761 2.143 2.024 2.977 2.077 15 0.258 0.691 1.341 1.753 2.131 2.602 2.947 3.77 16 $.256$ $.690$ 1.337 1.746 2.120 2.583 2.921 3.61 17 $.257$ $.689$ 1.333 1.740 2.110 2.567 2.898 3.66 18 $.257$ $.688$ 1.330 1.734 2.101 2.552 2.878 3.66 19 $.257$ $.688$ 1.328 1.729 2.093 2.539 2.861 3.57 20 0.257 0.687 1.325 1.725 2.086 2.528 2.845 3.57 21 $.257$ $.686$ 1.323 1.721 2.080 2.518 2.831 3.57 22 $.256$ $.686$ 1.321 1.717 2.074 2.508 2.819 3.57 23 $.256$ $.686$ 1.321 1.717 2.074 2.508 2.819 3.57 24 $.256$ $.685$ 1.319 1.714 2.069 2.500 2.807 3.44 25 0.256 0.684 1.316 1.708 2.060 2.485 2.787 3.44 26 $.256$ $.684$ 1.314 1.703 2.052 2.473 2.771 3.44 26 $.256$ $.683$ 1.311 1.699 2.045 2.462 2.7	13	.259	.694	1.550	1.//1	2.100	7674	2977	3.787
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	14	.258	.692	1.345	1.761	2147	2.024		2 722
16 $.258$ $.690$ 1.337 1.746 2.120 2.583 2.921 3.66 17 $.257$ $.689$ 1.333 1.740 2.110 2.567 2.898 3.66 18 $.257$ $.688$ 1.330 1.734 2.101 2.552 2.878 3.66 19 $.257$ $.688$ 1.328 1.729 2.093 2.539 2.861 3.57 20 0.257 0.687 1.325 1.725 2.086 2.528 2.845 3.57 21 $.257$ $.686$ 1.323 1.721 2.080 2.518 2.831 3.57 22 $.256$ $.686$ 1.321 1.717 2.074 2.508 2.819 3.59 23 $.256$ $.685$ 1.319 1.714 2.069 2.500 2.807 3.44 24 $.256$ $.685$ 1.316 1.708 2.060 2.485 2.797 3.44 25 0.256 0.684 1.316 1.708 2.060 2.485 2.787 3.44 26 $.256$ $.684$ 1.314 1.703 2.052 2.473 2.777 3.44 28 $.256$ $.683$ 1.313 1.701 2.048 2.467 2.763 3.44 29 $.256$ $.683$ 1.311 1.697 2.042 2.473 2.776 3.34 30 0.256 0.683 1.310 1.697 2.042 2.475 2.76	15	0.258	0.691	1.341	1.753	2.131	2.602	2947	3.133
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	16	.258	.690	1.337	1.746	2.120	2.583	2.921	3.080
18 $.257$ $.688$ 1.330 1.734 2.101 2.552 2.878 3.6 19 $.257$ $.688$ 1.328 1.729 2.093 2.539 2.861 3.57 20 0.257 0.687 1.325 1.725 2.086 2.528 2.845 3.57 21 $.257$ $.686$ 1.323 1.721 2.080 2.518 2.831 3.57 22 $.256$ $.686$ 1.321 1.717 2.074 2.508 2.819 3.51 23 $.256$ $.685$ 1.319 1.714 2.069 2.500 2.807 3.44 24 $.256$ $.685$ 1.318 1.711 2.064 2.492 2.797 3.44 25 0.256 0.684 1.316 1.708 2.060 2.485 2.787 3.44 25 0.256 0.684 1.316 1.708 2.060 2.485 2.797 3.44 26 $.256$ $.684$ 1.315 1.706 2.052 2.473 2.779 3.44 27 $.256$ $.684$ 1.314 1.703 2.052 2.473 2.777 3.44 28 $.256$ $.683$ 1.313 1.701 2.048 2.467 2.763 3.44 29 $.256$ $.683$ 1.311 1.699 2.045 2.462 2.756 3.34 30 0.256 0.683 1.310 1.697 2.042 2.457 2.7	17	.257	.689	1.333	1.740	2.110	2.567	2.898	3.040
19 $.257$ $.688$ 1.328 1.729 2.093 2.539 2.861 3.57 20 0.257 0.687 1.325 1.725 2.086 2.528 2.845 3.57 21 $.257$ $.686$ 1.323 1.721 2.080 2.518 2.831 3.57 22 $.256$ $.686$ 1.321 1.717 2.074 2.508 2.819 3.57 23 $.256$ $.685$ 1.319 1.714 2.069 2.500 2.807 3.44 24 $.256$ $.685$ 1.318 1.711 2.064 2.492 2.797 3.44 25 0.256 0.684 1.316 1.708 2.060 2.485 2.787 3.44 26 $.256$ $.684$ 1.316 1.708 2.060 2.485 2.787 3.44 26 $.256$ $.684$ 1.316 1.708 2.060 2.485 2.787 3.44 27 $.256$ $.684$ 1.314 1.703 2.052 2.473 2.777 3.44 28 $.256$ $.683$ 1.313 1.701 2.048 2.467 2.763 3.44 29 $.256$ $.683$ 1.311 1.699 2.045 2.462 2.756 3.39 30 0.256 0.683 1.310 1.697 2.042 2.457 2.750 3.36 40 $.255$ $.681$ 1.303 1.684 2.021 2.423 2.704 3.36 <	18	.257	.685	1.330	1.734	2.101	2.552	2.878	3.010
