EFFECT OF ECONOMIC AND SOCIAL VARIABLES

ON THE PURCHASING LEVEL OF EGGS.

VICOSA, M.G., BRAZIL

A Thesis

Submitted to the Faculty

of

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by

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of

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To
My Adoptive Parents
Mr. and Mrs. Dr. Fleming A.O.G. Zeemann
This Thesis is
Dedicated

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ABSTRACT

Brandt, Sergio Alberto, M.S., Purdue University, June 1963.

Effect of Economic and Social Variables on the Purchasing Level of

Eggs. Vicosa, M.G., Brazil. Major Professor: J. Havlicek, Jr.

The general objective of this study is to identify the primary

factors affecting the demand for purchased eggs in Vicosa, Minas

Gerais, Brazil and to determine how these factors affect the quantity

of eggs purchased.

The basic sample consisted of 100 households divided into two

sub-samples of fifty households each. The stratification was based

on regional location. One additional sample was taken from a

minority group. This sample is composed of 15 families of

Mideastern origin.

The one-way classification analysis of variance and a weighted

analysis of variance approximation were used to test difference in

average per capita purchases between classes of social characteristics.

The social characteristics investigated included racial groups, ethnic

origins, living backgrounds, regional locations, and backyard production

of eggs. Least squares multiple regression techniques were used to

estimate a demand equation for purchased eggs. The functional relation-

ship expressed the quantity of purchased eggs as a function of the

price of eggs, disposable income, education level of the housewife,

and the number of children that were 11 years of age or less. Both

linear and curvilinear relationships were estimated for families with and without backyard production separately. Price and income elasticities of demand were estimated from the linear and curvilinear equations for both the groups of families.

The social factors which were most important in terms of affecting per capita purchases and which resulted in significant differences in weekly per capita purchases of eggs were ethnic origin or backyard production of eggs.

The important variables explaining the variation in per capita weekly purchases of eggs for the group of households without backyard production were prices paid for eggs, per capita monthly disposable income, level of formal education of the housewife, and number of children of 11 years or less. Price and income were identified as the important variables for the group with backyard production. The signs of the coefficients are consistent with economic theory and/or with the conceptive construct. For the two groups of households a linear relationship fitted the data better than did a curvilinear relationship.

The demand for purchased eggs was found to be price elastic and income inelastic for both groups of households. The purchasing level of the group without backyard production was more responsive to price and income changes than was the purchasing level of the group without backyard production. However, the average per capita purchases of the group without backyard production was over twice as much as for the group with backyard production.

One of the striking features of the results is the low average

per capita purchasing level of eggs. The households of Vicosa purchase
only about 0.12 dozen of eggs per capita per week which is equivalent
to only about 69 eggs per year per capita.

CHAPTER I

INTRODUCTION

Agricultural economic research is making its first steps in Brazilian institutions. The most developed sectors are related to farm management and general farm economics. Only recently has attention in economic research been focused at agricultural marketing. Marketing research in international trade is several years older and to a certain extent slightly more advanced.

Currently there is very little research information available about the functioning of the different phases of the agricultural marketing system and about the factors affecting demand for food in general as well as factors influencing the demand for specific agricultural commodities. Research information is needed in nearly every phase of marketing to give guidance to the growing marketing system and to more efficiently allocate resources within the agricultural marketing activities and between agricultural marketing and other economic activities in the Brazilian economy.

Basic changes in consumption are occurring because of a substantial movement of people from the rural to the urban zones. Rising income levels, the impact of a spreading educational system, the continuous flow of people from foreign countries to Brazil, and an increasing change in the religious balance of power are considered to

be important factors influencing changes in consumption patterns. Also marketing structures and processes have been changing in the last decade. Producer organizations seeking greater bargaining power, government actions in the transportation and processing sectors, horizontal and vertical integration in the final steps of the marketing process are some of the more commonly recognized changes that are occuring. Private marketing firms now under keen competition are striving for greater efficiency and lower costs. Also, increased advertising and sales promotion by those firms have been noticed.

Changes are also occurring in production techniques. Producers located near the larger markets are beginning to use improved animals, seeds and plants. Intensified use of fertilizers, defensives, and concentrated feeds are now prevalent. Also, mechanization is occurring on many farms, especially commercial poultry farms. The use of scientific management and of market information are increasingly spreading.

In selecting the area and a problem for a research project, consideration was given to developing research in markets of greater dimension, such as the cities of Sao Paulo, Rio de Janeiro or even the state capital of Belo Horizonte. Also, the selection of a city or town which could be taken as more representative for the country as a whole was given consideration. However, it was felt that for a pilot study much could be gained in terms of results and methodology if attention was focused at a smaller geographical area and if attention was focused on a single commodity. The area selected for the present study is the town of Vicosa, in the state of Minas Gerais, Brazil. The

particular selected commodity is eggs. Production and marketing of eggs constitute an activity of increasing specialization and economic volume.

The major egg producing units are now developing near the center of that town as new commercial producers are replacing the null cost producers (farmers who do not have an alternative enterprise for small flocks of low producing chickens) located in the rural areas, resulting in some fundamental changes in the production structure. However, marketing processes are still following old routines. Assembling is absent, transportation is mostly on foot, preservation facilities are lacking, grading is not performed at all and eggs are still packaged in corn husks. Producers and marketing agents do not have good information about demand characteristics and patterns of consumption.

The specific problem to be investigated in this study is the influence of social and economic factors upon the quantities of purchased eggs. This study of the market of Vicosa should provide information and methodological procedures useful in analysing other commodities and other markets. The information should provide guides for making changes in production and marketing processes. Also, it is assumed that if consumers have more information on which to base decisions they will be in a better position to maximize satisfaction.

