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SALES FORECASTING FOR THE FOOTWEAR INDUSTRY
IN TURKEY
IN RELATION TO THE BEYKOZ SHOE FACTORY

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by

Muhittin Oral

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Administration and Economics of Robert
College in partial fulfillment of the
requirements for the degree of Master of
Arts in Industrial Administration.

1966

P R E F A C E

The value of forecasting cannot be overestimated. In order to begin the production process in an industry, first it has to be determined what to produce, how and in what quantities. All these decisions rest on implicit or explicit assumptions with regard to the expected sales. The kind, quality and the amount of the product to be produced are determined upon the conditions of the market for that particular product. Therefore, the industrial activities have to be planned depending upon the sales forecast for the industry.

On first thought, the subject of sales forecasting might seem to belong to the field of marketing rather than to production planning. However, a more detailed study of the implications of sales forecasting will indicate that this is not so. Sales forecasting is the initial and essential step of production planning since it indicates the future volume and composition of the output. On this basis, the future need for the production factors such as the number of workers to be employed, the amount of raw materials and additional machinery and equipment, and the output composition are predicted. Therefore, the task of sales forecasting is usually assigned to the production planning department. In the USA, sales forecasting is made by the production control departments of the firms in 50 % of the cases. This paper is concerned with this aspect of sales forecasting rather than the marketing aspect. We are not concerned with how to market the estimated future output, but how to estimate and produce it.



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Talks on the selection of a thesis topic with Mr. Metin Göker, instructor at Robert College and head of the quality control department of the Beykoz Shoe Factory, revealed that a scientific long-range sales forecasting had never been attempted before in the Beykoz Factory. Mr. Göker suggested that such a study would reveal many facts in the shoe consumption in Turkey hitherto left unexplained and would form the base for future studies on this subject. This project was found interesting in that it would both bring into focus the practical aspects of the forecasting problem and would serve a practical purpose if the findings were utilized in the Beykoz Factory.

The expectation with regard to gaining experience in the field of forecasting proved to be especially true. First, it was seen that in a country like Turkey where even the most crude forms of statistical data do not exist in most fields, a forecasting study has to begin with the collection of data. Therefore, this kind of a study in Turkey is not a one-man job and requires a team of trained personnel for the collection and processing of the essential data. Second, to arrive at reliable measures of the functional relationship between the related economic variables, it is most essential to know the regional economic conditions in the country in question, and to design the sampling technique accordingly. Otherwise, the sample will not be a representative group for the country as a whole, and thus the functional relationships measured from this sample will not hold true for the whole population.

Here I would like to thank Professor Göker for his guidance and help in the preparation of this paper.

Muhittin Oral

Robert College, Istanbul.

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CONTENTS

	<u>Page</u>
PREFACE	
INTRODUCTION.....	1
A. DEMAND FOR SHOES IN TURKEY.....	4
1. Consumer Survey.....	6
2. Pattern of Shoe Consumption in Selected Foreign Countries.....	38
B. PROJECTIONS FOR THE FACTORS DETERMINING SHOE DEMAND.....	56
1. Projections for National Income.....	56
2. Projections for Population.....	59
3. Projections for Per Capita Income.....	60
C. SALES PROJECTIONS FOR TURKEY, 1966 - 1970.....	62
1. Consumer Survey.....	62
2. Simple Regression Equation Method.....	66
3. Comparison of the Estimates Obtained.....	67
D. ANALYSIS OF SALES OF THE BEYKOZ FACTORY.....	70
1. Trend for Beykoz's Sales.....	70
2. Projections for Beykoz's Sales, 1966 - 1970.....	73
E. QUALITATIVE STRUCTURE OF THE DEMAND FOR SHOES.....	75
F. IMPLICATIONS FOR THE FUTURE OUTPUT OF THE BEYKOZ FACTORY.....	80
Appendix I	
Appendix II	
Appendix III	
BIBLIOGRAPHY	

INTRODUCTION

The Beykoz Factory is owned by Sümerbank, an economic state enterprise with diversified investments. It is located in Beykoz, Istanbul. The factory has two main manufacturing units: the leather and the shoe manufacturing divisions. This paper is concerned with the shoe manufacturing division, which will be denoted by the term "Beykoz factory" throughout the paper. The capacity of this unit is 2 million pairs of shoes per year. This capacity is not utilized fully. In 1965, only 65% of the capacity was utilized. The determination of the level of output is dependent on the amount of the order received from the armed forces and the probable level of sales to the civilian customers. This decision is not made on a quantitative study of shoe demand in general and in particular for Beykoz shoes. Past sales of the factory are the most influential factor in this decision. Methods of sales promotion are not commonly applied by the factory. The growth of sales is left to develop by itself. Therefore attainment of full capacity has been dependent on the increase of sales to that level, which was not realized up to now. This situation leads both to waste of financial resources and invested funds, which are very scarce and thus valuable in Turkey, and to inflation of the production cost per pair of shoes.

This paper attempts to project the total sales of shoes in Turkey in the period 1966-1970 and at finding the relative importance of the factors determining shoe demand in order to estimate the growth possibilities for the capacity of the Beykoz shoe factory. In this respect, the first task undertaken was to estimate the relationships between the factors determining

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the demand for shoes in Turkey. The first method used for this purpose was conducting a consumer survey in the cities of Ankara and Istanbul. The survey was designed to obtain two kinds of data about the interviewee:

- 1) Objective data for his household such as net income, number of pairs of shoes used by the household members per year, average shoe prices paid by each member, size and location of the household,
- 2) Subjective data about his tastes and preferences in his demand for shoe.

The major factors determining shoe sales in this case were taken as income and supernumerary income per household, and size of the household. A multiple regression equation was calculated for these variables showing the degree of influence of each factor on the sales of shoes. The second method, in order to establish the relationship between per capita shoe consumption and income, used data for some selected foreign countries and led to a simple regression equation between the two variables.

In the second phase, projections of the data to be substituted in the regression equations were made. These variables are net national income, population, and per capita income. In the third phase, the projections of net national income, per capita income and population for the years 1966-70 were substituted in the regression equations to give the estimated annual shoe consumption in the same period. Here annual consumption was taken to equal annual sales as stocks are not customary in the shoe industry. In the fourth phase, the trend and projections for Beykoz sales were estimated. The next section is an analysis of the qualitative structure of shoe demand from data

obtained from the consumer survey. The last section contains the implications of the consumer survey for the future sales and capacity of the Beykoz factory.

This paper describes the study of the methods of sales forecasting in a situation where data, time, and personnel were extremely limited. In this respect, it has served the purpose of showing some of the difficulties that could be met in such a study rather than being an adequate sales forecast.

A. DEMAND FOR SHOES IN TURKEY

A quantitative study of the demand for shoes had not been conducted in Turkey at the time this study was started. This was probably due to the lack of statistical data ready for employment in the statistical analysis on one hand and the small scale of the shoe industry on the other. In Turkey, about 80-85 % of the population wears vulcanized black rubber shoes. About 10 % wears low-quality leather shoes and plastic shoes, and the remaining 5 %, medium or good quality leather shoes. Of these, rubber plastic and low-quality leather shoes are mostly manufactured locally in small workshops employing few workers and some very primitive machinery. Of the leather shoes sold in Turkey, again, a large part is manufactured locally while a small portion is manufactured in Istanbul, Ankara and Izmir and sent to the other provinces.

Except for a few large shoe manufacturing companies such as AS SHOE COMPANY, ŞAFAK SHOE COMPANY, and KUĞU SHOE COMPANY, BEYKOZ is unique in the footwear industry in that it operates on a nation-wide scale and is mechanized to a degree much greater than the others. AS operates in the Istanbul area and ŞAFAK and KUĞU in Izmir. In these firms also shoes are mostly manufactured by hand with the help of a few machines. They answer only the regional demand for shoes around Izmir and Istanbul, and therefore have not felt the need to know total shoe consumption in Turkey. In this situation, the task of estimating the total demand for shoes in Turkey was necessarily of concern to the BEYKOZ shoe factory. However, such a study has not been conducted in the BEYKOZ factory up to now. A large percentage of the BEYKOZ shoe sales is to the military

forces and the rest to the civilians. Therefore, the BEYKOZ factory administration has not been very much concerned with the consumer demand for shoes in Turkey and has not collected any data with regard to the footwear industry. Consequently, it was not possible to receive any help from the BEYKOZ factory concerning the statistical data on shoe production and consumption in Turkey. The Chambers of Commerce and Industry of Turkey were also of no help since the registration of the shoe manufacturers in a particular region in the Chamber of Commerce and Industry of that locality reaches only 40 % as stated by the officials of the Chambers. There is no data whatsoever as to the productive capacity and sales of the registered shoe manufacturers. On the other hand, the State Institute of Statistics in Ankara only has records on the annual production of the BEYKOZ factory and nothing else on leather and footwear industry.

This situation which emerged as a result of trips and contacts in Ankara, Izmir and Istanbul necessitated that all data required for an analysis of the shoe demand in Turkey and Beykoz's share thereof be collected and processed in the first step of the task. In these conditions, two methods were devised in order to measure the variables determining the shoe demand in Turkey as accurately as possible in the time period available. The methods were also devised as to constitute a check on the accuratness of each other. The methods followed were :

1. Consumer Survey
2. Regression between per capita income and shoe consumption in selected foreign countries.

1. Consumer Survey

Consumer surveys are conducted for a variety of reasons. In each survey, the sample, the data collection methods and the specific questions to be asked are determined on the basis of the final objective. In this survey, the objective was to determine the functional relationship between shoe consumption and income per household, size of household and supernumerary income per household. In this respect the sampling techniques available were:

1. Probabilistic Sampling Techniques
 - a. Simple Random Sampling
 - b. Stratified Random Sampling
 - c. Systematic Sampling
 - d. Cluster Sampling
2. Non-probabilistic Sampling Techniques
 - a. Quota Sampling
 - b. Convenience Sampling

The probabilistic sampling techniques allow the researcher to make statistical inferences about the population parameters from the statistics of the sample drawn, since the probability of drawing each sample is known. On the other hand, the non-probabilistic sampling techniques do not permit the researcher to make statistical inferences about the population parameters, but give information about the population parameters. In this case, the researcher cannot say with what probability the population parameters he has

estimated are between certain intervals. In this respect, the non-probabilistic sampling techniques are inferior to the probabilistic sampling techniques. However, the probabilistic sampling techniques always require much greater financial resources, personnel, organization and time than the non-probabilistic sampling techniques. Since all the listed factors were either extremely limited or completely non-existent in this study, none of the probabilistic sampling techniques could be employed in the final step.

Sampling Technique Employed

In the first stages of preparation of this project, help on providing personnel for the filling out of the survey questionnaires and for processing of the data was promised by the BEYKOZ management. Depending on their promise for help, cluster sampling was thought to be the most appropriate of the available sampling techniques for this study. Cluster sampling is a technique where the population is divided into blocks containing similar elements. Of these, a number of blocks as required are chosen by random sampling. Random sampling is again employed in choosing elements from the selected blocks. This technique proved to be applicable in Turkey in the Birth Control Survey conducted in the summer of 1963. The results obtained also proved to be reliable. Thus the original procedure chosen was as follows: Certain provincial stores of the SÜMERBANK were to be chosen to represent the geographical regions of Turkey. A number of questionnaires would be sent to these predetermined stores according to the population of the province in mind. The number of questionnaires sent to a certain province would be 50 at maximum and 15 at minimum. These questionnaires would be filled by the salesmen

by interviewing the people who come to Beykos shoe shops. Then they would be sent back to Istanbul for data processing and evaluation. However, although these questionnaires were printed, they could not be sent to the SÜMERBANK stores due to the objection of the Beykoz Sales Manager. The management objected that filling out of these questionnaires would consume too much time of the salesmen and result in neglect of salesmanship duties. Thus this project had to be abandoned. In the final step, a non-probabilistic sampling technique had to be employed, namely convenience sampling. Thus most of the questionnaires were filled in Istanbul by interviewing the people chosen by the author and a small portion in the Ankara Store of Beykoz by the efforts of Mr.Göker, the thesis advisor.

Description of the Questionnaire Used

Originally two types of sources were available in order to collect data for the shoe demand:

- a) Consumer
- b) Salesman

One type of questionnaire was prepared for the consumers, namely Questionnaire B, which will be described in detail in the coming sections. On the other hand, to collect data from the salesmen, two types of questionnaires were prepared, Questionnaire A and Questionnaire C. Questionnaire A was designed for the Sumerbank stores which have a shoe department. It included questions on the following points to be answered by the salesmen:

- a) Do the kinds of shoe styles meet the customer demand sufficiently
- b) Which styles are sold most ?

- c) Is it feasible to sell shoes manufactured by other firms in order to be able to have more shoe styles than manufactured by Beykoz ?
- d) What do the salesmen recommend for sales promotion ?

Questionnaire B was designed to serve two objectives :

- a-i) To obtain data about the size, income and shoe consumption in number of pairs per household, and
- ii) To obtain data about the size, income and shoe consumption in value per household in order to establish the functional relationship between these variables in Istanbul and Ankara.
- b) To obtain data about consumer opinion with regard to the other factors affecting consumer demand for shoes, and comments on Beykoz's shoes. Questionnaire B contained questions on the

number of pairs of shoes bought by each member of the household per year, the average price paid per pair for each member, the income of the household, the location of the household, the profession of the interviewee, the factors affecting his demand for shoes and his comments about Beykoz's shoes if he wears them. (Refer to page 10 for the Questionnaire B).

Processing the Data Obtained from the Survey

The number of questionnaires filled out was 66 from Ankara and 190 from Istanbul. When the questionnaires which weren't completely filled out were eliminated, 48 were left from Ankara and 152 from Istanbul. The answers in these questionnaires were processed separately for Ankara and Istanbul to

QUESTIONNAIRE - B

(Translation from Turkish)

Sex of the customer: Male - Female

Name of the Store the Questionnaire was filled:

INSTRUCTIONS FOR FILLING OUT THE QUESTIONNAIRE

Answer the following questions by asking the customers who visit your store and has free time. A separate questionnaire will be filled out for each customer. If a customer declines answering some questions because of certain reasons, leave it out and fill out the other questions. However, it is essential to fill out at least 10 questionnaires completely. Special attention should be paid to selecting the customers from various social groups. (Rich, medium income, poor, villagers, town and city people, young, old, clerks, free professions, traders etc.). In case the customer does not know the accurate answer to some questions, insert estimated figures (The estimates of the customer)

QUESTIONS

1. How many pairs of shoe do you purchase on the average per year ?
What is the average price you pay for each pair ?
..... Pairs
..... TL/Pair (Price paid per pair)
2. How many members are there in your household (excluding yourself) ?
..... Persons
Of these,
..... Male (over the age 17)
..... Female (over the age 17)
..... Adolescents (between the ages 10-17)
..... Children (below the age 10)

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 12

9. What is your occupation ?

.....

10. What kinds of shoes do you wear ?

() Rubber (Vulcanized rubber shoe)

() Leather-bottom shoes

() Rubber-bottom shoes

11. What points do you take into account when purchasing shoes ? (You can list more than one point).

() Cheapness () Installment sales

() Strength () Other reasons

() Style

12. If you wear Beykoz shoes, why do you prefer them ? (You can list more than one point).

() Its low price () Due to habit

() Its strength () Other reasons

() Its style

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 43

give the following data for employing in the regression analysis:

1. Annual shoe consumption per household in pairs,
2. Annual shoe consumption per household in value,
3. Annual income per household,
4. Size of household,
5. Supernumerary income per household.