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	19	.257	.688	1.328	1.729	2.093	2.539	2.861	3.57
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	20	0.257	0.687	1.325	1.725	2.086	2.528	2.845	3.552
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	21	.257	.686	1.323	1.721	2.080	2.518	2.831	3.52
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	22	.256	.686	1.321	1.717	2.074	2.508	2.819	3.505
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	23	256	.685	1.319	1.714	2.069	2.500	2.807	3.485
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	24	.256	.685	1.318	1.711	2.064	2.492	2.797	3.467
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	25	0.256	0.684	1.316	1.708	2.060	2.485	2.787	3.450
27 .256 .684 1.314 1.703 2.052 2.473 2.771 3.44 28 .256 .683 1.313 1.701 2.048 2.467 2.763 3.44 29 .256 .683 1.313 1.701 2.048 2.467 2.763 3.44 29 .256 .683 1.311 1.699 2.045 2.462 2.756 3.35 30 0.256 0.683 1.310 1.697 2.042 2.457 2.750 3.36 40 .255 .681 1.303 1.684 2.021 2.423 2.704 3.30 60 .254 .679 1.296 1.671 2.000 2.390 2.660 3.22 120 .254 .677 1.289 1.658 1.980 2.358 2.617 3.10 120 .254 .677 1.289 1.658 1.960 2.326 2.576 3.00	26	.256	.684	1.315	1.706	2.056	2.479	2.779	3.435
28 .256 .683 1.313 1.701 2.048 2.467 2.763 3.40 29 .256 .683 1.311 1.699 2.045 2.462 2.756 3.39 30 0.256 0.683 1.310 1.697 2.042 2.457 2.750 3.39 40 .255 .681 1.303 1.684 2.021 2.423 2.704 3.30 60 .254 .679 1.296 1.671 2.000 2.390 2.660 3.23 120 .254 .677 1.289 1.658 1.980 2.358 2.617 3.10 120 .254 .677 1.289 1.658 1.980 2.358 2.617 3.10	27	256	.684	1.314	1.703	2.052	2.473	2.771	3.421
20	28	256	683	1.313	1.701	2.048	2.467	2.763	3.408
30 0.256 0.683 1.310 1.697 2.042 2.457 2.750 3.36 40 .255 .681 1.303 1.684 2.021 2.423 2.704 3.36 60 .254 .679 1.296 1.671 2.000 2.390 2.660 3.23 120 .254 .677 1.289 1.658 1.980 2.358 2.617 3.16 120 .254 .677 1.289 1.658 1.980 2.358 2.617 3.16	29	.256	.683	1.311	1.699	2.045	2.462	2.756	3.396
40 .255 .681 1.303 1.684 2.021 2.423 2.704 3.30 60 .254 .679 1.296 1.671 2.000 2.390 2.660 3.23 120 .254 .677 1.289 1.658 1.980 2.358 2.617 3.10 120 .254 .677 1.289 1.655 1.980 2.358 2.617 3.10	20	0.256	0.683	1,310	1.697	2.042	2.457	2.750	3.385
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	10	255	681	1,303	1.684	2.021	2.423	2.704	3.307
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	40	25%	670	1 295	1.671	2.000	2.390	2.660	3.232
120	120	254	677	1 289	1.658	1.980	2.358	2.617	3.160
	120	252	674	1 282	1.645	1,960	2.326	2.576	3.090

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