Objectives

The general objective of this study is to identify the primary factors affecting the demand for purchased eggs in Vicosa and to determine how these factors affect the quantity of eggs purchased.

Specifically, the objectives are:

(1) to determine the effects of race, ethnic origin, living
background, backyard production of eggs and regional location
on the per capita egg purchases.

(2) to estimate a demand function for purchased eggs including
price of eggs, income level, education level, size of family
and number of children as causal variables.

(3) to estimate the price and income elasticities of demand
for purchased eggs.

The remainder of this chapter consists of a brief review of
literature closely related to this study. A detailed description of
the market and characteristics of the population are presented in
Chapter II. A theoretical framework consisting of a simplified demand
model and of a conceptual framework for qualitative factors is discussed
in Chapter III. Chapter IV consists of a discussion on procedures used
in the two groups of analyses. Results are discussed in Chapters V and
VI and the summary and conclusions are presented in Chapter VII. The
sampling procedure is presented in Appendix A.

Review of Literature

A brief review of the literature concerning social and economic
factors influencing egg consumption indicates that prices paid, family
income, size or composition of the family and race or nationality are
the most important factors affecting the demand for eggs.

Aplin (1952) in a study conducted in the retail level, in Ithaca,
New York, observed among other findings that the demand for special
delivery eggs was very price elastic. ($\epsilon = -4.87$) This study was made

in order to determine the demand for high-quality eggs and to analyze the effect of a promotional program on egg sales. The study was conducted in five stores during 16 weeks.

Quackenbush (1960) in a consumer panel study operated in Lansing, Michigan concluded that prices paid for eggs do not appear to be related to the quantity of eggs purchased. The consumers with higher incomes purchased larger sizes and higher priced eggs. The study covers an eight year period and includes over 100,000 food purchase diaries which were returned by about 250 families. The analysis consists of cross-tabulations. The author also indicated that income level and education of homemakers appear to have little relationship to egg consumption. Family composition and age of homemaker, however, seemed associated.

Cerra (1959) in a review of literature on demand and price structure for eggs reports elasticities of demand for eggs ranging from -0.3 to -1.3. Cross-sectional studies and time series studies were included in his review. Also, different types of equations were used by the different authors. In his own research Cerra obtained an income elasticity of demand equals to 0.2. From the other studies included in his review, income elasticity of demand ranges from 0.3 to 1.1.

Baker and Goldman (1951) in a cross-sectional study of habits, preferences, and demands of Des Moines egg consumers concluded that income was an important factor determining the consumption rate of eggs. They also reported that education and race were important sociological factors influencing egg consumption. The analyses involved mostly

cross-tabulations.

Rockwell (1959) in an analysis of data collected in the 1955 Household Food Consumption Survey indicated that income elasticity of demand for eggs was higher (ϵ = 0.19) among wealthier families than among low income families (ϵ = 0.17) and middle income families (ϵ = 0.16). These results refer only to non-farm households and are based on the value of consumption per person. Furthermore, Rockwell reports "elasticities of demand with respect to household size" ranging from ϵ = -0.12 (high family-income class) to ϵ = -0.20 (medium family-income class) and to ϵ = -0.26 (low family-income class). These also refer to non-farm households and are based on value of consumption per person.

Bylund (reported by Gerra, 1959) in a study conducted in Pennsylvania, reported that the relationship between per capita consumption (X_1) and per capita income (X_2) was different for households with and without children. The logarithmic functions were:

(a) For households with children:

$$\log X_1 = 0.91 + 0.20 \log X_2$$
$$(0.03)$$

$$r^2 = 0.92 \quad s = 0.02$$

(b) For households without children:

$$\log X_1 = -0.52 + 0.09 \log X_2$$
$$(0.02)$$

$$r^2 = 0.41 \quad s = 0.04$$

The results of this study also seem to indicate that, as far as the consumption of eggs is concerned, the number of children in a household is a more important factor than the size of the household itself.

Jasper (1953) in a review of consumer egg studies, reports that family size was one of the most important factors influencing the demand for eggs. He also reports that race of consumers was an important factor influencing egg consumption. Jewish people (in New York City) had the highest egg consumption and negroes the lowest, the negroes (in Columbus, Ohio) used fewer eggs than white people.

Slocum and Swanson (1954) in a cross-sectional study conducted in Seattle, Washington, observed that the volume of each purchase was associated with the race of consumers, white families buying larger volumes than non-white.

Tax (1958) in a study of changing consumption patterns in rural Guatemala indicates that consumption of eggs increased when the Indian advanced in the social scale and became a Ladino (social group of Spanish predominancy). He also points out the relationship between consumption levels and income levels. In the lower income level the Indians had a per capita weekly consumption of eggs of 21 grams and the Ladinos had a per capita weekly consumption of 41 grams. In the upper income level the Indians had a per capita weekly consumption of eggs equal to 41 grams and the Ladinos had a per capita weekly consumption of 129 grams.

Taylor, Owens and Jasper (1954) in two cross-sectional studies conducted with 605 families in Providence, Rhode Island, reported that the proportion of families whose per capita consumption was less than 6 eggs varied from 50 per cent in the case of the German, Dutch and Scandinavian families to 38 per cent for the Italian and French families. There were no significant differences among nationality groups in the proportion of families consuming over 12 eggs. The author also stated

that per capita consumption decreased markedly with increases in family size. Number of children showed the same type of relationship as that found with size of family.