Price was not included within the factors determining shoe consumption since the analysis was designed to obtain implications about the future of Beykoz's sales and thus its production capacity. The Beykoz shoe factory manufactures shoes to answer the shoe demand of the low-income people in Turkey. Thus its prices are set on social service considerations rather than economic consideration. Therefore it was deemed unnecessary to include price as a variable in the analysis since it would not be considered in the long run.

The first four variables given above were calculated from the answers given on the questionnaires. The fifth item, supernumerary income, is the disposable income left in the hands of the household after the minimum living allowance is subtracted. The minimum living allowance was determined on the basis of the size of the household and its composition. Different minimum living allowances were accepted for children, adolescents and adults as follows :

<u>Group</u>	<u>Minimum Living Allowance per Year</u>
Children	TL 1000
Adolescents	TL 1000
Adults	TL 4000

The source of these figures is a study made on living allowance by TÜRK-İŞ which was provided by Mr.Göker. The following is an example to illustrate how the supernumerary income is calculated :

Questionnaire No: A-1

Annual net income of the household : TL 14,900

Number of children : 1

Number of adolescents : 2

Number of adults : 2

Therefore, the minimum living allowance is :

1 x TL 1000 : TL 1000

2 x TL 2000 : TL 4000

2 x TL 4000 : TL 8000

TL 13,000 Minimum living allowance for the household.

Thus supernumerary income : TL 14,900 - TL 13,000 : TL 1900 .

The supernumerary income was calculated similarly for all of 200 questionnaires from Ankara and Istanbul.

The variables obtained from the questionnaires were used to calculate two regression equations for both Ankara and Istanbul to show the following relationships :

1. Annual value of shoe consumption per household and annual income per household, size of the family, annual supernumerary income per household,
2. Annual number of shoe pairs purchased per household and annual income per household, size of the household, annual supernumerary income per household.

The second relationship is more meaningful from the viewpoint of production at the Beykoz shoe factory, since output is planned as number of pairs of shoes. However, the first relationship is also meaningful since it expresses the shoe demand in value, i.e., it indicates the money income to be spent for shoe consumption.

In calculating equations of the regression hyperplanes, two assumptions were made :

1. The dependent variable, i.e., shoe consumption both in pairs and in value, is linearly related to the independent variables, i.e., annual income per household, size of the household and annual supernumerary income per household.
2. The universe distribution was assumed to be homosedastic, i.e., for all values of the independent variables, the distribution of the dependent variable is normal and the standard deviations in all cases are equal to each other. In other words, the standard deviations of the dependent variable at different values of the independent variables are constant.

The four methods of estimation available to estimate the universe parameters are :

1. Maximum Likelihood Method
2. Method of Moments
3. Bayes Estimation Method
4. Least-squares Method

In the case of homosedastic distribution, the least-squares method gives the best unbiased estimators. Therefore, the least-squares method was used in calculating the equations of the regression hyperplane.

The equation of the universe regression hyperplane is :

$$X_1 : a_{1.234} + b_{12.34} X_2 + b_{13.24} X_3 + b_{14.23} X_4$$

where

X_1 : Shoe consumption in value or in pairs per household per year.
(for pairs, one pair; for value, TL 1000)

X_2 : Annual income per household per year, (TL 1000).

X_3 : Size of household

X_4 : Supernumerary income per household per year, (TL 1000).

$a_{1.234}$, $b_{12.34}$, $b_{13.24}$, $b_{14.23}$ are coefficient constants.

The calculations for Ankara and Istanbul are given in the following sections.

Calculation of the Regression Equation for Ankara in Pairs of Shoe

The regression coefficients are calculated below in order to estimate the annual consumption of shoes in pairs per household, X_1 .

$\sum X_1$: 545.0	$\sum X_1 X_2$: 9728.1
$\sum X_2$: 795.4	$\sum X_1 X_3$: 2511.0
$\sum X_3$: 196.0	$\sum X_1 X_4$: 2684.3
$\sum X_4$: 229.4	$\sum X_2 X_3$: 3346.9
$\sum X_1^2$: 7297.0	$\sum X_2 X_4$: 8582.1
$\sum X_2^2$: 19031.0	$\sum X_3 X_4$: 817.1
$\sum X_3^2$: 905.0	\bar{X}_1 : 11.6
$\sum X_4^2$: 5650.4	\bar{X}_2 : 16.9
N : 47	\bar{X}_3 : 4.2
	\bar{X}_4 : 4.9

The values stated above are calculated in Appendix I.

T H E S I S

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 17

The centered values were calculated by the method given below :

$$\sum x_1^2 : \sum X_1^2 - N \bar{X}_1^2 : 7297.0 - 47 (11.6)^2 : 970$$

$$\sum x_2^2 : \sum X_2^2 - N \bar{X}_2^2 : 19031.0 - 47 (16.9)^2 : 5607$$

$$\sum x_3^2 : \sum X_3^2 - N \bar{X}_3^2 : 904.0 - 47 (4.2)^2 : 75$$

$$\sum x_4^2 : \sum X_4^2 - N \bar{X}_4^2 : 5650.4 - 47 (4.9)^2 : 4522$$

$$\sum x_1 x_2 : \sum X_1 X_2 - N \bar{X}_1 \bar{X}_2 : 9728.1 - 47 (11.6)(16.9) : 514$$

$$\sum x_1 x_3 : \sum X_1 X_3 - N \bar{X}_1 \bar{X}_3 : 2511.0 - 47 (11.6)(4.2) : 121$$

$$\sum x_1 x_4 : \sum X_1 X_4 - N \bar{X}_1 \bar{X}_4 : 2685.3 - 47 (11.6)(4.9) : 13$$

$$\sum x_2 x_3 : \sum X_2 X_3 - N \bar{X}_2 \bar{X}_3 : 3346.9 - 47 (16.9)(4.2) : 11$$

$$\sum x_2 x_4 : \sum X_2 X_4 - N \bar{X}_2 \bar{X}_4 : 8582.1 - 47 (16.9)(4.9) : 4690$$

$$\sum x_3 x_4 : \sum X_3 X_4 - N \bar{X}_3 \bar{X}_4 : 817.1 - 47 (4.2)(4.9) : -150$$

The values found above were substituted in the following equations:

$$c_{22} \sum x_2^2 + c_{23} \sum x_2 x_3 + c_{24} \sum x_2 x_4 : 1$$

$$c_{22} \sum x_2 x_3 + c_{23} \sum x_3^2 + c_{24} \sum x_3 x_4 : 0$$

$$c_{22} \sum x_2 x_4 + c_{23} \sum x_3 x_4 + c_{24} \sum x_4^2 : 0$$

$$c_{23} \sum x_2^2 + c_{33} \sum x_2 x_3 + c_{34} \sum x_2 x_4 : 0$$

$$c_{23} \sum x_2 x_3 + c_{33} \sum x_3^2 + c_{34} \sum x_3 x_4 : 1$$

$$c_{23} \sum x_2 x_4 + c_{33} \sum x_3 x_4 + c_{34} \sum x_4^2 : 0$$

$$c_{24} \sum x_2^2 + c_{34} \sum x_2 x_3 + c_{44} \sum x_2 x_4 : 0$$

$$c_{24} \sum x_2 x_3 + c_{34} \sum x_3^2 + c_{44} \sum x_3 x_4 : 0$$

$$c_{24} \sum x_2 x_4 + c_{34} \sum x_3 x_4 + c_{44} \sum x_4^2 : 1$$

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 18

Thus the three sets of auxiliary equations arrived at were :

$$5607 c_{22} + 11 c_{23} + 4690 c_{24} : 1$$

$$11 c_{22} + 75 c_{23} - 150 c_{24} : 0$$

$$4690 c_{22} - 150 c_{23} + 4522 c_{24} : 0$$

$$5607 c_{23} + 11 c_{33} + 4690 c_{34} : 0$$

$$11 c_{23} + 75 c_{33} - 150 c_{34} : 1$$

$$4690 c_{23} - 150 c_{33} + 4522 c_{34} : 0$$

$$5607 c_{24} + 11 c_{34} + 4690 c_{44} : 0$$

$$11 c_{24} + 75 c_{34} - 150 c_{44} : 0$$

$$4690 c_{24} - 150 c_{34} + 4522 c_{44} : 1$$

These sets of auxiliary equations were solved and the values obtained for c's are as follows :

$$c_{22} : .28858523 E - 02$$

$$c_{23} : -.68648189 E - 02$$

$$c_{24} : -.32207807 E - 02$$

$$c_{33} : .30610671 E - 01$$

$$c_{34} : .81352506 E - 02$$

$$c_{44} : .38314350 E - 02$$

These values were substituted in the following equations to obtain the coefficients of the regression equation.

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 19

$$b_{12.34} : c_{22} \sum x_1 x_2 + c_{23} \sum x_1 x_3 + c_{24} \sum x_1 x_4$$

$$b_{13.24} : c_{33} \sum x_1 x_2 + c_{33} \sum x_1 x_3 + c_{34} \sum x_1 x_4$$

$$b_{14.23} : c_{44} \sum x_1 x_2 + c_{34} \sum x_1 x_3 + c_{44} \sum x_1 x_4$$

And thus

$$b_{12.34} : (.0028858523)(514) - (.00686482)(121) - (.0032207807)(13) : \underline{.6108}$$

$$b_{13.24} : (-.00686482)(514) + (.0306107)(121) + (.00813525)(13) : \underline{.4811}$$

$$b_{14.23} : (-.00322078)(514) + (.00813525)(121) + (.00383144)(13) : \underline{-.6213}$$

The value of $a_{1.234}$ was found by employing the following formula:

$$\begin{aligned} a_{1.234} &: \bar{X}_1 - b_{12.34} \bar{X}_2 - b_{13.24} \bar{X}_3 - b_{14.23} \bar{X}_4 \\ &: 11.6 - (.6108)(16.9) - (.4811)(4.2) + (.6213)(4.9) \\ &: \underline{2.30123} \end{aligned}$$

Hence the multiple regression equation was found to be

$$\underline{X_1 : 2.301 + .6108 X_2 + .4811 X_3 - .6213 X_4}$$

The explanation of the regression coefficients is given below:

$b_{12.34} : .6108$. This indicates that in the Ankara city, when annual income per household increases by TL 1000, shoe consumption per household in pairs goes up by .6108 other variables being constant, i.e., to increase shoe consumption per household by one pair per year, annual household income has to increase about TL 1800.

$b_{13.24} : .4811$. This indicates that when the size of the household increases by one person, shoe consumption per year increases by .4811 pairs other variables being constant, i.e., the annual consumption of shoes per

household goes up by about a pair in case two persons are added to the household.

$b_{14.23} : -.6213$. This value is meaningful only when it is taken into consideration that the supernumerary income of an overwhelming number of households in the survey turned out to be negative, i.e., the net annual income of most households were even below the minimum living allowance estimated by TÜRK-İŞ, the Confederation of the Turkish Labour Unions. Therefore, the relationship between supernumerary income per household and shoe consumption was calculated to be negative.

In order to measure the reliability of the estimate of the annual consumption of shoes in pairs per household estimated from size of household, annual income and supernumerary income per household, its standard error of estimate was calculated by means of the following formula :

$$S_{1.234}^2 : \frac{\sum v_{1.234}^2}{N - 4}$$

where $\sum v_{1.234}^2 : \sum x_1^2 - b_{12.34} \sum x_1 x_2 - b_{13.24} \sum x_1 x_3 - b_{14.23} \sum x_1 x_4$.

Substituting the values calculated before, we have

$$\sum v_{1.234}^2 : 970 - (.6108)(514) - (.4811)(121) + (.6213)(13) : 406$$

Thus

$$S_{1.234}^2 : \frac{406}{47 - 4} : \frac{406}{43} : 9.4413$$

and finally the standard error of estimate is $S_{1.234} : 3.07$.

The multiple correlation coefficient which measures the degree of association between the dependent variable and the function of the independent

variables represented by the regression equation is calculated below.

$$R_{1.234}^2 : 1 - \frac{(N-1) \sum v_{1.234}^2}{(N-4) \sum x_1^2}$$

$$: 1 - \frac{(47-1)(406)}{(47-4)(970)}$$

$$: .5529$$

Thus the correlation coefficient is $R_{1.234} : .74$. $R_{1.234}^2$ measures the percentage of 'explained' variance of X_1 , the dependent variable. In this case, the value of $R_{1.234}^2$ is .5529. This indicates that household size, annual income per household and annual supernumerary income per household jointly account for 55 % of the variance in annual shoe consumption per household.

Similar explanations are valid for the calculations in the coming sections where the regression equations are found for Ankara in value and for Istanbul both in pairs and value. In these sections, explanations are not given for the calculations. The results are presented in a table at the end of the sections.

Calculation of the Regression Equation for Ankara in Value

In this section, the regression coefficients are calculated to estimate the annual consumption of shoes in value (in TL 1000) per household, X_1 .

$\sum X_1 : 34.317$	$\sum X_1 X_2 : 622.5$
$\sum X_2 : 747.0$	$\sum X_1 X_3 : 155.4$
$\sum X_3 : 202.0$	$\sum X_1 X_4 : 163.5$

$\Sigma x_4 : 165.0$	$\Sigma x_2 x_3 : 3198.8$
$\Sigma x_1^2 : 29.368$	$\Sigma x_2 x_4 : 5758.4$
$\Sigma x_2^2 : 15\ 621.5$	$\bar{x}_1 : .715$
$\Sigma x_3^2 : 936.0$	$\bar{x}_2 : 15.6$
$\Sigma x_4^2 : 3640.5$	$\bar{x}_3 : 4.2$
$N : 48$	$\bar{x}_4 : 3.4$
	$\Sigma x_3 x_4 : 584.0$

The values stated above were calculated in Appendix I.

The centered values were calculated by the method employed previously and are listed below:

$$\begin{aligned} \Sigma x_1^2 &: 29.4 - 48(.715)^2 : 4.9 \\ \Sigma x_2^2 &: 15621.5 - 48(15.6)^2 : 3940 \\ \Sigma x_3^2 &: 936.0 - 48(4.2)^2 : 89 \\ \Sigma x_4^2 &: 3640.5 - 48(3.4)^2 : 3085 \end{aligned}$$

$$\begin{aligned} \Sigma x_1 x_2 &: 622.5 - 48(.715)(15.6) : 87 \\ \Sigma x_1 x_3 &: 155.4 - 48(.715)(4.2) : 11 \\ \Sigma x_1 x_4 &: 163.5 - 48(.715)(3.4) : 47 \\ \Sigma x_2 x_3 &: 3198.8 - 48(15.6)(4.2) : 54 \\ \Sigma x_2 x_4 &: 5758.4 - 48(15.6)(3.4) : 3212 \\ \Sigma x_3 x_4 &: 584.0 - 48(4.2)(3.4) : -101 \end{aligned}$$

From these values the three sets of auxiliary equations to be solved were found.

$$3940 c_{22} + 54 c_{23} + 3212 c_{24} : 1$$

$$54 c_{22} + 89 c_{23} - 101 c_{24} : 0$$

$$3212 c_{22} - 101 c_{23} + 3085 c_{24} : 0$$

$$3940 c_{23} + 54 c_{33} + 3212 c_{34} : 0$$

$$54 c_{23} + 89 c_{33} - 101 c_{34} : 1$$

$$3212 c_{23} - 101 c_{33} + 3085 c_{34} : 0$$

$$3940 c_{24} + 54 c_{34} + 3212 c_{44} : 0$$

$$54 c_{24} + 89 c_{34} - 101 c_{44} : 0$$

$$3212 c_{24} - 101 c_{34} + 3085 c_{44} : 1$$

The values obtained for c's are as follows :

$$c_{22} : .33314583 E - 02$$

$$c_{23} : -.61875009 E - 02$$

$$c_{24} : -.36711773 E - 02$$

$$c_{33} : .20161530 E - 01$$

$$c_{34} : .72005088 E - 02$$

$$c_{44} : .40821954 E - 02$$

From the c's the regression coefficients were computed as follows:

$$b_{12.34} : (.003331)(87) + (-.006188)(11) + (-.003672)(47) : \underline{.0490}$$

$$b_{13.24} : (-.006188)(87) + (.020161)(11) + (.007200)(47) : \underline{.0217}$$

$$b_{14.23} : (-.003672)(87) + (.007200)(11) + (.004082)(47) : \underline{-.0485}$$

$$a_{1.234} : .715 - (.0490)(15.6) + (.0217)(4.2) + (.0485)(3.4) : \underline{.0244}$$

Hence the multiple regression equation was found to be

$$\underline{X_1 : .0244 + .0490 X_2 + .0217 X_3 - .0485 X_4}$$

Standard error of estimate :

$$\sum v_{1.234}^2 : 4.9 - (.049)(87) - (.0217)(11) + (.0244)(43) : 1.545$$

$$S_{1.234}^2 : \frac{1.545}{48-4} : \frac{1.545}{44} : .0351$$

$$S_{1.234} : \underline{.19}$$

Correlation coefficient :

$$R_{1.234}^2 : 1 - \frac{(48-1)(.0351)}{(48-4)(4.9)} : .9924$$

$$R_{1.234} : \underline{.99}$$

Calculation of the Regression Equation for Istanbul in Pairs of Shoe

In this case, X_1 is the annual shoe consumption in pairs per household in Istanbul.