CHAPTER II

POPULATION CHARACTERISTICS AND DESCRIPTION OF THE MARKET

The purpose of this chapter is to give a basic description of the town of Vicosa, its population, and the egg production and marketing activities in this area. Also, an attempt will be made to describe what might be considered a "typical consumer". Because of the lack of available data, part of this descriptive background information is based on data obtained from the sample[1]/ being used in this study.

The county of Vicosa is located in the state of Minas Gerais, in the economic region called Zona da Mata. The town of Vicosa is located in the county with the same name. It is approximately 140 miles north of Rio de Janeiro, 80 miles south of the state capital (Belo Horizonte), and 470 miles southeast of Brasilia.

Population Characteristics

In terms of population the town of Vicosa is the largest metropolitan area in the county of Vicosa. According to the 1960 census survey the population of the town of Vicosa was 11,472 people. From 1950 to 1960 the average population increase was 4.5 per cent a year. The rate of birth for the same period was 4.0 per cent a year. According to the 1960 census approximately 52 per cent of the people are males. The last census survey also indicates an increasing

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1/ See Appendix A. Sampling Procedures

migration of farm people from the surrounding districts and counties to the town of Vicosa. This seems to be an important aspect to be taken in consideration in future policies and forecasting. Farm people seem to be fundamentally different from city people in terms of food consumption habits and in terms of changing their pattern of consumption.

The racial structure of the population is composed of three major categories, namely white, negro and mulatto people. An attempt to classify these categories under scientific criteria would constitute a risk, for in Brazilian communities the concept of a "race" is quite different from many other parts of the world. In Brazil, race is a subjective concept. A "white" or "negro" classification does not necessarily mean either European or African ancestry or a predominantly white or dark color. It only means that those people "look" more white or negro than the opposite color. An investigator attempting to classify people according to race would need to be well versed in anthropology in order to obtain a really scientifically precise classification of the country's population.

According to the "flexible" census classification, the negroes make up the smallest fraction of the population, followed by the mulattoes, while the largest proportion of the population consists of whites. Another possible source of bias in racial classification is the tendency for "whitening". In the areas where intermarriages are prevalent and there is a large proportion of negro, there appears to be a tendency to avoid the classification of negro. However, in those areas where intermarriages are not as prevalent and there is a small proportion of negro, the tendency is to emphasize the negro

classification.

Previous research[1]/ shows the average household size to be 6.2 persons and 61.5 per cent of the households had 5 or more people. Households include servants having meals at the same house. The average number of children under 11 years of age per household was 1.8 and 64.6 per cent of the households had 2 or less children.

The farm population was not included in this study. The urban population (that living in the town of Vicosa) constitutes 42.45 per cent of the county's total population. Its locational distribution is as follows[1]/: 56.6 per cent are located in the center, 36.2 per cent are located in the suburban area, and 7.2 per cent are on the university campus.

The major part of the population is of Portuguese origin. The first settlers came to the area about two hundred years ago. Since that time intermarriage between Portuguese and negro people has been common. Small businesses and government agencies located in the town are the primary source of employment of the population. Also a rural university provides jobs for a considerable part of the population. With regard to their food consumption habits, the natives have only one or two typical dishes which includes eggs. The use of eggs for breakfast is not a habit of the majority.

The Mideastern immigration families constitute a wealthy minority group which is increasing in size. This group is commonly referred to as the "Turkish" or as the "Syrian-libanese" colony. Their

1/ Brandt, Sergio Alberto, Aquisicao e Consumo de Hortalicas e Frutas em Vicosa, M.G., 1958, Revista "Seiva", No. 53, ano XVI, pp 40-50.

origin consists of several countries of the Middle East. Members of the group do not readily mingle with the natives and they strongly cling to their homeland customs and habits, especially their homeland eating habits. Commonly the people of this group are engaged in some form of business and own retail stores or similar kinds of business. As they increase their wealth and education they change their popular classification. The people who have recently immigrated into Brazil are referred to as "Turkish". When these people move into the average income bracket they are called "Syrian". Later on, when they reach the upper level of the power structure of the community, they are referred to as "Libanese", a more respectable classification.

Prior to this study, no information was available about the income levels of families in Vicosa. This study is the first attempt to classify families according to this characteristic. The figures presented come from the sample. Inflation has been occurring at a relatively high level. During 1960 the cruzeiro lost about 50 per cent of its value. In the time period after the data was collected, inflation increased even more because of the political events which were occurring at the national level.[1] The cruzeiro was valued at a rate of 200 per U.S. dollar when the data were being collected, however, the current exchange rate (January 1963) is approximately 800 cruzeiros per U.S. dollar. About 23 per cent of the families were

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[1] In August 1961 an unexpected change occurred in the political regime of the country. After seven months in office, the President resigned and the Congress voted a bill changing the regime from Presidentialism to Parliamentarism.

in the higher income bracket (above Cr$ 20,000 per family per month),
22 per cent in the middle group (between Cr$ 10,000 and Cr$ 20,000
per family per month) and 55 per cent of the families were in the
lower bracket. The families in the lower income classification were
earning less than Cr$ 10,000 per family per month. The average family
income was Cr$ 14,387.76 per month and the average per capita income
was Cr$ 2,085.91 per month. In terms of the American dollar the average
annual per capita income was approximately $125.

Production and Marketing of Eggs

In Vicosa eggs may be separated into two basic types, country
eggs and commercial eggs. The country eggs are produced in small
quantities by most farms in the neighboring region of the town. The
cost of production of these eggs is nearly zero or nil, because producers
really do not have an economic alternative for their resources. No
modern technique such as concentrated feeds and equipment is used in
the production of this particular type of eggs.

The commercial eggs, which are produced by a few modern units
located in the town, provide a fresher and higher quality type of eggs
to the consumers. Producers of commercial eggs are really a type of
specialized entrepreneurs and are more market-conscious than the
general farmers. They use more advanced production techniques and
equipment such as concentrated feeding, selection of layers, semi-
automatic equipment, and periodic renewal of the flocks. The producers
of commercial eggs had to struggle vigorously in order to continue
operating in the market. In addition to having higher costs of production,
they were faced with the problem of promoting their product to consumers

who, for generations, were accustomed to purchasing the competitors' product, the country eggs. However, indications are that these producers have survived the difficulties of getting initially established and are operating efficiently enough so that returns to resources are adequate to warrant continued operation.

Egg production in the region tends to follow a seasonal trend and the peak is usually during the months of June and July. The lowest level of production is reached in December and January. During the time of seasonal surplus, June and July, part of the production of country and commercial eggs is distributed to neighboring or distant cities.

Consumers may purchase eggs from several sources. Some purchase eggs in retail stores and groceries, others buy directly from the commercial producers located in the town, and the rest receives country eggs which are delivered to their homes. There are no assembling points between production and retail outlets. In a certain way it could be said that the bakeries and the retail stores act as assembling points after the eggs are transported into the town. Both country and commercial eggs are usually transported into the town and distributed by people on foot. Country eggs usually are meticulously wrapped with corn husks, each egg being wrapped individually, whereas, commercial eggs are not packaged for delivery but are delivered in bulk. Some of the small producers sell their own production directly to consumers or to the bakeries and part of them sell through the several retailers located in the town. Most of the commercial producers sell their own production directly to consumers.

Grading and standardization have not been attempted by either the small farmers or by the commercial producers. Eggs are not subject to government inspection or grading regulations. Sanitary and preservation facilities are completely lacking.

The bakery absorbs a large share of the production of country eggs. A small part of the supply sold to these bakeries is bought by consumers, but this does not seem to be a regular source for most of the consumers. There are no figures available on the economic importance of the bakery industry either as a source of demand for eggs or as a marketing channel between producers and final consumers.

Extreme differences in the price of eggs may prevail in the market during a given time period. On a given day it is possible for the price of eggs in one section of the town to be more than double the price in another section only a few city blocks away. During the period of time that the data was collected retail prices of eggs ranged from about 30 to about 80 cruzeiros per dozen. Part of this price difference may be due to premium prices being paid for higher quality eggs, however, information regarding this is not available.

CHAPTER III

THEORETICAL MODEL AND CONCEPTUAL FRAMEWORK

A Demand Model for Purchased Eggs

The quantity which consumers will take of any commodity is
affected by many factors. Although economic and social factors are of
primary importance, other factors may substantially influence this
quantity. Furthermore, many of the factors affecting the quantity which
consumers will take may not act independently but rather may interact
with each other. The group of variables which influence the demand
for a commodity such as purchased eggs is complex. To investigate
all of these variables at once would be impossible. The analysis of
the demand for purchased eggs needs to be performed in a simplified
framework so that some of the more important factors of interest may be
analyzed and, insofar as possible, their effects isolated from the
effects of other factors.

In this study, the model which will be used to explain the quanti-
ties of eggs purchased will include selected economic and social
variables. The functional relationship is:

$$Y = f (X_1, X_2, \ldots, X_k/X_{k+1}, X_{k+2}, \ldots, X_n)$$

Where:

Y is the quantity of eggs purchased.

X_i (i = 1, 2, ..., k) are the economic and social variables which

are explicitly incorporated in the model.

X_i (i = k + 1, k + 2, ..., n) are all the other variables which may affect the quantity of eggs purchased and which are assumed to be of relatively less importance and tend to cancel each other.

The economic variables included in the model are, specifically, the price of eggs per dozen and per capita disposable income. The quantity of eggs purchased and the price of eggs should be inversely related because of real income and substitution effects. From a theoretical viewpoint the relationship between quantity purchased and per capita income will be positive and income may be viewed as a demand shifter.

The measurable household[1]/ characteristics included in the model are the education level of the housewife in terms of years of formal education, the household size, and the number of children of 11 years or under. These variables are assumed to be an important part of this theoretical construct and are explicitly incorporated in the model along with the economic variables. Each of these variables may affect the quantity purchased by shifting the demand for purchased eggs. The per capita purchases of eggs and the number of years of formal education of the housewife are expected to be positively related because housewives with more years of formal education are assumed to be more familiar with the nutritional value of eggs and would use greater quantities of eggs. Family size and the number of children are expected to be inversely related to the quantity of eggs purchased per capita. Some economies of scale may exist because families with larger numbers

[1]/ The term "household" as used in this study means a group of persons, usually related by links of blood, living at the same house and having meals at home. Servants taking meals at home are also included as part of the household. In this study the term "family" is used as a synonimous of "household".

of individuals more efficiently utilize the quantities of eggs
purchased than do families with fewer individuals. Also, the
consumption capacity of children is less than of adults which would
tend to decrease the per capita purchases of families which have larger
numbers of children.

Race, living background, regional location, ethnic origin, and
backyard production of eggs, are the social characteristics explicitly
included in the model. Not included in the model will be factors such
as the prices of other commodities, tastes and preferences.

The Elasticity Concepts

Two elasticity concepts of demand are traditionally used in
economic theory. One is the price elasticity of demand and the other
is the income elasticity of demand.