$\sum X_1 : 1653.0$	$\sum X_1 X_2 : 38\ 670.7$
$\sum X_2 : 3037.8$	$\sum X_1 X_3 : 7\ 678.0$
$\sum X_3 : 643.0$	$\sum X_1 X_4 : -1\ 260.1$
$\sum X_4 : -307.5$	$\sum X_2 X_3 : 13\ 555.2$
	$\sum X_2 X_4 : 21\ 271.1$
$\sum X_1^2 : 22\ 675$	$\sum X_3 X_4 : -2\ 269.3$
$\sum X_2^2 : 94\ 680$	$\bar{X}_1 : 10.947$
$\sum X_3^2 : 3\ 087$	$\bar{X}_2 : 20.117$
$\sum X_4^2 : 33\ 507$	$\bar{X}_3 : 4.2$

$$N : 151$$

$$\bar{X}_4 : - 2.0$$

These values were obtained from Appendix I.

The centered values were calculated by the method employed previously and are listed below :

$$\sum x_1^2 : 22\ 675 - (151)(10.947)^2 : 4580$$

$$\sum x_2^2 : 94\ 680 - (151)(20.117)^2 : 33\ 571$$

$$\sum x_3^2 : 3\ 087 - (151)(4.2)^2 : 423$$

$$\sum x_4^2 : 33\ 507 - (151)(-2.0)^2 : 32\ 903$$

$$\sum x_1 x_2 : 38\ 670.7 - (151)(10.947)(20.117) : 7017$$

$$\sum x_1 x_3 : 76\ 780 - (151)(10.947)(4.2) : 735$$

$$\sum x_1 x_4 : - 1260.1 - (151)(10.947)(-2.0) : 2046$$

$$\sum x_2 x_3 : 13\ 552.2 - (151)(20.117)(4.2) : 797$$

$$\sum x_2 x_4 : 21\ 271.1 - (151)(20.117)(-2.0) : 27\ 346$$

$$\sum x_3 x_4 : - 2269 - (151)(4.2)(-2.0) : - 1001$$

From these values the three sets of auxiliary equations to be solved were found.

$$33\ 571\ c_{22} + 797\ c_{23} + 27\ 346\ c_{24} : 1$$

$$797\ c_{22} + 423\ c_{23} - 1001\ c_{24} : 0$$

$$27\ 346\ c_{22} - 1001\ c_{23} + 32\ 903\ c_{24} : 0$$

$$33\ 571\ c_{23} + 797\ c_{33} + 27\ 346\ c_{34} : 0$$

$$797\ c_{23} + 423\ c_{33} - 1\ 001\ c_{34} : 1$$

$$27\ 346\ c_{23} - 1001\ c_{33} + 32\ 903\ c_{34} : 0$$

$$33\ 571\ c_{24} + 797\ c_{34} + 27\ 346\ c_{44} : 0$$

$$797\ c_{24} + 423\ c_{34} - 1\ 001\ c_{44} : 0$$

$$27\ 346\ c_{24} - 1001\ c_{34} + 32\ 903\ c_{44} : 1$$

The values obtained for c's are as follows :

$$c_{22} : .24486350\ E - 03$$

$$c_{23} : -.9161021\ E - 03$$

$$c_{24} : -.23442107\ E - 03$$

$$c_{33} : .67639625\ E - 02$$

$$c_{34} : .10502715\ E - 02$$

$$c_{44} : .25717412\ E - 03$$

From the c's the regression coefficients were computed as follows :

$$b_{12.34} : (.000244864)(7017) + (-.000961)(735) + (-.0002344)(2046) : \underline{.4913}$$

$$b_{13.24} : (-.000961)(7017) + (.006764)(735) + (.00105)(2046) : \underline{.3038}$$

$$b_{14.23} : (-.000234)(7017) + (.00105)(735) + (.000257)(2046) : \underline{-.4466}$$

$$a_{1.234} : 10.95 - (.4913)(20.11) - (.3038)(4.2) + (.4466)(2.0) : \underline{1.171}$$

Hence the multiple regression equation was found to be:

$$\underline{X_1 : 1.171 + .4913\ X_2 + .3038\ X_3 - .4466\ X_4}$$

Standard error of estimate :

$$\sum v_{1.234}^2 : 4580 - (.4913)(7017) - (.3038)(735) + (.4466)(2046) : 1821$$

$$S_{1.234}^2 : \frac{1821}{151 - 4} : 12.3877$$

$$S_{1.234} : \underline{3.52}$$

Correlation coefficient :

$$R_{1.234}^2 : 1 - \frac{(151 - 1)(1821)}{(151 - 4)(4580)} : .5943$$

$$R_{1.234} : \underline{.77}$$

Calculation of the Regression Equation for Istanbul in Value

X_1 in this case is the annual shoe consumption per household in value (in TL 1000) in Istanbul.

$\sum X_1 : 118.69$	$\sum X_1 X_2 : 2998.6$
$\sum X_2 : 2976.3$	$\sum X_1 X_3 : 543.5$
$\sum X_3 : 644.0$	$\sum X_1 X_4 : 113.3$
$\sum X_4 : -362.2$	$\sum X_2 X_3 : 13 315$
	$\sum X_2 X_4 : 17 108$
$\sum X_1^2 : 141.0$	$\sum X_3 X_4 : -2 535$
$\sum X_2^2 : 88 235$	$\bar{X}_1 : .781$
$\sum X_3^2 : 3 086$	$\bar{X}_2 : 19.6$
$\sum X_4^2 : 31 215$	$\bar{X}_3 : 4.2$
$N : 152$	$\bar{X}_4 : -2.4$

The values stated above were calculated in Appendix I.

The centered values were calculated by the method employed previously and are listed below :

$$\begin{aligned} \sum x_1^2 &: 141.0 - 152(.781)^2 : 48.3 \\ \sum x_2^2 &: 88 235 - 152(19.6)^2 : 29 843 \\ \sum x_3^2 &: 3086 - 152(4.2)^2 : 405 \\ \sum x_4^2 &: 31 216 - 152(-2.4)^2 : 30 340 \end{aligned}$$

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 28

$$\sum x_1 x_2 : 2998.6 - 152(.781)(19.6) : 672$$

$$\sum x_1 x_3 : 543.5 - 152(.781)(4.2) : 45$$

$$\sum x_1 x_4 : 113.3 - 152(.781)(-2.4) : 398$$

$$\sum x_2 x_3 : 13\ 315 - 152(19.6)(4.2) : 802$$

$$\sum x_2 x_4 : 17\ 108 - 152(19.6)(-2.4) : 24\ 258$$

$$\sum x_3 x_4 : -2535.1 - 152(4.2)(-2.4) : -1\ 003$$

From these values the three sets of auxiliary equations to be solved were found.

$$29\ 843\ c_{22} + 802\ c_{23} + 24\ 258\ c_{24} : 1$$

$$802\ c_{22} + 405\ c_{23} - 1\ 003\ c_{24} : 0$$

$$24\ 258\ c_{22} - 1003\ c_{23} + 30\ 340\ c_{24} : 0$$

$$29\ 843\ c_{23} + 802\ c_{33} + 24\ 258\ c_{34} : 0$$

$$802\ c_{23} + 405\ c_{33} - 1\ 003\ c_{34} : 1$$

$$24\ 258\ c_{23} - 1003\ c_{33} + 30\ 340\ c_{34} : 0$$

$$29\ 843\ c_{24} + 802\ c_{34} + 24\ 258\ c_{44} : 0$$

$$802\ c_{24} + 405\ c_{34} - 1\ 003\ c_{44} : 0$$

$$24\ 258\ c_{24} - 1003\ c_{34} + 30\ 340\ c_{44} : 1$$

The values obtained for c's are as follows :

$$c_{22} : .32034793\ E - 03$$

$$c_{23} : -.15222182\ E - 02$$

$$c_{24} : -.26695250\ E - 03$$

$$c_{33} : .69613380\ E - 02$$

$$c_{34} : .18404017\ E - 02$$

$$c_{44} : .28740403\ E - 03$$

From the c's the regression coefficients were computed as follows :

$$b_{12.34} : (.00032035)(672) - (.0015222)(45) - (.000267)(398) : \underline{.040578}$$

$$b_{13.24} : (-.0015222)(672) + (.006961)(45) + (.00184)(398) : \underline{.022807}$$

$$b_{14.23} : (-.000367)(672) + (.0018404)(45) + (.000287)(398) : \underline{-.049389}$$

$$a_{1.234} : .781 - (.0405)(19.6) - (.0228)(4.2) + (.0494)(2.4) : \underline{.012}$$

Hence the multiple regression equation was found to be

$$\underline{X_1 : .012 + .0406 X_2 + .0228 X_3 - .0494 X_4}$$

Standard error of estimate :

$$\sum v_{1.234}^2 : 48.3 - (.0406)(672) - (.0228)(45) + (.0494)(398) : 29.6$$

$$S_{1.234}^2 : \frac{29.6}{152 - 4} : .2000$$

$$S_{1.234} : \underline{.44}$$

Correlation coefficient :

$$R_{1.234}^2 : 1 - \frac{(152 - 1)(29.6)}{(152 - 4)(48.3)} : .3770$$

$$R_{1.234} : \underline{.61}$$

Up to now, the necessary calculations and explanations for the regression equations were given. In the following sections, the general evaluation of the regression equations are made. In Table 1, the four regression equations obtained for Ankara and Istanbul are given, together with their standard errors of estimate, R values and the sample sizes. In order to project the demand for shoes in pairs, either the equation for Ankara A or for Istanbul A should be chosen. To make this decision, the regression coefficients were tested for significance at a certain

TABLE I

REGRESSION EQUATIONS
- Summary -

CODE	REGRESSION EQUATION	Standard Error $S_{1.234}$	Correlation Coefficient $R_{1.234}$	Sample Size N
Ankara A	$X_1 = 2.301 + .6108 X_2 + .4811 X_3 - .6213 X_4$	3.07	.74	47
İstanbul A	$X_1 = 1.171 + .4913 X_2 + .3038 X_3 - .4466 X_4$	3.52	.77	151
Ankara B	$X_1 = .0244 + .0490 X_2 + .0217 X_3 - .0485 X_4$	.19	.99	48
İstanbul B	$X_1 = .0120 + .0406 X_2 + .0228 X_3 - .0494 X_4$	.44	.61	152

confidence level in order to see which of the independent variables were significant in determining shoe consumption.

To test the significance of the coefficients of the regression hyperplane, the standard errors of the regression parameters were calculated. Then the degrees of freedom were found according to the sample size which is different for each regression hyperplane and the number of variables, which is four. In the next step, the t-values were read from the table of t-values according to the degrees of freedom at the 95% confidence level. Each regression coefficient was then tested for significance by adding and subtracting the product of the standard error of the parameter and the t-value to and from the regression coefficient. Thus an interval was obtained for the coefficient in question. If this interval contains the zero element, it implies that the regression coefficient might also take the value zero. This in turn indicates that the variable to which the coefficient pertains, might vanish from the regression equations, i.e. this particular variable is not a determining variable. In this case, it is eliminated from the equation of the regression hyperplane. On the other hand, if the interval does not include the zero element, i.e. the interval is either in negative or positive values, then the coefficient is significant. This means that the particular variable in question cannot be eliminated from the equation of the regression hyperplane since it will never take the value zero. Therefore it is a determining factor of the dependent variable.

To explain the calculations, the equation for Ankara A is taken as an example below. The same procedure is repeated for Ankara B and for Istanbul A and B.

Ankara A :

The standard errors of the regression parameters are :

$$s_{a_{1.234}} = \frac{s_{1.234}}{\sqrt{N}} = \frac{3.07}{\sqrt{47}} = .4449$$

$$s_{b_{12.34}} = s_{1.234} \sqrt{c_{22}} = (3.07)(.002886)^{1/2} = .166$$

$$s_{b_{13.24}} = s_{1.234} \sqrt{c_{33}} = (3.07)(.030611)^{1/2} = .536$$

$$s_{b_{14.23}} = s_{1.234} \sqrt{c_{44}} = (3.07)(.003831)^{1/2} = .620$$

Sample size is 47. Since there are 4 variables, the degrees of freedom is 43 : 47 - 4 . At 95 % confidence level and degrees of freedom equal to 43, $t_{.025}$ is 2.021 as read from the table of t-values⁽¹⁾.

Significance test for $a_{1.234}$:

$$a_{1.234} \mp (s_{a_{1.234}}) (t_{.025})$$

$$2.301 \mp (2.021)(.4449) : 2.301 \mp .899$$

$$1.402 < a_{1.234} < 3.200$$

Therefore $a_{1.234}$ is significant since the interval does not contain zero .

Significance test for $b_{12.34}$:

$$.6108 \mp (2.021)(.166) : .6108 \mp .3354$$

$$.2754 < b_{12.34} < .9462$$

Therefore $b_{12.34}$ is significant .

(1) Quality Control and Industrial Statistics, Acheson J. Duncan.
Richard D. Irwin, Inc. Illinois, 1959, p.870, Table B.

Significance test for $b_{13.24}$:

$$.4811 \mp (2.021)(.536) : .4811 \mp 1.0833$$

$$-.6022 < b_{13.24} < 1.5644$$

Therefore $b_{13.24}$ is not significant.

Significance test for $b_{14.23}$:

$$-.6213 \mp (2.021)(.620) = -.6213 \mp 1.2530$$

$$-1.8743 < b_{14.23} < .6317$$

Therefore $b_{14.23}$ is not significant.

Istanbul A:

$$s_{a_{1.234}} : \frac{3.52}{\sqrt{151}} : \frac{3.52}{12.32} : .286$$

$$s_{b_{12.34}} : (3.52)(.000245)^{\frac{1}{2}} : (3.52)(.0156) : .055$$

$$s_{b_{13.24}} : (3.52)(.006764)^{\frac{1}{2}} : (3.52)(.0823) : .290$$

$$s_{b_{14.23}} : (3.52)(.00257)^{\frac{1}{2}} : (3.52)(.016) : .056$$

Significance test for $a_{1.234}$:

$$1.171 \mp (1.97)(.286) : 1.17 \mp .563$$

$$.608 < a_{1.234} < 1.734$$

Therefore $a_{1.234}$ is significant.

Significance test for $b_{12.34}$:

$$.4913 \mp (1.97)(.055) = .4913 \mp .108$$

$$.383 < b_{12.34} < .599$$

Therefore $b_{12.34}$ is significant.

Significance test for $b_{13.24}$:

$$.3038 \mp (1.97)(.29) = .3038 \mp .5713$$

$$-.2675 < b_{13.24} < .8751$$

Therefore $b_{13.24}$ is not significant.

Significance test for $b_{14.23}$:

$$-.4464 \mp (1.97)(.056) = -.4464 \mp .1103$$

$$-.5567 < b_{14.23} < -.3361$$

Therefore $b_{14.23}$ is significant.

Ankara B :

$$S_{a_{1.234}} : \frac{.19}{\sqrt{48}} : \frac{.19}{7} : .027$$

$$S_{b_{12.34}} : (.19)(.003331)^{1/2} : (.19)(.05775) : .0108$$

$$S_{b_{13.24}} : (.19)(.020162)^{1/2} : (.19)(.142) : .0270$$

$$S_{b_{14.23}} : (.19)(.004082)^{1/2} : (.19)(.0638) : .0121$$

Significance test for $a_{1.234}$:

$$.0244 \mp (2.01)(.027) = .0244 \mp .0543$$

$$-.0299 < a_{1.234} < .0787$$

Therefore $a_{1.234}$ is not significant.

Significance test for $b_{12.34}$:

$$.049 \mp (2.01)(.0108) = .049 \mp .022$$

$$.027 < b_{12.34} < .071$$

Therefore $b_{12.34}$ is significant.

Significance test for $b_{13.24}$:

$$.0217 \mp (2.01)(.027) = .0217 \mp .0543$$

$$-.0800 < b_{13.24} < -.0286$$

Therefore $b_{13.24}$ is significant.

Significance test for $b_{14.23}$:

$$-.0485 \mp (2.01)(.0121) = -.0485 \mp .0243$$

$$-.0728 < b_{14.23} < -.0242$$

Therefore $b_{14.23}$ is significant.

Istanbul B :

$$S_{a_{1.234}} = \frac{.44}{\sqrt{152}} : \frac{.44}{12.34} : .0357$$

$$S_{b_{12.34}} : (.44)(.000320)^{\frac{1}{2}} : (.44)(.01786) : .00786$$

$$S_{b_{13.24}} : (.44)(.006961)^{\frac{1}{2}} : (.44)(.08335) : .03667$$

$$S_{b_{14.23}} : (.44)(.000287)^{\frac{1}{2}} : (.44)(.01693) : .00745$$

Significance test for $a_{1.234}$:

$$.012 \mp (1.97)(.0357) = .012 \mp .070$$

$$-.058 < a_{1.234} < .082$$

Therefore $a_{1.234}$ is not significant.

Significance test for $b_{12.34}$:

$$.0406 \mp (1.97)(.00786) = .0406 \mp .0155$$

$$.0251 < b_{12.34} < .0561$$

Therefore $b_{12.34}$ is significant.

Significance test for $b_{13.24}$:

$$.0228 \mp (1.97)(.03667) = .0228 \mp .0709$$

$$-.0481 < b_{13.24} < .0937$$

Therefore $b_{13.24}$ is not significant.

Significance test for $b_{14.23}$:

$$-.0494 \mp (1.97)(.00745) = -.0494 \mp .0154$$

$$-.0648 < b_{14.23} < -.0340$$

Therefore $b_{14.23}$ is significant.

After all the regression parameters were tested for significance, the insignificant coefficients were eliminated from the regression equations. In Table 2, the regression equations after this elimination are given. Now the equations contain only those variables which are significant in the determination of shoe consumption. Table 2 indicates that in all equations except in Ankara B, the household size is insignificant in the determination of shoe consumption.

The equations in Table 2 will be used to project total shoe demand in Turkey for the years 1966-1970.

TABLE 2

REGRESSION EQUATIONS

CODE	Regression Equation	Coefficients eliminated in the original regression equations
Ankara A	$X_1 = 2.301 + .6108 X_2$	.4811 of X_3 and .6213 of X_4 .
İstanbul A	$X_1 = 1.171 + .4913 X_2 - .4466 X_4$	.3038 of X_3 .
Ankara B	$X_1 = .049 X_2 + .0217 X_3 - .0485 X_4$	.0244
İstanbul B	$X_1 = .0406 X_2 - .0494 X_4$	.012 and .0228 of X_3 .

2. Pattern of Shoe Consumption in Selected Foreign Countries

The consumer survey described in the previous sections yielded the functional relationship between the demand for shoe on one hand and income and size of family on the other. In order to check the reliability of the results obtained from the consumer survey, the relationship between national income per capita and shoe consumption per capita (in pairs) was studied for the years 1958 to 1962 for some selected countries. These countries were selected on two bases:

a) They are all members of the Organization for Economic Cooperation and Development, of which Turkey is also a member. Care was taken to present a collection of countries with different income and shoe consumption data to avoid giving a biased relationship between shoe consumption and income, based on either data from developed countries or data from under-developed countries.

b) Data for these countries were readily available, which is important since statistics on shoe consumption are totally non-existent in most countries.

The data for these countries are given in Tables 3-7.

Originally population was included as a variable also in the analysis, and an attempt was made to calculate the relationship between shoe demand, per capita income, and population. However, the multiple regression equations obtained for the years 1958-1962 did not yield meaningful results. The theoretical shoe demand values calculated from the regression equations showed very significant deviations from actual values. Therefore this method was abandoned (Appendix II).

TABLE 3

STATISTICS FOR THE YEAR 1958

Countries	Population (Thousand)	National Income (Million TL)	Per Caput Income (TL)	Shoe Consumption (Thousand Pairs)	Per Caput Shoe Consumption(Pairs)
Austria	7,021	36,738	5,133	8,036	1.14
Denmark	4,515	36,084	7,992	5,594	1.24
France	44,789	377,701	8,432	68,066	1.52
West Germany	52,051	387,954	7,451	94,298	1.81
Ireland	2,853	11,848	6,809	3,558	1.25
Italy	49,041	194,247	3,961	42,838	.87
Netherlands	11,186	70,689	6,139	17,142	1.52
Norway	3,523	27,745	7,785	4,614	1.31
Portugal	8,725	16,038	1,838	4,218	.48
Spain	29,798	65,268	2,190	27,330	.92
Sweden	7,409	87,649	11,800	12,111	1.63
Switzerland	5,199	58,350	11,223	9,246	1.78
U.K.	51,843	464,676	8,963	100,920	1.95
U.S.A.	174,882	3,282,300	18,769	489,711	2.80

Source for shoe consumption estimates: The Hides and Skins Industry, O.E.C.D. Publication, November 1960, pp. 42-43, Table 1.

Source for population estimates: Demographic Yearbook 1963, United Nations, New York, 1964, pp. 149-161.

Source for national income estimates and exchange rates: Statistical Yearbook, State Institute of Statistics, Ankara 1963, pp. 515 and 545.

TABLE 4

STATISTICS FOR THE YEAR 1959

Countries	Population (Thousand)	National Income (Million TL)	Per Caput Income (TL)	Shoe Consumption (Thousand Pairs)	Per Caput Shoe Consumption(Pairs)
Austria	7,049	38,106	5,406	9,050	1.28
Denmark	4,547	40,046	8,850	5,782	1.27
France	45,240	397,043	8,776	74,860	1.65
West Germany	52,674	418,698	7,949	104,173	1.98
Ireland	2,846	12,616	4,433	3,691	1.30
Italy	49,350	207,927	4,213	45,745	.93
Netherlands	11,346	75,065	6,616	17,776	1.57
Norway	3,553	28,965	8,096	4,863	1.37
Portugal	8,776	16,857	1,921	4,519	.51
Spain	30,049	74,322	2,473	30,307	1.00
Sweden	7,446	92,539	12,428	13,416	1.80
Switzerland	5,259	61,186	14,635	10,001	1.90
U.K.	52,128	485,123	9,306	111,500	2.14
U.S.A.	177,830	3,580,020	20,132	491,212	2.76

Source: Ibid.

TABLE 5

STATISTICS FOR THE YEAR 1960

Countries	Population (Thousand)	National Income (Million TL)	Per Caput Income (TL)	Shoe Consumption (Thousand Pairs)	Per Caput Shoe Consumption(Pairs)
Austria	7,081	43,164	6,095	8,304	1.17
Denmark	4,581	43,144	9,418	6,830	1.49
France	41,684	416,313	9,112	77,132	1.69
West Germany	53,224	495,846	9,316	115,703	2.17
Greece	8,327	24,390	2,929	8,000	.96
Ireland	2,834	13,468	4,752	3,656	1.29
Italy	49,642	227,565	4,584	48,680	.98
Netherlands	11,480	83,924	7,310	20,254	1.76
Norway	3,581	31,033	8,667	5,436	1.52
Portugal	8,826	18,702	2,118	6,649	.75
Spain	30,303	78,930	2,604	27,697	.91
Sweden	7,480	90,711	13,245	14,691	1.96
Switzerland	5,362	65,530	12,244	10,646	1.99
U.K.	52,508	516,888	9,843	121,788	2.32
U.S.A.	180,684	3,702,600	20,492	501,217	2.77

Source: Ibid.

TABLE 6

STATISTICS FOR THE YEAR 1961

Countries	Population (Thousand)	National Income (Million TL)	Per Caput Income (TL)	Shoe Consumption (Thousand Pairs)	Per Caput Shoe Consumption(Pairs)
Austria	7,087	47,070	6,641	9,461	1.33
Denmark	4,617	47,951	10,385	7,845	1.70
France	46,163	448,344	9,712	81,168	1.76
West Germany	54,029	567,792	10,509	114,972	2.13
Greece	8,402	27,783	3,306	8,600	1.02
Ireland	2,818	14,532	5,156	4,123	1.46
Italy	49,903	249,813	5,004	51,523	1.03
Netherlands	11,637	91,475	7,860	21,577	1.85
Norway	3,610	33,600	9,307	5,150	1.43
Portugal	8,894	20,061	2,255	6,938	.78
Spain	30,559	88,560	2,898	31,520	1.03
Sweden	7,520	108,034	14,366	14,013	1.86
Switzerland	5,496	72,860	13,256	11,242	2.05
U.K.	52,925	552,558	10,440	127,928	2.42
U.S.A.	183,756	3,805,200	20,707	520,683	2.83

Source: Ibid.

TABLE 7

STATISTICS FOR THE YEAR 1962

Countries	Population (Thousand)	National Income (Million TL)	Per Caput Income (TL)	Shoe Consumption (Thousand Pairs)	Per Caput Shoe Consumption(Pairs)
Austria	7,128	49,680	6,969	9,824	1.38
Denmark	4,654	53,202	11,431	8,087	1.74
France	46,998	497,016	10,575	88,085	1.87
West Germany	54,767	615,006	12,230	121,652	2.22
Greece	8,451	29,250	3,461	9,900	1.17
Ireland	2,824	15,802	5,596	4,271	1.51
Italy	50,170	281,232	5,605	54,898	1.09
Netherlands	11,797	96,750	8,201	21,253	1.80
Norway	3,639	35,866	9,856	5,487	1.51
Portugal	8,471	21,060	2,397	8,794	.98
Spain	30,817	100,620	3,265	36,114	1.17
Sweden	7,562	102,044	13,494	14,882	1.97
Switzerland	5,660	80,624	14,244	11,587	2.05
U.K.	53,441	570,780	10,680	120,145	2.25
U.S.A.	186,656	4,052,700	21,712	547,215	2.93

Source: Ibid.

THE S I S

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BEBEK, ISTANBUL

PAGE 44

After excluding population from the calculations, the simple regression between per capita national income and shoe consumption was calculated for the years 1958 to 1962. The scatter diagrams of per capita income versus shoe consumption indicated a straight-line regression equation for the relationship in question. Therefore straight-line equations were fitted to the data (Figures 1-5). The calculations for the simple regression equations are given in Tables 8-12.

Finally, all five simple regression equations were drawn on the same graph and a line approximating the average of (a) and (b) values was drawn.

The equations found for each year are:

$$1958 : X_1 : .548 + .000117 X_2$$

$$1959 : X_1 : .667 + .000108 X_2$$

$$1960 : X_1 : .805 + .000095 X_2$$

$$1961 : X_1 : .793 + .000097 X_2$$

$$1962 : X_1 : .812 + .000097 X_2 \quad , \text{ where}$$

X_1 : Per capita shoe consumption (in pairs), and

X_2 : Per capita national income (1000 TL) .

The regression equation approximating the relationship for the five-year period was found to be:

$$X_1 : .725 + .000103 X_2$$

where $.725 : \frac{.548 + .667 + .805 + .794 + .812}{5}$ and

$$.000103 : \frac{.000117 + .000108 + .000095 + .000097 + .000097}{5} .$$

.000103 means that 1 TL increase in per capita income causes .000103 pair

Simple Regression Between Per Capita Income and Shoe Consumption, 1958

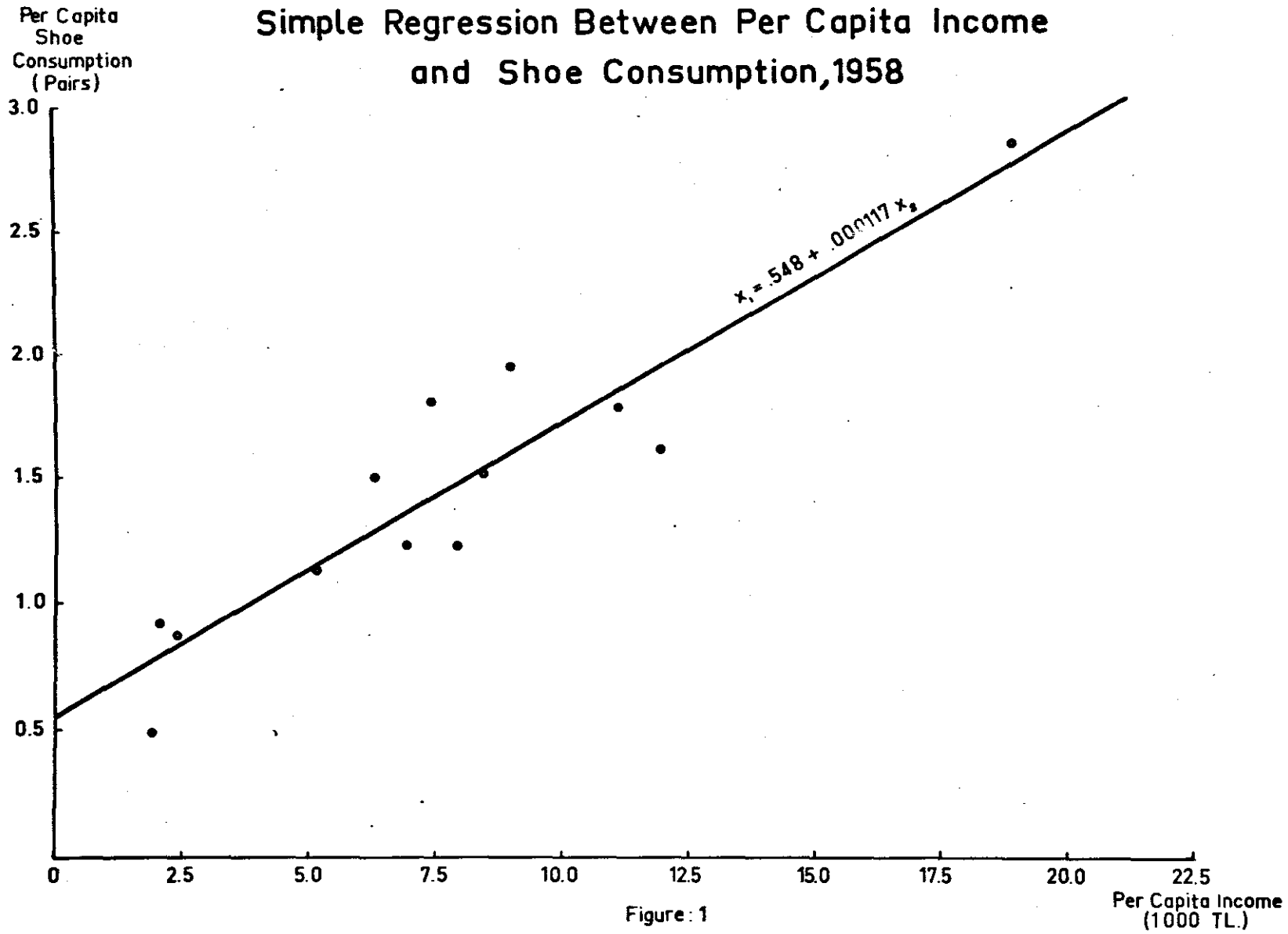


Figure : 1

Simple Regression Between per Capita Income and Shoe Consumption, 1959

Per Capita Shoe Consumption (Pairs)