Price elasticity of demand is a measure of the sensitivity of
buyers' reaction to price changes. It is a measure of how Y, the
quantity purchased, is responsive to a change in X, the price of the
commodity, given a demand curve. The relationship between relative
changes in quantity purchased and relative changes in prices paid is
denoted as coefficient of price elasticity of demand. Mathematically,
the elasticity coefficient is defined as:

$$\eta_p = \frac{\frac{dY}{Y}}{\frac{dX}{X}} = \frac{dY}{dX} \cdot \frac{X}{Y}$$

Where:

  Y = quantity purchased

  dY = infinitesimal change in quantity purchased

$$X \quad = \quad \text{price}$$

$$dX \quad = \quad \text{infinitesimal change in price}$$

$$\eta\, p \quad = \quad \text{price elasticity coefficient}$$

Demand is said to be elastic when η_p is $-\infty < \eta_p < -1$ for all values of Y. It will be inelastic when η_p is $-1 < \eta_p < 0$. The demand curve is said to have an unitary elasticity when the coefficient has an value equal to -1.0.

The elasticity is different for all points on a linear demand curve. At the point where the elasticity coefficient is equal to -1.0 (Cournot's point) the total revenue is a maximum. Above this point elasticity of demand increases, and below it, elasticity decreases (Figure 1).
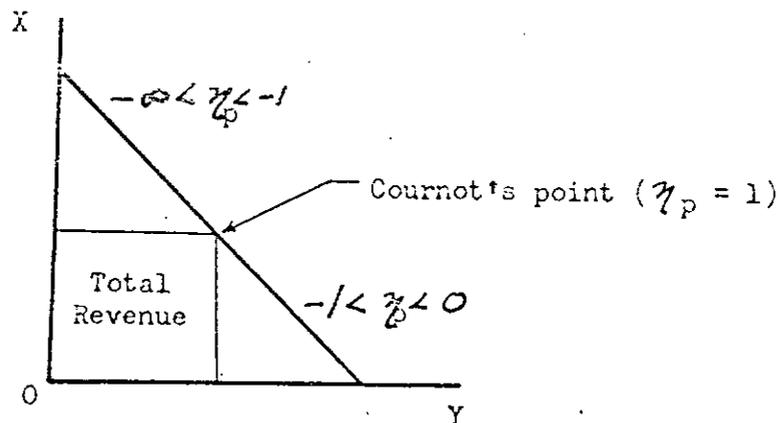
Figure 1. Point of Maximum Revenue (Cournot's Point)

If elasticity of demand is a constant, say η_{p_0}, then

$$\eta\, p_0 = \frac{\dfrac{dY}{Y}}{\dfrac{dX}{X}} = \frac{d \log Y}{d \log X}$$

where the functional form of the demand curve of constant elasticity is

$$Y = \alpha X^{\eta_{p_o}}$$

which may be expressed in a logarithmic form as

$$\log Y = \log \alpha + \eta_{p_o} \log X$$

Knowledge of the price elasticity coefficient of demand may be utilized to determine the quantity or the price or the profit margin which will yield the highest total returns to a firm or to a sector of the economy. Also, it may be used to quantify expected changes in quantity associated with changes in price.

The concept of income elasticity may be used to quantify expected changes in quantity resulting from an income change. The income elasticity is the relationship between a relative change in quantity purchased and a relative change in income.

Mathematically, the coefficient may be denoted as

$$\eta_I = \frac{\frac{dY}{Y}}{\frac{dX}{X}} = \frac{dY}{dX} \cdot \frac{X}{Y}$$

where:

Y = quantity purchased

dY = infinitesimal change in quantity purchased

X = income

dX = infinitesimal change in income

η_I = income elasticity coefficient.

The coefficient of income elasticity may be either negative or positive. If the quantity purchased of a good declines as incomes increase, income elasticity coefficient is negative; such goods are called inferior goods. If the quantity purchased increases as income

increases, the coefficient is positive, indicating a superior good. The income elasticity coefficient gives some notion of how purchasing of different goods will vary as income changes.

A Conceptual Framework for Social Factors

The six discrete variables discussed in this section are the social factors to be considered in part of the study. They were assumed to be cancelled in the previous demand model. A conceptualization of their possible effects upon the purchasing level of eggs is developed for each of them. It suggests some hypotheses to be tested and provides the framework for the analysis.

Races

The white families are expected to have a larger average quantity of eggs purchased than the mulattoes. The mulattoes are expected to have a higher average purchasing level of eggs than the negroes. One reason for these differences remains apparently in differences in dietary habits of whites and negroes. Coming originally from different cultures, these two opposing groups would have carried over to some extent the differences in food uses and habits of eating. It seems also that changes in consumption habits occur more slowly in the negro groups than in the white groups. The mulattoes would be in the middle of the race scale and are expected to show an intermediary purchasing level of eggs.

Ethnic Groups

Another social factor to be considered is the ethnic origin of the families. The middle-eastern origin families are expected to have

higher levels of purchase of eggs than the native background families.

People of the Middle-eastern origin group have several typical meals

which are made with eggs. On the contrary, the native people are not

great eaters of eggs. Despite the long-run tendency to adapt to the

local customs, it is expected that this difference in purchasing levels

will remain.

Living Background

Among the discrete variables, living background might also be an

important factor in determining the level of egg purchases. The basis

for believing that farm background people have higher levels of eggs

purchase than their city counterparts is that people coming from a farm

environment seem to have taken eggs for granted. They became used to

them when it was free and disposable at the farm. After moving to the

city they tend to buy more eggs than people without that past

experience.

Early life on a farm is a factor that has become of considerable

importance in the urbanization process of a population. However, it is

believed that some other habits brought from the rural environment, like

raising their own chickens, might obscure the significance of the

differences in purchasing levels of eggs.