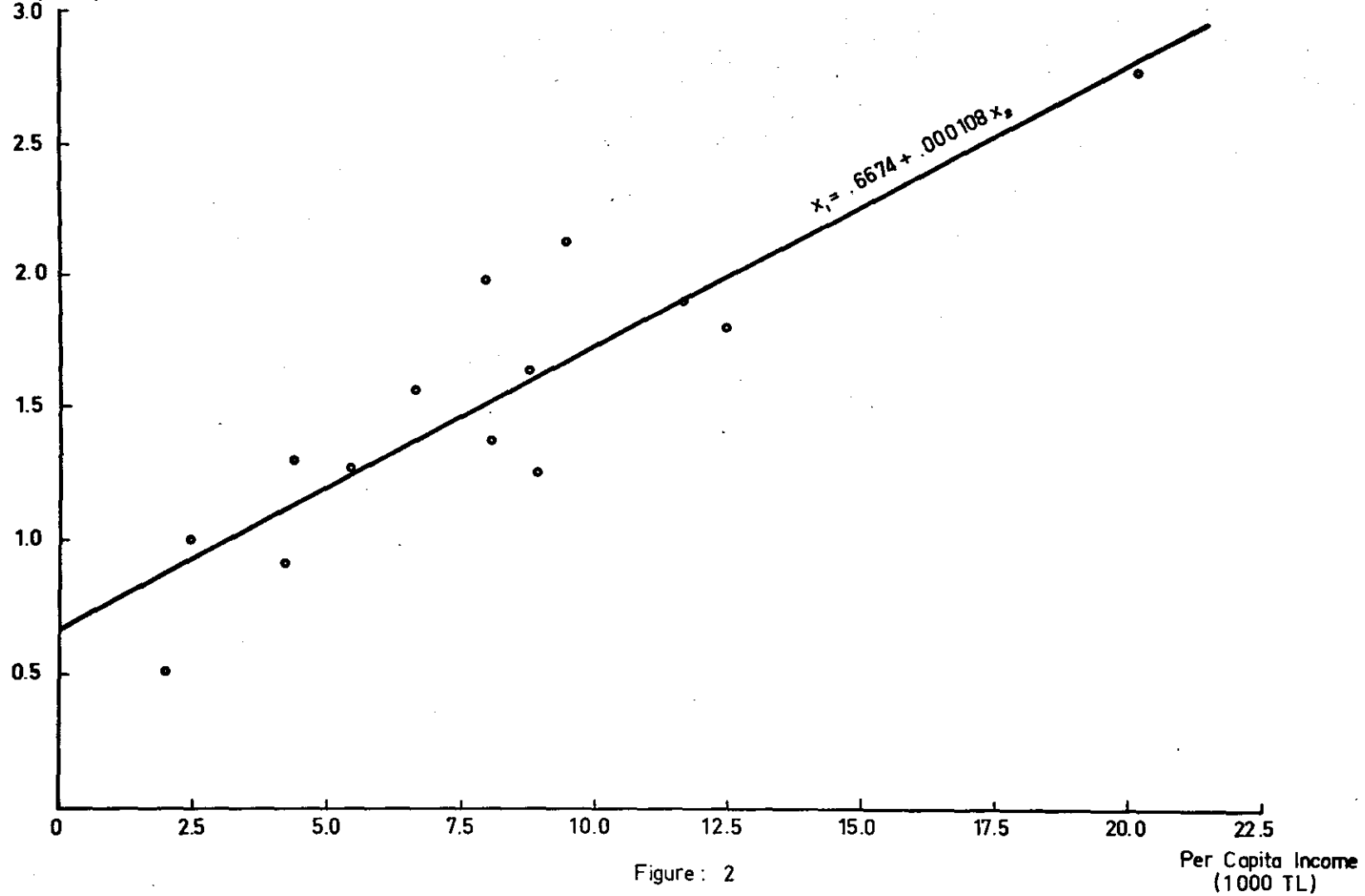


Figure : 2

Simple Regression Between per Capita Income and Shoe Consumption, 1960

Per Capita
Shoe
Consumption
(Pairs)

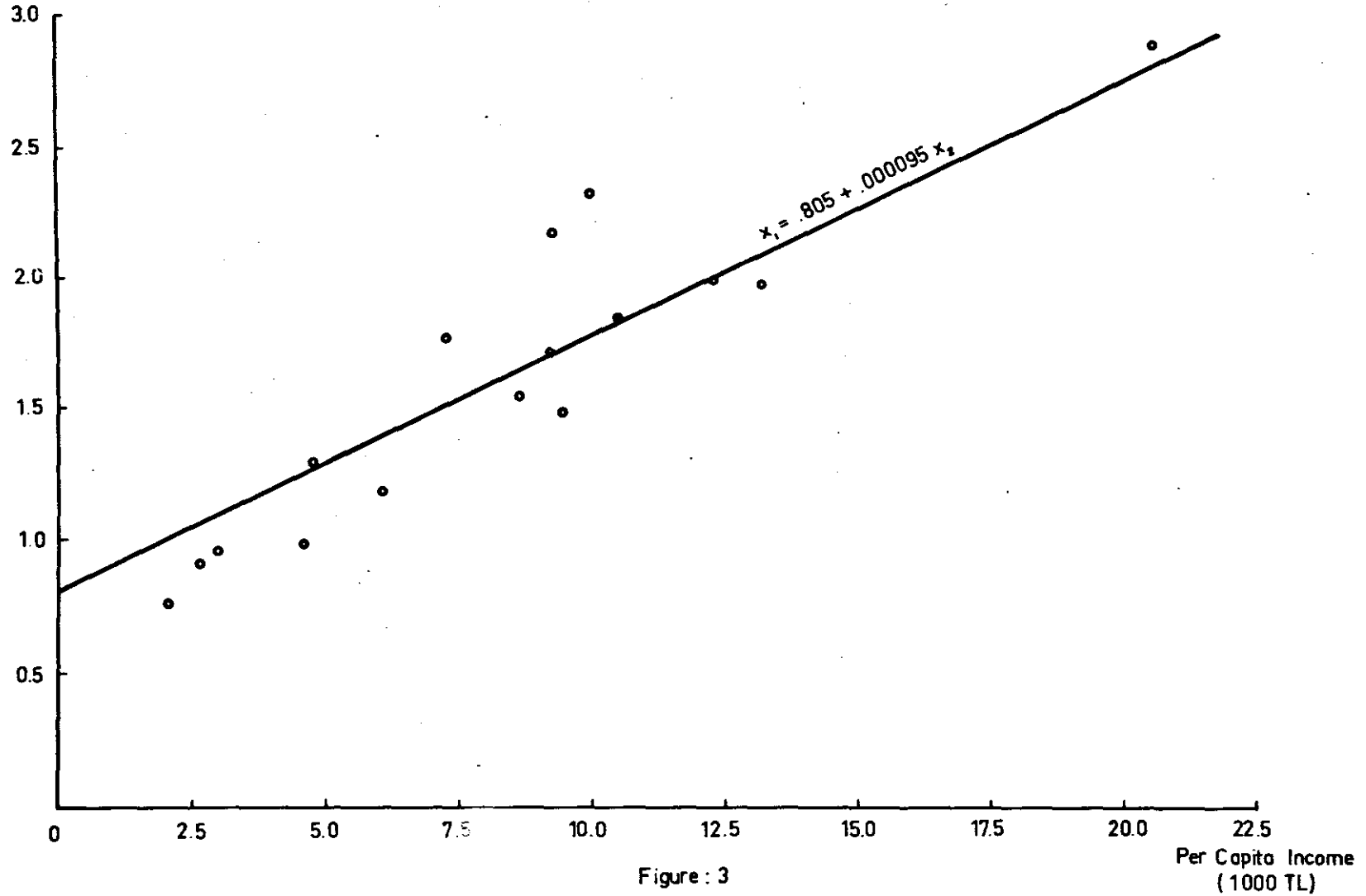
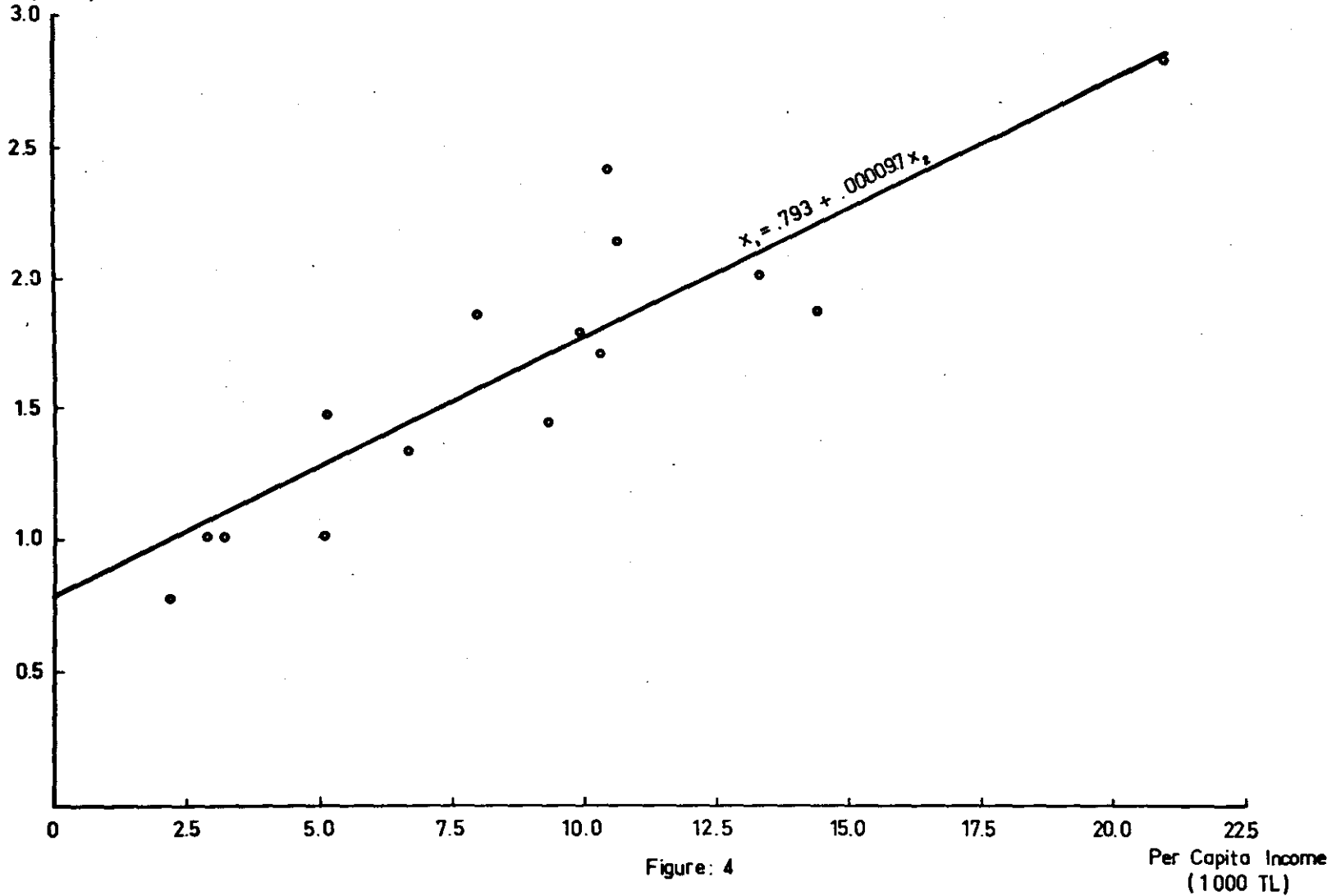


Figure : 3

Simple Regression Between per Capita Income and Shoe Consumption, 1961

Per Capita Shoe Consumption (Pairs)



Simple Regression Between per Capita Income and Shoe Consumption, 1962

Per Capita Shoe Consumption (Pairs)

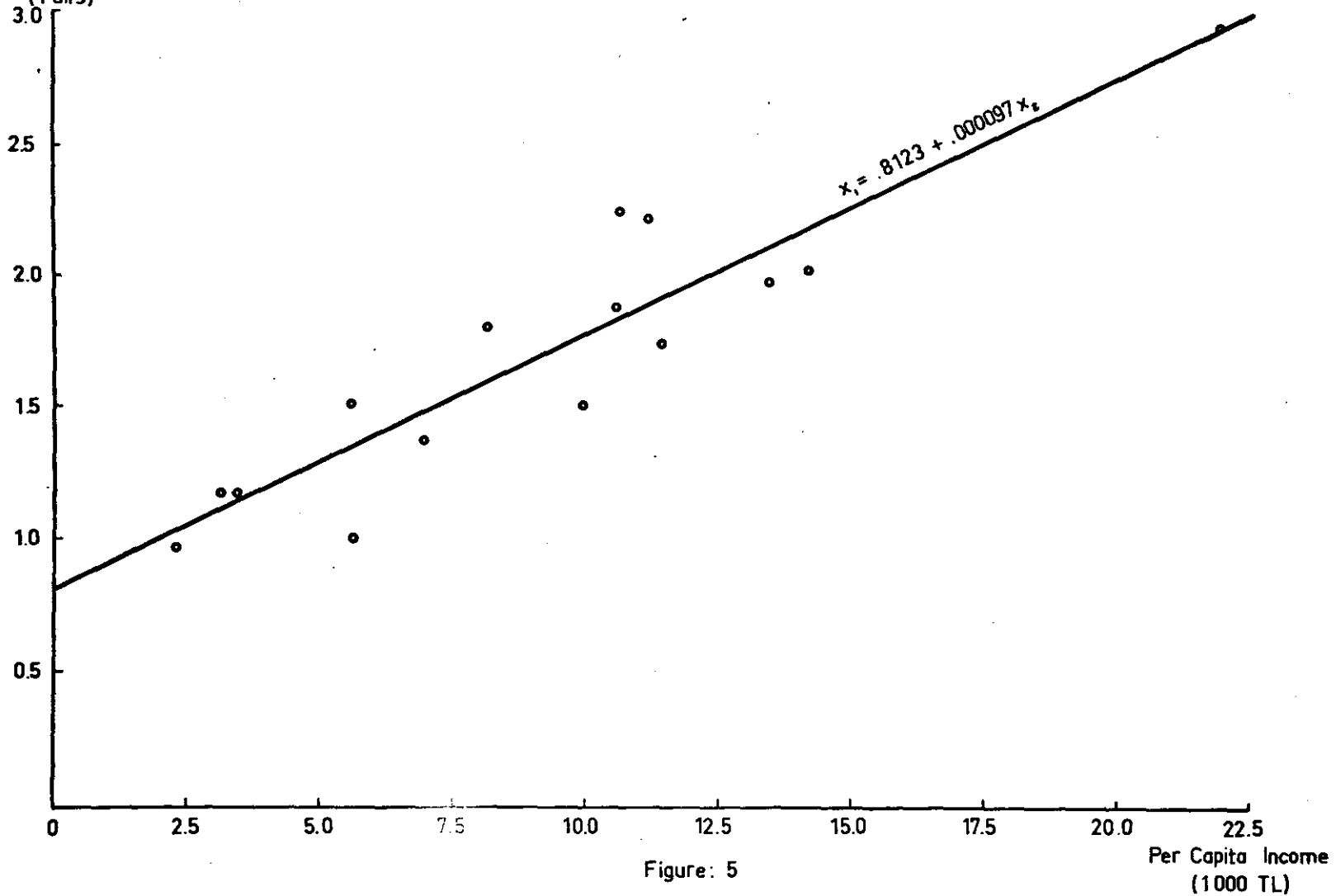


Figure: 5

TABLE 8

SIMPLE REGRESSION
BETWEEN PER CAPITA INCOME AND SHOE CONSUMPTION
1958

Countries	Per Capita Shoe Consumption(Pairs) X_1	Per Capita Income (TL) X_2	$X_1 X_2$	X_2^2
Austria	1.14	5,233		
Denmark	1.24	7,992		
France	1.52	8,432		
West Germany	1.81	7,451		
Ireland	1.25	6,809		
Italy	.87	2,416		
Netherlands	1.53	6,319		
Norway	1.31	7,875		
Portugal	.48	1,838		
Spain	.92	2,190		
Sweden	1.63	11,830		
Switzerland	1.78	11,223		
U.K.	1.95	8,963		
U.S.A.	2.80	18,769		
Total	20.23	107,340	184,964.07	1,078,707,004

The simple regression equation is:

$$\underline{X_1 = .548 + .000117 X_2}$$

TABLE 9

SIMPLE REGRESSION
BETWEEN PER CAPITA INCOME AND SHOE CONSUMPTION
1959

Countries	Per Capita Shoe Consumption(Pairs) X_1	Per Capita Income (TL) X_2	$X_1 X_2$	X_2^2
Austria	1.28	5,406		
Denmark	1.27	8,807		
France	1.65	8,776		
West Germany	1.98	7,949		
Ireland	1.30	4,433		
Italy	.93	4,213		
Netherlands	1.57	6,616		
Norway	1.37	8,096		
Portugal	.51	1,921		
Spain	1.00	2,473		
Sweden	1.80	12,428		
Switzerland	1.90	11,635		
U.K.	2.14	9,306		
U.S.A.	2.76	20,132		
<hr/>				
Total	21.46	112,191	202,892.39	1,185,243,831

The simple regression equation is:

$$\underline{X_1 = .6674 + .000108 X_2}$$

TABLE 10

SIMPLE REGRESSION

BETWEEN PER CAPITA INCOME AND SHOE CONSUMPTION

1960

Countries	Per Capita Shoe Consumption(Pairs) X_1	Per Capita Income (TL) X_2	$X_1 X_2$	X_2^2
Austria	1.17	6,065		
Denmark	1.49	9,418		
France	1.69	9,112		
West Germany	2.17	9,316		
Greece	.96	2,929		
Ireland	1.29	4,752		
Italy	.98	4,584		
Netherlands	1.76	7,310		
Norway	1.52	8,666		
Portugal	.75	2,118		
Spain	.91	2,604		
Sweden	1.96	13,245		
Switzerland	1.99	12,244		
U.K.	2.32	9,843		
U.S.A.	2.77	20,493		
Total	23.73	122,728	217,513.33	1,250,021,960

The simple regression equation is:

$$\underline{X_1 = .805 + .000095 X_2}$$

TABLE II

SIMPLE REGRESSION
BETWEEN PER CAPITA INCOME AND SHOE CONSUMPTION
1961

Countries	Per Capita Shoe Consumption(Pairs) X_1	Per Capita Income (TL) X_2	$X_1 X_2$	X_2^2
Austria	1.33	6,641		
Denmark	1.70	10,381		
France	1.76	9,712		
West Germany	2.13	10,509		
Greece	1.02	3,306		
Ireland	1.46	5,156		
Italy	1.03	5,004		
Netherlands	1.85	7,860		
Norway	1.43	9,350		
Portugal	.78	2,255		
Spain	1.03	2,898		
Sweden	1.86	14,366		
Switzerland	2.05	13,256		
U.K.	2.42	10,440		
U.S.A.	2.83	20,707		
Total	24.68	131,802	250,255.34	1,501,027,338

The simple regression equation is:

$$\underline{X_1 = .793 + .000097 X_2}$$

TABLE 12

SIMPLE REGRESSION

BETWEEN PER CAPITA INCOME AND SHOE CONSUMPTION

1962

Countries	Per Capita Shoe Consumption (Pairs) X_1	Per Capita Income (TL) X_2	$X_1 X_2$	X_2^2
Austria	1.38	6,969		
Denmark	1.74	11,431		
France	1.87	10,575		
West Germany	2.22	11,230		
Ireland	1.51	5,596		
Greece	1.17	3,465		
Italy	1.09	5,605		
Netherlands	1.80	8,201		
Norway	1.51	9,856		
Portugal	.98	2,397		
Spain	1.17	3,265		
Sweden	1.97	13,494		
Switzerland	2.05	14,244		
U.K.	2.25	10,680		
U.S.A.	2.93	21,712		
Total	25.64	138,716	272,064.80	1,643,143,896

The simple regression equation is :

$$\underline{X_1 = .8123 + .000097 X_2}$$

increase in per capita shoe consumption in the selected countries. It is assumed that this equation also reflects the functional relationship between per capita income and shoe consumption in Turkey, since the selected countries include both countries of low income level like Greece, Portugal and Spain as well as countries of high income. Thus the equation is an approximation of the relationship between shoe consumption and income at both low and high income levels. Therefore it will be used to project the shoe demand in Turkey in the years 1966-1970 to provide a check for the total shoe demand estimates made from the consumer survey results.

In the following sections, the demand for shoes in Turkey will be projected for the period 1966-1970 by employing both functional relationships obtained from the consumer survey on one hand, and from the data for selected countries on the other.

B. PROJECTIONS FOR THE FACTORS DETERMINING SHOE DEMAND

The factors included in the regression equations in both methods determining shoe demand were projected into years 1966-1970 for Turkey. These factors are the aggregate national income, population and per capita income.

1. Projections for National Income

The national income data were obtained from the Development Plan and the Annual Programs of the State Planning Organization.⁽¹⁾ The scatter diagram of the net national income between 1948-1963 indicated a constant growth path of the form $Y : a + bX$.(Figure 6 and Table 13). The equation of the trend line was found to be:

$$X_1 : 35,071.8 + 1,476.0 X_2$$

The equation indicates that net national income at 1961 prices grew by TL 1.476 billion per year in the period 1948-1963. By employing this trend equation, the net national income is estimated for the following years in the table below:

<u>Year</u>	<u>Net National Income (Million TL)</u>
1966	51,307.8
1967	52,783.8
1968	54,259.8
1969	55,735.8
1970	57,211.8

These projections will be employed later to project the total shoe demand in Turkey for the same years.

(1) Development Plan, First Five-Year, 1963-1967. State Planning Organization Ankara, 1960. pp.14, Table 7.

National
Income
(Billion TL)

Trend for National Income in Turkey 1948 - 1963 (1961 Prices)

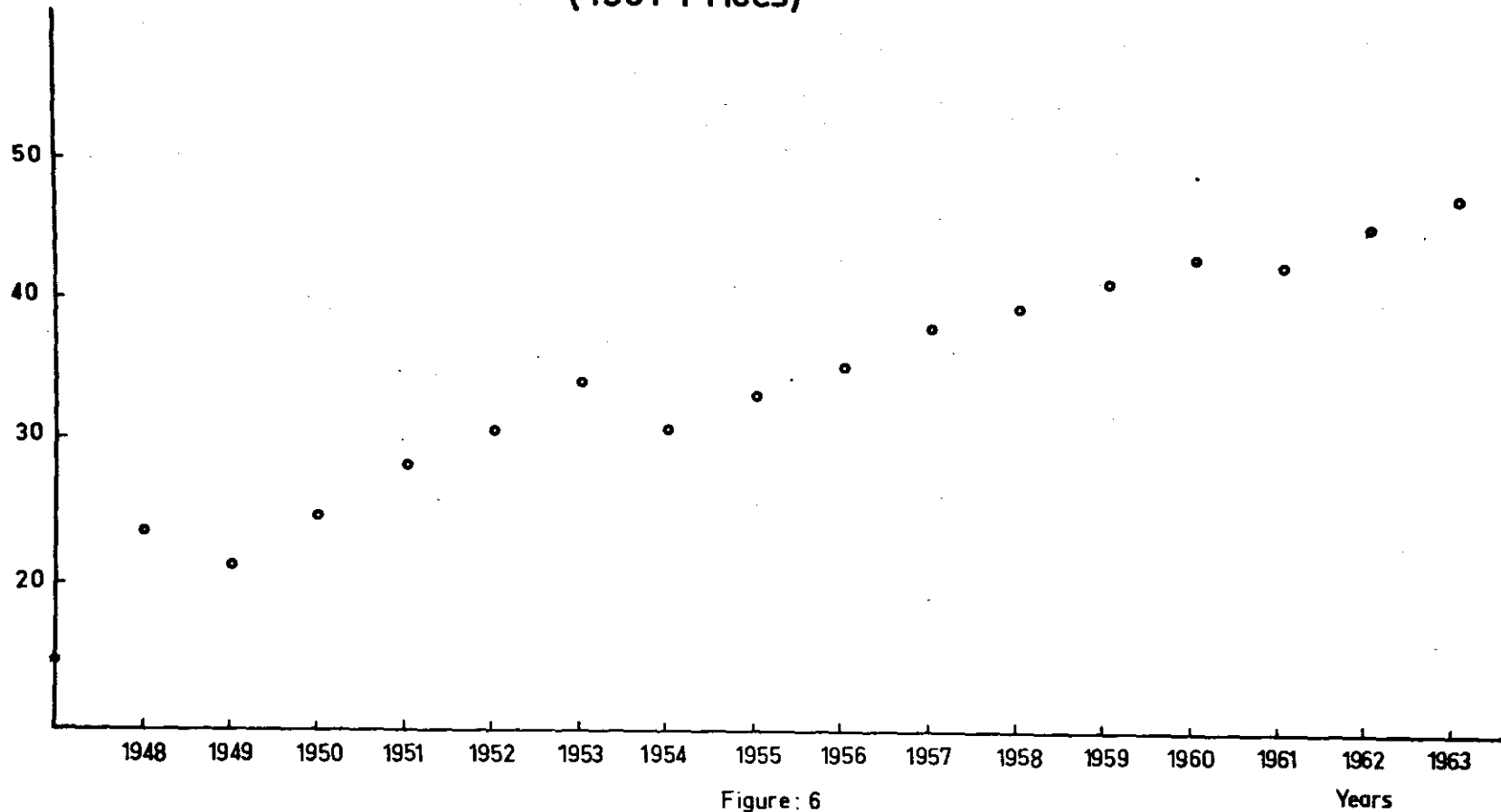


Figure : 6

TABLE : 13

TREND CALCULATION FOR NET NATIONAL INCOME
 (At 1961 Prices)

Year	X_2	X_1	$X_1 X_2$	X_2^2
1948	- 8	23,875.6		
1949	- 7	21,686.4		
1950	- 4	24,744.2		
1951	- 5	28,469.6		
1952	- 4	30,898.8		
1953	- 3	34,382.5		
1954	- 2	31,206.6		
1955	- 1	33,516.0		
1956	1	35,789.5		
1957	2	38,045.3		
1958	3	39,660.9		
1959	4	41,343.1		
1960	5	42,834.9		
1961	6	42,337.9		
1962	7	44,801.9		
1963	8	47,555.9		
TOTAL	0	561,149.1	602,202.9	408

The trend equation is

$$\underline{X_1 : 35,072 + 1476 X_2}$$

2. Projections for Population

The estimated rate of growth of population during 1966-1970 was derived from the projections of population given for the years 1965 and 1970 in the Development Plan as follows⁽¹⁾ :

Projected population estimates for the years 1965 and 1970 are 31.8 and 36.4 millions respectively in the Development Plan. As the growth path of population in Turkey is projected to be exponential in the period 1965-70 depending on past data, the annual rate of growth of population was calculated by solving the following equation :

$$36.4 : 31.8(1+r)^5$$

$$\text{Log } 36.4 : \text{Log } 31.8 + 5 \text{ Log}(1+r)$$

$$1.5611 : 1.5024 + 5 \text{ Log}(1+r)$$

$$\text{Log } (1+r) : .01174$$

$$r : .028$$

Therefore the annual rate of growth of population is 2.8 % in the period 1966-70. This figure was accepted as valid for the population projections in this paper. The population projections estimated by employing this average annual percentage growth are given below :

Year	Projected Population (1000)
1966	32,690.4
1967	33,605.7
1968	34,546.7
1969	35,514.0
1970	36,400.0

(1) 1965 Annual Program, SPO, Ankara 1965, pp.26, Table:9 .

3. Projections for Per Capita Income

The per capita income figures (Table:14) were estimated by dividing the national income figures by the corresponding population figures. The trend equation for per capita income for the period 1948-63 is :

$$X_1 : 1406.2 + 25.3 X_2$$

which shows that per capita income increased by TL 25.3 per annum in real terms. The projections of per capita income for the period 1966-70 are given below :

Year	Projected per Capita Income TL
1966	1684.5
1967	1709.8
1968	1735.1
1969	1760.4
1970	1785.7

The projections of national income and per capita income will be employed later to project the shoe demand in Turkey for the years 1966-70.

TABLE 14
TREND CALCULATION FOR PER CAPITA NATIONAL INCOME
(1961 Prices)

Year	X_2	X_1	$X_1 X_2$	X_2^2
1948	- 8	1187.8		
1949	- 7	1057.9		
1950	- 6	1183.9		
1951	- 5	1318.0		
1952	- 4	1391.8		
1953	- 3	1508.0		
1954	- 2	1333.6		
1955	- 1	1390.7		
1956	1	1449.0		
1957	2	1492.0		
1958	3	1513.8		
1959	4	1531.2		
1960	5	1546.4		
1961	6	1485.5		
1962	7	1529.1		
1963	8	1579.9		
TOTAL	0	22,498.6	10,336.9	408

Thus the trend equation is

$$\underline{X_1 : 1406.2 + 25.3 X_2}$$

C. SALES PROJECTIONS FOR TURKEY, 1966-1970

1. Consumer Survey Method

The primary aim of this paper is to estimate the probable sales volume of the Beykoz shoe factory in order to determine the optimum level of production for the plant in the years 1966-70. Since the production unit in the Beykoz factory is pairs of shoes, the regression equations which include shoe consumption as pairs will be employed to make the sales projections, and these equations are :

$$\text{For Istanbul, } X_1: 1.171 + .4913 X_2 - .4456 X_4$$

$$\text{For Ankara , } X_1: 2.301 + .6108 X_2$$

In these equations,

X_1 : Shoe demand per household in pairs,

X_2 : Income per household,

X_3 : Size of household,

X_4 : Supernumerary income per household .