Regional Location

Regional location refers to whether the families live in the center

of the town or whether they live in the suburbs. The center is usually

associated with the wealthier families, whereas families with lower

incomes tend to live in the suburbs. It is expected that people living

in the center of the town would have a higher level of egg purchases than the suburbanites. If there is really a difference between the downtowners and the suburbanites, other things remaining equal, it may be explained by an indirect influence of income levels of the populations in the two areas in attracting and distributing the marketing facilities over the whole area. The suburbs still being the most impoverished area did not attract as many marketing agencies and facilities. As this is true, a family earning a specified level of income is expected to purchase different volumes of the product depending on the area in which it is located. This would be due to differences in degrees of marketing facilities available in the two areas. In this sense, it is assumed that, ceteris paribus, the downtowners will have higher levels of purchasing eggs than the suburbanites.

Backyard Production of Eggs

Backyard production of eggs is the last variable to be taken into consideration in this analysis of purchasing levels of eggs. The main reason explaining why the families raising their own chickens tend to buy smaller volumes is that home-produced eggs are nearly perfect substitutes for purchased eggs. Some factors may motivate families to increase the number and the size of backyard flocks for their own needs and thus reduce the demand for purchased eggs. A current shortage in the market and/or a predominance of low-quality product could be mentioned as two such factors. Families owning their home supply would only occasionally need to buy eggs at the market in order to fulfill their requirements.

The simplified demand model for purchased eggs, the elasticity concepts and the conceptual framework for social factors will provide the necessary framework for the analyses in the subsequent chapters.

CHAPTER IV

PROCEDURES

Social Factors

In this study racial groups, ethnic origins, living backgrounds, regional locations, and backyard production of eggs were selected as the primary social factors affecting per capita egg purchases. With the exception of ethnic groups, analyses are confined to the data obtained from the main sample[1] of one hundred families of native origin. In addition to the main sample, supplementary data consisting of fifteen families of Midcastern origin are used in the analyses of per capita differences among ethnic groups.

The data were separated into groups for each social factor on the basis of the number of classes of each of the social factors. The variable of interest is per capita egg purchases in terms of dozens per week. A one-way classification analysis of variance was used to investigate the differences in the purchases among groups for each social factor. The symbolic representation of the analysis of variance table for a one-way classification consisting of t treatments or groups and r_i observations per groups is given in Table 1.

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[1] See Appendix A. Sampling Procedures.

Table 1. Symbolic Representation of a One-Way Classification Analysis of Variance With Different Number of Observations Per Treatment.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares
Among treatments	$t-1$	$\sum_{i=1}^{t}\left[\dfrac{(\sum_{j=1}^{r}X_{ij})^2}{r_i}\right] - \dfrac{(\sum_{i=1}^{t}\sum_{j=1}^{r}X_{ij})^2}{\sum_{i=1}^{t}r_i}$	SS(treatments)/
Error	$\sum_{i=1}^{t}(r_i-1)$	by subtraction	$SS(Error)/\sum_{i=1}^{t}(r_i-1)$
Total	$\sum_{i=1}^{t}r_i-1$	$\sum_{i=1}^{t}\sum_{j=1}^{r}X_{ij}^2 - (\sum_{i=1}^{t}\sum_{j=1}^{r}X_{ij})^2/\sum_{i=1}^{t}r_i$	

The total variation in per capita egg purchases for any one social factor may divided into two component parts. The among treatments variability refers to the variation in per capita egg purchases due to differences in the mean per capita purchases among the classes for a particular social factor. The error variability is the variation arising from differences in per capita purchases of the individual observations within a given class. The X_{ij}'s in Table 1 refer to the individual observations of per capita egg purchases.

The F ratio was used to test differences in per capita egg purchases among the classes. The computed F value is:

$$F = \frac{\text{Mean square treatments}}{\text{Mean square error}}$$

with $(t-1)$ degrees of freedom in the numerator and $\sum_{i=1}^{t}(r_i-1)$ degrees freedom in the denominator. The F tests indicate whether the mean per capita egg purchases are significantly different from each other.

Prior to the analyses of variance, the hypothesis of homogeneity of variances was tested. The F test was used in the cases where there were only two groups. In the cases where there were three groups, Bartlett's test of homogeneity of variances was used.[1]

In the analyses which involve more than two groups of data and unequal variances are observed, a weighted procedure suggested by Snedecor[2] was used to test differences among weekly per capita egg purchases. This procedure involves multiplying the means by weights consisting of the number of observations divided by the estimated variance of that group. A pair of weighted mean squares is calculated and their ratio is tested against the F-distribution. Although this method is an approximated test, it is assumed that the test provides results which are sufficiently accurate for the purposes of this study.

Estimation of Demand for Purchases Eggs

The functional relationship between per capita purchases of eggs, two economic variables and three measurable household characteristics is to be estimated. The two economic variables are the price of eggs in terms of cruzeiros per dozen, and the per capita disposable income in terms of thousand cruzeiros per month. The three measurable household characteristics are the education level expressed in terms of years of formal education of the housewife, the household size and the number of children of 11 years of age or less per household. This functional relationship is to be estimated by least-squares multiple regression

[1] Steel, R.G.D. and J.H. Torrie, _Principles and Procedures of Statistics_, (McGraw-Hill Book Company, N.Y., 1960) pp 81.
[2] Snedecor, G.W. and G.W. Cochran, _Statistical Methods_, (The Iowa State College Press, Ames, Iowa, 1956) pp 285-289.