The variable X_3 , which is size of household, was found to be insignificant and therefore was eliminated from the equations.

The equations for Ankara and Istanbul reflect the relationship between shoe demand and income per household and supernumerary income per household for a highly urbanized social and economic environment such as exists in Ankara and Istanbul. Hence these equations give the relationship between shoe demand and income in a monetized urban economy which exists only in the

big cities of Turkey. Therefore it is very probable that this relationship is much less important for the whole of Turkey, where more than 70 % of the population lives in rural areas. Therefore it is assumed that the total shoe demand estimated from these equations represents the maximum level of demand for leather shoes in Turkey. From this figure, implications will be drawn for the maximum feasible output for the Beykoz factory.

First the total shoe demand will be projected by using the regression equation for Ankara, namely :

$$X_1 : 2.301 \quad .6108 X_2$$

The equation shows that the annual shoe consumption per household is a function of the annual income per household. Therefore the annual household income had to be projected for the years 1966-70. To do this, the average size of a household was taken to be 5 as estimated in the Birth Control Survey conducted in the summer of 1963. This was assumed to stay constant in 1966-70. To project values of X_2 , the per capita income projections for 1966-70 were each multiplied by 5, the average size of household. Thus the household income per annum was found. These were substituted in the regression equation and the annual shoe demand per household was calculated for the years 1966-70. In the second step, the projected total population estimates for Turkey were divided by 5, the average family size, to give the estimated number of households for the years 1966-70. The number of households were then multiplied by the shoe demand per household to give the total demand for shoes in number of pairs per year in the period 1966-70. The figures for Ankara are indicated below :

T H E S I S

**ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL**

PAGE 64

Year	Per Capita Income (1000 TL)	Income per Household (1000 TL)	Shoe Demand per Household (Pairs)	Population (1000)	Number of Households	Total Demand for Shoe (Pairs)
1966	1.685	8.425	5.146	32 690	6 538 080	33 644 960
1967	1.710	8.550	5.222	33 606	6 721 140	35 097 793
1968	1.735	8.675	5.299	34 547	6 909 340	36 612 593
1969	1.760	8.800	5.375	35 514	7 102 800	38 177 550
1970	1.786	8.930	5.454	36 400	7 280 000	39 705 120

The regression equation for Istanbul contains one extra variable, i.e., supernumerary income per household :

$$X_1 : 1.171 + .4913 X_2 - .4466 X_4 .$$

To project supernumerary income per household, first the average size per family was broken down as :

- 2 Children below age 10
- 1 Adolescent between ages 11-17
- 2 Adults above age 17
- 5 Average size of family

This breakdown was made according to the age composition of the population revealed by the 1960 Population Census. The minimum living allowance figures were assumed to remain constant as given in the previous sections :

TL 1000 per annum for each child

TL 2000 per annum for each adolescent

TL 4000 per annum for each adult

To estimate total minimum living allowance per household, the above figures

were multiplied by the family age composition :

TL 1000 X 2 Children : TL 2000

TL 2000 X 1 Adolescent: TL 2000

TL 4000 X 2 Adults : TL 8000

Minimum living allowance per household TL 12 000

Thus the minimum living allowance for each household was calculated as TL 12 000. This figure was assumed to stay constant between 1966-70. The calculations for Istanbul are given below:

The supernumerary income was calculated by subtracting minimum living allowance, i.e., TL 12 000, from the household income for each year. Shoe demand was calculated by substituting household income and supernumerary income in the regression equation. The total shoe demand was calculated by multiplying shoe demand per household by the number of households for the respective years.

Year	Household Income (TL 1000)	Supernumerary Income (TL 1000)	Shoe Demand per Household (Pairs)	Number of Households	Total Demand (Pairs)
1966	8.425	-3.575	6.816	6 538 080	44 563 553
1967	8.550	-3.450	6.912	6 721 140	46 456 520
1968	8.675	-3.325	6.918	6 909 340	47 798 814
1969	8.800	-3.200	6.923	7 102 800	49 172 674
1970	8.930	-3.070	6.889	7 280 000	50 151 920

When the total shoe demand figures projected for Turkey from Ankara and Istanbul surveys are compared, it is seen that the projections made by the Istanbul regression equation are higher than the ones made by the Ankara regression equation by more than 10 millions pairs of shoes each year.

This is due to the presence of one more variable, i.e., supernumerary income in the Istanbul regression equation. This adds more to the shoe demand per household and thus to the annual demand for shoes in Turkey estimated from this regression equation. Of the two estimates, it is more logical to accept the estimate made by the Ankara regression equation, since the survey sample from Ankara was a more homogeneous sample compared to Istanbul with regard to income data. The Istanbul data contained very high income figures out of proportion for some households, which made the average income in Istanbul TL 20 100 compared to TL 16 900 in Ankara. On the other hand, the average supernumerary income for Istanbul was TL-2000 while it was TL 4900 for Ankara. This shows that the Istanbul data were not valid enough with regard to income distribution since the average household size is 4.2 persons both for Ankara and Istanbul. Due to the extreme income figures per household the Istanbul survey does not resemble the income distribution in Turkey. Therefore the projection made by the Ankara regression equation was accepted as the total demand for shoes in Turkey. However, these estimates will again be accepted as the upper limit of shoe demand in Turkey, since the income level in Ankara is also much above Turkey's average income.

2. Simple Regression Equation Method

The projections of shoe demand given above are estimated from the results of the consumer survey. Now similar calculations are made by employing the simple regression equation calculated for selected foreign countries which shows the functional relationship between the per capita shoe consumption and

per capita income. The final simple regression equation which approximated all the equations for the years 1958-62 was found to be :

$$X_1 : .725 + .000103 X_2$$

where X_1 : per capita shoe consumption

X_2 : per capita income .

The projections for per capita income were made in the section B-3 . These values were substituted in the equation above to estimate the per capita shoe consumption in Turkey for the years 1966-70 . The per capita estimates were then multiplied by the population projections to find the total estimates of shoe demand. The estimates are given below :

Year	Per Capita Shoe Demand (Pairs)	Total Shoe Demand (Pairs)
1966	.899	29 388 670
1967	.901	30 278 735
1968	.904	31 230 220
1969	.906	32 175 685
1970	.909	33 087 600

3. Comparison of the Estimates Obtained

The comparison of the shoe demand estimates obtained in two different ways shows that the estimates made by the Ankara regression equation are much higher than the estimates made by the regression equation computed for the selected foreign countries. For 1966, the estimate is about 34 million pairs while it is 29 million pairs which is calculated from the regression equation

THE S I S

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 68

for selected foreign countries. The shoe demand estimates made by the regression equation for selected foreign countries reaches the figure of 33 million pairs only in the last year of the projection period in 1970. This indicates that it will be wise to take the estimates made by the Ankara regression equation as the maximum total demand for leather shoes in Turkey in the projection period as indicated earlier.

When comparisons are made with the shoe consumption figures for some foreign countries, it is seen that even the projections made by the regression equation for selected foreign countries are high. For Turkey, it is projected that shoe consumption per capita will be .90 and .91 pairs at the beginning and at the end of the period 1966-70. For the same years, per capita income in Turkey is projected as 1685 TL and 1786 TL respectively. These figures indicate that in the period 1966-70, each person in Turkey will have almost one pair of leather shoes per annum. The high level of this estimate will be clear from a look at the similar data for Portugal and Greece whose per capita income figures are nearer to those of Turkey than to those of the other selected countries.

Year	PORTUGAL		GREECE	
	Per Capita Income (TL)	Per Capita Shoe Consumption (Pairs)	Per Capita Income (TL)	Per Capita Shoe Consumption (Pairs)
1958	1838	.48	-	-
1959	1921	.51	-	-
1960	2118	.75	2929	.96
1961	2255	.78	3306	1.02
1962	2397	.98	3465	1.17

This table shows that when Portugal's per capita income was TL 1,838 in 1958, its per capita shoe consumption was .48 pairs. Both in Greece and Portugal, the .90 pairs per capita level is reached only after the per capita income goes above the TL 2,000 level. These figures indicate that the results obtained for Turkey are too high when the particular characteristics of the Turkish economy and society are taken into account. In Turkey, more than 70% of the population lives in rural areas and engage in a kind of subsistence agriculture, where income is in kind rather than in cash. A considerable number of the rural people manufacture their own shoes out of hides and skins of their livestock or buy vulcanized rubber shoes rather than leather ones. The level of income in the rural areas furthermore is not a decisive factor on the type of shoes worn and the average price paid. The decisive factors are custom and proximity to markets rather than income for a large portion of the Turkish population.

On the other hand, the relationship between per capita income and shoe consumption is an exponential one after a certain level of income is reached. For example, in the case of Greece, this level seems to be TL 2000 after which per capita shoe consumption suddenly increased from .51 pairs to .75 pairs. It can be assumed that this level will be about the same also for Turkey since the economic and the social picture of the two resemble each other. Therefore it can be predicted that the total shoe demand in Turkey will also suddenly increase once such a level of per capita income is reached. However, since per capita income will reach only TL 1785 at the end of the projection period, the estimates of the total shoe demand in Turkey will be referred to as maximum potential figures provided no radical improvement of the per capita income takes place.

D. ANALYSIS OF SALES OF THE BEYKOZ FACTORY1. Trend for Beykoz's Sales

The sales of the Beykoz factory during the years 1950-1962 are given in Table 15. The table indicates that the sales are in two categories: civilian and military sales. Military sales constitute the bulk of the total sales, i.e. more than 60% of the total in recent years. The Beykoz factory receives about 90% of the military orders each year. The growth of the military sales is limited by the number of soldiers in service, who are given two pairs of shoes each year. The Turkish armed forces are about 500,000-600,000 persons according to unofficial estimates. Thus the military sales cannot go above one million pairs, assuming the policy of the armed forces stays constant. As it has become almost traditional for Beykoz to receive the bulk of the military orders and since no other manufacturer exists whose capacity is large enough to meet the military demand for shoes, it can be assumed that Beykoz's sales to the military forces will be about the one-million-pair level in the years 1966-1970. This portion of the sales cannot be increased by the efforts of the factory. Therefore the portion of the sales to be emphasized is the civilian sales.

The military sales in the period 1950-1962 have shown significant fluctuations from year to year as they were determined by the specific orders of the military forces. On the other hand, the civilian sales indicate a smoother path of increase. The trend equation for the civilian sales in the period 1950-1962 was calculated to be:

$$X_1: 379,111 + 28,412 X_2$$

TABLE 15
THE SALES OF THE BEYKOZ SHOE FACTORY
1950-1962.

Year	Military Sales (pairs)	Civilian Sales (pairs)	Total Sales (pairs)
1950	520,700	160,844	681,544
1951	617,385	202,879	820,264
1952	528,565	365,568	894,133
1953	607,022	288,579	895,601
1954	550,800	340,457	891,257
1955	501,075	404,868	905,943
1956	658,253	366,564	1,024,787
1957	769,548	405,424	1,174,972
1958	739,357	436,070	1,176,320
1959	735,776	447,203	1,182,979
1960	788,052	462,840	1,250,892
1961	883,147	526,704	1,409,851
1962	860,634	519,578	1,380,212

Source: The files of the Beykoz factory.

TABLE 16

TREND FOR BEYKOZ'S CIVILIAN SALES

1950-1962

Year	Civilian Sales X_1	X_2	$X_1 X_2$	X_2^2
1950	160,844	- 6		
1951	202,879	- 5		
1952	365,568	- 4		
1953	288,579	- 3		
1954	340,457	- 2		
1955	404,868	- 1		
1956	366,534	0		
1957	405,424	1		
1958	436,970	2		
1959	447,203	3		
1960	462,840	4		
1961	526,704	5		
1962	519,578	6		
Total	4,928,448	0	4,830,071	170

The trend equation is:

$$X_1 = 379,111 + 28,412 X_2$$

The trend equation indicates that Beykoz's civilian sales increased by 28,412 pairs of shoes on the average per annum (Table 16).

2. Projections for Beykoz's Sales, 1966-1970.

The civilian sales of the factory for the years 1966-1970 were projected by the trend equation built in the previous section. The estimates are given in the table below:

Year	Projections of Civilian Sales (pairs)
1966	663,230
1967	691,640
1968	720,050
1969	748,460
1970	776,880

Since the military sales are estimated to be about one million pairs of shoes each year, the total sales in the same period will be:

Year	Projections for Total Sales (pairs)
1966	1,660,000
1967	1,690,000
1968	1,720,000
1969	1,750,000
1970	1,780,000

These estimates were made on the basis of past data and constant expectations for the future. Therefore these figures do not represent the maximum annual sales attainable in the period 1966-1970. Thus they should not be employed to indicate the maximum output to be produced by the factory in this period. This point will be discussed in the last section taking into account the total projected demand in Turkey and the full utilization of the

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 74

present capacity of the Beykoz factory. To throw more light on this analysis, the answers to the qualitative questions in the consumer survey will be discussed in the next section.

E. QUALITATIVE STRUCTURE OF THE DEMAND FOR SHOES

As can be seen in the translation of the survey questionnaire, the schedule also included some opinion questions in order to determine the most influential factors on the demand for shoes. The first of these questions asked about the preference of the consumers for different types of shoes (Question 10). The next listed the points emphasized by the consumers when purchasing shoes (Question 11). The last one listed the reasons for preferring Beykoz shoes, if the interviewee wore Beykoz shoes (Question 12). The answers to these questions are given in a frequency table below:

	<u>Ankara</u>	<u>Istanbul</u>
I. Types of shoes worn		
a. Preference for vulcanized rubber shoes	6	15
b. Preference for leather-bottom shoes	63	168
c. Preference for rubber-bottom shoes	32	94
II. Points emphasized when purchasing shoes		
a. Emphasis on price of shoe	22	84
b. Emphasis on strength of shoe	61	142
c. Emphasis on style of shoe	43	134
d. Emphasis on installment sales	3	15
e. Emphasis on other reasons	6	19
III. Reasons for preferring Beykoz shoes		
a. Low price of Beykoz shoes	35	38
b. Strength of Beykoz shoes	57	53
c. Style of Beykoz shoes	1	12
d. Due to habit	-	11
e. Other reasons	1	3

The survey revealed that out of 256 persons interviewed in Ankara and Istanbul, 21 purchase vulcanized rubber shoes, 231 leather-bottom shoes and

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 76

126 rubber-bottom shoes. As percentage of the total, these figures are 8.2 % 90.2 % and 49.2 % respectively. This shows that the majority of the persons interviewed prefer leather-bottom shoes to the other two kinds. Only 8.2 % of the sample wear vulcanized rubber shoes. However, the low level of this percentage is deceptive as the survey was conducted in Ankara and Istanbul, which are the two biggest urban centers in Turkey. Therefore, this only indicates that the vulcanized rubber shoes are consumed by less than 10 % of the urban population living in metropolitan centers like Ankara and Istanbul. The demand for vulcanized shoes in the low-income rural areas is higher, owing to its very low price compared to other kinds of shoes. Leather-bottom shoes are preferred by 90 % of the households. These figures also should be accepted only for the urban population rather than the rural. The high percentage of people using rubber-bottom shoes is probably brought about by the facilities of urban living. Otherwise, in the rural areas where transportation facilities are lacking and especially in regions with hard winters rubber-bottom shoes and boots are the standard footwear for the people in Turkey. Thus these figures indicate that the largest possibilities of expansion lie in the production of leather-bottom shoes if the Beykoz factory aims for the urban markets. Rubber-bottom shoes constitute the second important area of expansion.