techniques. Both linear and curvilinear relationships are to be estimated. The multiple linear regression estimating equation is of the form:

$$\hat{Y} = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5$$

where

$\hat{Y}$ is the estimated per capita purchasing level of eggs expressed in dozens per week

b_0 is the estimated Y intercept

b_1 through b_5 are the estimated partial regression coefficients

X_1 is the price of eggs expressed in cruzeiros per dozen

X_2 is the per capita disposable income expressed in thousand cruzeiros per month

X_3 is the number of years of formal education of the housewife

X_4 is the number of persons in the household

X_5 is the number of children of eleven years of age or less

The multiple curvilinear regression estimating equation is as follows:

$$\log \hat{Y} = \log b_0 + b_1 (\log X_1) + b_2 (\log X_2) + b_3 (\log X_3)$$
$$+ b_4 (\log X_4) + b_5 (\log X_5)$$

where the variables and the estimates are the same as those in the linear function, expressed in logarithms.

Separate functions are to be calculated for households with backyard production of eggs and for households without backyard production of eggs.

The significances of the coefficients of determination (R^2) are to be tested by means of the F test. The significance of the partial regression coefficients (b_i) are to be tested by the use of t test.

Estimation of Elasticities

Price and income elasticities of demand for purchased eggs are to be estimated directly from the multiple regression curvilinear equation. The logarithmic form of the curve for that model is identical to curve of constant elasticity. The partial regression coefficients (b_1 and b_2) directly satisfy the elasticity formula, respectively for price and income.

Both elasticity values are also to be estimated from the linear equation. Here, the elasticity values are given by the formula:

$$\varepsilon = b_i \cdot \frac{\overline{X}_i}{\overline{Y}_i}$$

where b_i can be either b_1 or b_2, and $\overline{X}_i$ can be either $\overline{X}_1$ or $\overline{X}_2$, giving respectively the price and income elasticities of demand for purchased eggs. $\overline{Y}$ is the average per capita purchasing level of eggs. For $i = 1$ the formula gives the price elasticity coefficient of demand for purchased eggs and when $i = 2$ the income elasticity coefficient is obtained. $\overline{X}_1$ is the average price of eggs and $\overline{X}_2$ is the average per capita disposable income.

CHAPTER V

EFFECTS OF SOCIAL FACTORS ON EGG PURCHASES

Racial Classification

The main sample was partitioned into three parts for purposes of making comparisons among the racial groups. The first part consisted of 69 white households, the second part was composed of 16 mulatto households, and the third part contained 15 negro households.[1]

The white families purchased 0.134 dozen eggs per week per capita which was the highest for the three racial groups. The per capita egg purchases of the mulattoes was 0.074 dozen per week while the per capita purchases of the negroes was 0.065 dozen per week. A test of the variances of the three groups[2] indicated that the variances were not homogeneous and that one of the assumptions underlying analysis of variance would be violated if this technique was applied without modification. Therefore, a weighted analysis of variance[3] was performed and the F' value obtained was not significant at the 0.05 level indicating that the mean per capita purchases among the three racial groups were not significantly different from each other.

The observed differences in average per capita egg purchases among the whites, mulattoes and negroes should not be interpreted as due to

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[1] See Appendix B. Household Characteristics According to Social Classifications.

[2] See Appendix C. Bartlett's Test of Homogeneity of Variances.

[3] See Appendix D. Snedecor's Test for Weighted Mean Squares.

differences in behavior, but only as differences arising from random variation. For purposes of investigating egg purchases the three racial groups could be considered as representing one population. If originally any differences among races prevailed in patterns of behavior these have been changed probably by intermarriage and cultural interchange so that they are no longer identifiable.

Ethnic Origins

The main sample was compared with a second supplementary sample for purposes of testing the differences between the ethnic groups. The main sample was composed of 100 native families and the additional sample contained 15 families of Mideastern origin.

The average per capita purchasing level of eggs of the Mideastern families was 0.465 dozen per week, which is about four times as great as the average of the natives. The average per capita purchases of eggs of the natives was only 0.118 dozen per week. The F value in Table 2 was significant at the 0.01 level indicating that the differences in the mean per capita purchases of the two ethnic origin group were highly significant.

Table 2. Analysis of Variance for Per Capita Egg Purchases of Ethnic Origin Groups.

Source of Variation	Degrees of Freedom	S.S.	M.S.	F value[1]
Between groups	1	1.57626	1.57626	45.971**
Within groups	113	3.87457	0.03429	
Total	114	5.45083		

[1] A single asterisk (*) means significant at 0.05 level and two asterisks mean significant at 0.01 level.

The patterns of behavior of the two ethnic groups are quite different and it may be that the recent coming of the Mideastern group is one of the reasons why that difference still prevails and may be identified.

Living Backgrounds

For this part of the investigation, the main sample was partitioned according to the living backgrounds of the housewives. The urban living background group is composed of 48 households and the rural living background group consists of the remaining 52 households.

The urban living background families purchased an average of 0.123 dozen eggs per week per capita which is slightly higher than the average of the rural background people. The per capita purchases of the rural background people was 0.112 dozen eggs per week. The F value in Table 3 was not significant at the 0.05 level which indicates that the mean per capita purchases of the two living background groups were not significantly different from each other.

Table 3. Analysis of Variance for Per Capita Egg Purchases of Living Background Groups.

Source of Variation	Degrees of Freedom	S.S.	M.S.	F value
Between groups	1	0.00277	0.00277	0.087
Within groups	98	3.11880	0.03182	
Total	99	3.12157		

The observed differences in average per capita purchasing level of eggs between the urban background people and the rural background people should not be interpreted as differences arising from differences in behavior, but only as differences due to random variation. With regard to this characteristic, both groups may be considered as a homogeneous group, rather than as two distinct groups.