The answers to the next question indicate what factors are taken into account most in the purchase of shoes. It is seen that out of 256 interviewees, 106 take into account the level of the price, 203 the strength of the shoe, 177 the style, 18 the availability of installment payments, and 25 other reasons.

Thus the strength of the shoe comes into view as the most influential factor determining the demand for shoes. In this respect, Beykoz has a great advantage over the other shoe manufacturers. The Beykoz factory uses good materials of standard strength and its products are recognized in the shoe market for their strength. The style of the shoe comes next in importance. Taste is influential on the demand for shoes in 69.1 % of the cases in urban areas. Thus it is seen that Beykoz should stress style if it wants to increase its sales in the urban areas. It should bring its styles up-to-date and also diversify its styles at the same time. The price of the shoe comes third in importance with 41.4 % . However, this figure underestimates the importance of price in the demand for shoes. The answers given to the questionnaires indicate that the range of average shoe prices paid by the interviewees change between TL 50-240 . Each person decides on a price to be paid for his shoe consumption. Small deviations from this average price might not affect his consumption much. However, the range of 50 TL per pair to 240 TL per pair indicates a great variation in shoe prices, which would certainly influence the shoe consumption for people in the low and medium income brackets. When it is taken into account that in the rural areas people pay between 10-20 TL for vulcanized rubber and low-quality leather shoes, the high level of the shoe prices indicated by the Ankara and Istanbul surveys will be clear. Therefore it will be wise for the Beykoz shoe factory to continue its present policy of producing low-priced shoes if it aims to expand its sales.

The survey also indicates that only 7% is influenced by installment sales in their purchase of shoes. The consumption of 9.8 % is affected by other reasons.

T H E S I S

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 78

The number of people who use Beykoz shoes is 57 out of 66 in Ankara and 63 out of 190 in Istanbul. The respective percentages are 86 % and 33.3%. The high percentage of Ankara is due to the fact that the questionnaires were filled out at the Beykoz stores in Ankara. Of the people using Beykoz shoes in Ankara and Istanbul, 59 % give the relative low price of the Beykoz products as the main reason for their preference. This fact clearly points out the importance of price. Ninety percent prefer Beykoz shoes for their strength. Only 11 % claim that they like the styles of Beykoz shoes. This shows that Beykoz styles are comparatively inferior, since it was found that taste was influential in about 70 % of the cases in shoe purchases. The comments written on the survey schedules about the unchanging, ugly and old-fashioned styles of Beykoz, although no question was asked in this respect, reveal the importance of this point in urban areas.

Nine percent of the people wearing Beykoz shoes claim that they do so on the basis of custom. Three percent attribute their use of Beykoz shoes to other reasons, such as being given Beykoz shoes by their employer.

Thus it emerges that Beykoz shoes are mostly preferred due to their comparative low prices and strength. On the other hand, these advantages are offset by the old and unbecoming styles of its products. This is a serious setback in a market where styles change more than once each year, and where 70 % of the people make their purchases according to the style of the product. Therefore, if Beykoz aims at the urban market, it should bring its styles up-to-date and follow the changing fashions. In this case, it could increase the prices of its products and still expand

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 79

its sales volume. On the other hand, if the rural market is taken as the target, then diversification of styles is not very important. In this case, it would do well to produce a few standard models adapted to the needs and conditions of rural life. However, in this case, Beykoz should bring the prices of its products down in order to serve the low income groups which constitute the bulk of the rural population.

F. IMPLICATIONS FOR THE FUTURE OUTPUT OF THE BEYKOZ FACTORY

As was indicated earlier in this paper, the potential production capacity of the Beykoz factory is 2 million pairs of shoes per year, of which 65% is utilized at maximum. The analysis of the figures for production costs indicates that full utilization of the present capacity will lower cost per pair of shoes.

In 1965, the total output of the factory was 1.332 million pairs. The cost comparison is made by comparing cost of production at this level of output to the cost at full capacity. According to figures obtained from the cost accounting department of the factory, the cost of producing 1.332 million pairs is TL 14.660 million, of which TL 6.170 is fixed costs. In this case, average cost per pair of shoes is TL 11.02. On the other hand, cost of producing 2 million pairs is TL 16.810 million. At this level of output, per unit cost is TL 8.45. Thus the unit cost decreases by TL 2.57 in case of full utilization of capacity.

Utilizing full capacity of the factory will not result in excessive additional costs from the marketing aspect. Beykoz shoes are either sold in shoe sections of Sümerbank stores or in Beykoz stores directly tied to the factory. It is estimated that the present personnel and store space will be sufficient to market the output at full capacity. Since expenditures for personnel and rents constitute about 90% of the total sales administration expenses, the main portion of the sales expenditures will not change. The remaining 10% which includes transportation, packaging, etc. costs will increase, but this will not affect total sales expenditures since it is only one-tenth of the total.

T H E S I S

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 81

Thus the analysis of production costs also favors expansion of the output of the Beykoz factory. The expansion of the output could go up to 4 million pairs per year, in case two shifts are worked. Previous experience indicates that the application of two shifts is feasible in the factory.

However, if the past trend of sales continues, it will take years even before the 2-million-pair level of output is attained. Even though the estimated total demand in Turkey increases significantly in the period 1966-1970, the Beykoz sales estimated from past trend increase slowly to reach 1.780 pairs only in the last year of the period. The rounded estimates of total shoe demand and of Beykoz's sales for the years 1966-1970 are repeated below to facilitate comparison:

Total Shoe Demand estimated from:

Year	Ankara Survey	Selected Foreign Countries	Beykoz Sales
(M i l l i o n P a i r s)			
1966	33.645	29.389	1.660
1967	35.098	30.279	1.690
1968	36.612	31.230	1.720
1969	38.178	32.175	1.750
1970	39.705	33.088	1.780

The figures indicate that the estimates of shoe demand in Turkey do not present any limitations to the growth of the Beykoz sales. Beykoz's future sales constitute about 5 % of the total shoe demand. However this percentage is probably higher since total shoe demand estimates are taken as maximum potential estimates for Turkey. The important point is that the estimated percentage share of the Beykoz sales in the total shoe demand declines from year to year. This is indicated in the following table.

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 82

Estimated Share of Beykoz's Sales in Total Projected Shoe Demand

Year	According to Ankara Survey	According to Selected Countries
1966	4.93%	5.64%
1967	4.82%	5.57%
1968	4.70%	5.51%
1969	4.58%	5.44%
1970	4.48%	5.38%

As indicated by the above table, from 1966 to 1970, the percentage share of Beykoz's sales declines from 4.93% to 4.48% according to the Ankara survey. This means that the Beykoz sales will not grow as fast as total shoe demand if the past trend continues. Therefore it is essential to take some radical measures in the production of the Beykoz shoe factory. The nature of these changes are indicated by the qualitative findings from the consumer survey. Otherwise, the increase of capacity in the factory will result in growing stocks, which will defeat the purpose of increasing production capacity. Therefore the Beykoz management must solve the problem of promoting its sales before it can attain optimum production.

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE 8

APPENDIX-II

TABLE 17

MULTIPLE REGRESSION ANALYSIS

1958

Countries	Shoe Consumption (Million Pairs) X_1	National Income (Million TL) X_2	Population (Million) X_3
Austria	8.0	36.7	7.0
Denmark	10.3	80.6	9.4
France	68.1	382.7	44.8
West Germany	94.3	388.0	52.1
Greece	6.1	22.1	8.2
Italy	42.8	11.9	49.0
Ireland	3.6	194.2	2.9
Netherlands	17.1	70.7	11.2
Norway	4.6	27.7	3.5
Portugal	4.2	16.0	8.7
Spain	27.3	65.3	29.8
Sweden	12.1	87.6	7.4
Switzerland	9.2	58.4	5.2
U.K.	100.9	464.7	51.8
U.S.A.	458.7	3,282.3	174.9
Total	872.9	6,013.9	470.4

$$\begin{aligned}
 \sum X_1 X_2 &= 1,632,127.9 & \sum X_1^2 &= 237,507.6 & \bar{X}_1 &= 54.6 \\
 \sum X_1 X_3 &= 96,947.9 & \sum X_2^2 &= 12,115,881.5 & \bar{X}_2 &= 375.9 \\
 \sum X_2 X_3 &= 647,773.7 & \sum X_3^2 &= 41,812.2 & \bar{X}_3 &= 29.4
 \end{aligned}$$

The multiple regression equation is:

$$\underline{X_1 = -13.7 + .0541 X_2 + 1.696 X_3}$$

TABLE 18

MULTIPLE REGRESSION ANALYSIS

1959

COUNTRIES	Shoe Consumption (Million Pairs) X_1	National Income (Million TL) X_2	Population (Million) X_3
Austria	9.1	38.1	7.0
Denmark	11.9	81.7	9.4
France	5.8	40.0	4.5
West Germany	74.9	397.5	45.2
Greece	7.2	22.9	8.3
Italy	104.2	418.7	52.7
Ireland	3.7	12.6	2.8
Netherlands	45.7	207.9	49.4
Norway	17.8	75.1	11.3
Portugal	4.9	28.8	3.6
Spain	4.5	16.9	8.8
Sweden	13.4	92.5	7.4
Switzerland	10.0	61.2	5.3
U.K.	115.1	485.1	52.1
U.S.A.	479.4	3,580.0	177.8
Total	934.3	6,466.2	475.6

$\sum X_1 X_2 = 1,871,823$	$\sum X_1^2 = 262,095$	$\bar{X}_1 = 58.4$
$\sum X_1 X_3 = 103,772$	$\sum X_2^2 = 14,311,056$	$\bar{X}_2 = 404.1$
$\sum X_2 X_3 = 724,043$	$\sum X_3^2 = 43,023$	$\bar{X}_3 = 29.8$

The multiple regression equation is:

$$\underline{X_1 = -12.8 + .0494 X_2 + 1.724 X_3}$$

TABLE 19

MULTIPLE REGRESSION ANALYSIS

1960

Countries	Shoe Consumption (Million Pairs) X_1	National Income (Million TL) X_2	Population (Million) X_3
Austria	8.3	43.2	7.1
BENELUX	12.0	87.8	9.5
Denmark	6.8	43.1	4.6
France	77.1	416.3	45.7
West Germany	115.7	495.8	53.2
Greece	8.0	24.4	8.3
Italy	3.7	227.6	2.8
Ireland	48.7	13.5	9.6
Netherlands	20.3	83.9	11.5
Norway	5.4	31.1	3.6
Portugal	6.6	18.7	8.8
Spain	27.7	78.9	30.3
Sweden	14.7	99.1	7.5
Switzerland	10.6	95.5	5.4
U.K.	121.8	516.9	52.5
U.S.A.	500.1	3,702.6	180.7
Total	987.5	6,870.0	441.1

$\sum X_1 X_2 = 2,027,245$	$\sum X_1^2 = 288,555$	$\bar{X}_1 = 61.7$
$\sum X_1 X_3 = 108,507$	$\sum X_2^2 = 15,464,756$	$\bar{X}_2 = 429.4$
$\sum X_2 X_3 = 755,485$	$\sum X_3^2 = 41,884$	$\bar{X}_3 = 27.6$

The multiple regression equation is:

$$\underline{X_1 = - 4.8 + .0398 X_2 + 1.978 X_3}$$

TABLE 20

MULTIPLE REGRESSION ANALYSIS

1961

Countries	Shoe Consumption (Million Pairs) X_1	National Income (Million TL) X_2	Population (Million) X_3
Austria	9.4	47.1	7.1
BENELUX	12.6	93.1	9.5
Denmark	7.8	48.0	4.6
France	81.2	448.3	46.2
West Germany	115.0	567.8	54.0
Greece	8.6	27.8	8.4
Italy	51.5	14.5	49.9
Ireland	4.1	249.8	2.8
Netherlands	21.6	91.5	11.6
Norway	5.2	33.6	3.6
Portugal	6.9	20.1	8.9
Spain	31.6	88.6	30.6
Sweden	14.0	108.0	7.5
Switzerland	11.2	72.9	5.5
U.K.	127.9	552.6	52.9
U.S.A.	520.7	3,805.2	183.8

Total	1,029.2	7,241.2	486.9
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$\sum X_1 X_2 = 2,178,766$	$\sum X_1^2 = 312,211$	$\bar{X}_1 = 64.3$
$\sum X_1 X_3 = 116,769$	$\sum X_2^2 = 16,574,974$	$\bar{X}_2 = 452.6$
$\sum X_2 X_3 = 795,673$	$\sum X_3^2 = 45,611$	$\bar{X}_3 = 30.4$

The multiple regression equation is:

$$\underline{X_1 = - 14.7 + .0458 X_2 + 1.918 X_3}$$

TABLE 21

MULTIPLE REGRESSION ANALYSIS

1962

Countries	Shoe Consumption (Million Pairs) X_1	National Income (Million TL) X_2	Population (Million) X_3
Austria	9.8	49.7	7.1
BENELUX	13.2	96.2	9.5
Denmark	8.1	53.2	4.7
France	88.1	497.0	47.0
West Germany	121.7	615.0	54.8
Greece	9.9	29.3	8.5
Italy	54.9	281.2	50.2
Ireland	4.3	15.8	2.8
Netherlands	21.3	96.8	11.8
Norway	5.5	35.9	3.6
Portugal	8.8	21.1	9.0
Spain	36.1	100.6	30.8
Sweden	14.9	102.0	7.6
Switzerland	11.6	80.6	5.7
U.K.	120.1	570.8	53.4
U.S.A.	547.2	4,052.7	186.7
Total	1,075.5	7,616.3	493.2

$\sum X_1 X_2 = 2,445,021$	$\sum X_1^2 = 342,112$	$\bar{X}_1 = 67.2$
$\sum X_1 X_3 = 124,502$	$\sum X_2^2 = 18,538,747$	$\bar{X}_2 = 476.0$
$\sum X_2 X_3 = 872,881$	$\sum X_3^2 = 46,955$	$\bar{X}_3 = 30.8$

The multiple regression equation is:

$$\underline{X_1 = - 14.7 + .0465 X_2 + 1.942 X_3}$$

THESIS

ROBERT COLLEGE GRADUATE SCHOOL
BEBEK, ISTANBUL

PAGE

BIBLIOGRAPHY

1. Bu rsk, Edward C. New Decision-Making Tools for Managers . Harvard University Press, Massachusetts, 1963 .
2. Census of Population, October 23,1960, Population of Turkey. SIS Publication, No.452 .
3. Dean,Joel. Managerial Economics . Prentice-Hall, Inc. New Jersey, 1964 .
4. Duncan, J.Acheson. Quality Control and Industrial Statistics. Richard D. Irwin,Inc. Homewood, Illinois, 1959 .
5. Development Plan, First Five Years, 1963-67 , SPO, Ankara, 1964 .
6. Ezeikal, Mordecai and Fox, Karl A. Methods of Correlation and Regression Analysis .John Wiley and Sons, Inc. New York,1959.
7. The Hides and Skins Industry, OECD Publications, Paris, 1959, 1960, 1961, 1962 Statistics.
8. Nemmers, Frederic Esser. Managerial Economics . John Wiley and Sons, Inc. New York, 1962 .