It is possible that the total egg consumption levels of the two groups are really different even though the per capita egg purchases are not. Information on the quantity of eggs produced by the few chickens raised by individual families in their backyards was not obtained. However this source of eggs could account for a substantial proportion of total egg consumption of the families who have this backyard production. It is possible that the housewives with a rural background would be more inclined to raise a few chickens in their backyards and this could lead to real differences in per capita consumptions between these two groups, but such differences could not be identified by investigating egg purchases alone.

Regional Location

The two parts which compose the main sample were taken at random from the families living in each of the two regional locations of the town. The sample taken in the center of the town and the sample taken in the suburbs both consist of 50 households each.

The families living in the center of the town purchased 0.124 dozen of eggs per week per capita and the families living in the suburb purchased 0.111 dozen of eggs per week per capita. The difference between the average purchases of the two groups is very small. The

F value in Table 4 is not significant at the 0.05 level indicating that the mean per capita purchases of the two groups were not significantly different.

Table 4. Analysis of Variance for Per Capita Purchases of Regional Location Groups.

Source of Variation	Degrees of Freedom	S.S.	M.S.	F value
.Between groups	1	0.00422	0.00422	0.133
Within groups	98	3.11735	0.03181	
Total	99	3.12157		

The marketing facilities are better developed in the downtown section than in the suburbs. But this difference which is specifically a difference in access to stores, did not lead to higher purchasing levels of eggs.

Backyard Production of Eggs

The main sample was partitioned into two parts for purposes of investigating differences in egg purchases between the groups with and without backyard production of eggs. The first part contained 55 households with backyard production of eggs and the second part consisted of 45 households which did not have backyard production of eggs.

The group of households without backyard production of eggs purchased an average of 0.176 dozen eggs per week per capita whereas the weekly per capita purchases of eggs of the households with backyard production of eggs was 0.072 dozen. The F value in Table 5 is significant at the 0.01 level indicating that the differences in the

mean per capita purchases between the two groups is highly significant.

Table 5. Analysis of Variance for Per Capita Purchases of Eggs of Groups With and Without Backyard Production of Eggs.

Source of Variation	Degrees of Freedom	S.S.	M.S.	F value
Between groups	1	.26631	0.2631	9.140**
Within groups	98	2.85526	0.0291	
Total	99	3.12157		

The presence of home production of eggs is an important factor reducing the quantity of eggs purchased. Eggs produced at home are nearly perfect substitutes for eggs sold in the market and this in part accounts for the lower purchases of the families with backyard production.

Summary

The social factors which were most important in terms of affecting per capita egg purchases and which resulted in significant differences in weekly per capita purchases of eggs were ethnic origin and backyard production of eggs. The factors which did not result in significant differences in weekly per capita purchases of eggs were racial classification, living background, and regional location.

Several factors may have accounted for the non identification of differences in egg purchases. The difficulty of precise racial classification due to intermarriage over time, social mingling and cultural interchange among the racial groups are some of the factors which in part may have been responsible for the non significant differences. Other characteristics of farm background people such as

raising their own chickens, may have accounted for the lack of differences in purchases of eggs between farm and city background groups. Existing differences in marketing facilities in the center of the town as compared to the suburbs did not lead to a significantly higher purchasing level of eggs of the families living in the center of town.

In the future changes in the number of families keeping backyard production could substantially influence the quantities of eggs purchased in the market, however, it is difficult to precisely identify the direction of the trend for the number of families keeping backyard production of eggs. This seems to be a social characteristic which could be strongly influenced by market and production policies such as improvement of quality and increasing the supply of market eggs.

One of the striking features of the results is the low average per capita purchasing level of eggs. This suggest that there are possible opportunities of increasing per capita egg purchases through educational programs.

CHAPTER VI

DEMAND FOR PURCHASED EGGS

The functional relationship between weekly per capita egg

purchases and selected economic variables and measurable family

characteristics were estimated for the group of households with backyard

production of eggs and the group of households without backyard egg

production separately. The reason for partitioning the main sample of

100 native origin families into the groups with and without

backyard production of eggs is that the average per capita weekly

purchases differed between the two groups and could not justifiably

be considered as one homogeneous group. Linear and curvilinear

relationships were estimated for each of these groups. Estimates of

price and income elasticities were derived from both the linear and

curvilinear functions for each of the two groups.

Group Without Backyard Production

The group of households which did not keep chickens for backyard

production of eggs consists of 45 households of the main sample. All

of these families are of native origin.

The weekly per capita purchase of eggs was expressed as a function

of the price paid for eggs in cruzeiros per dozen, per capita disposable

income in thousand cruzeiros per month, number of years of formal

education of the housewife and the number of children of eleven years or

under. For this group of households, estimates of purchases are also

estimates of consumption. Least squares techniques were used in fitting the multiple regression equation. Both linear and curvilinear relationships were investigated. The curvilinear relationship was estimated in the form of a logarithmic equation. The estimates of regression coefficients, standard errors of regression coefficients, and coefficients of determination for the linear and curvilinear equations are presented in Table 6.

In both the linear and curvilinear equations the signs of the coefficients for price and income are consistent with economic theory. The negative sign of the price coefficient indicates inverse relationship, and the positive sign of the income coefficient indicates a direct relationship. In both equations the positive sign of the coefficient for education of the housewife is also consistent with the conceptual construct and indicates a direct relationship between education level and purchasing level. The sign of the coefficient for number of children is negative in the linear equation indicating an inverse relationship which is consistent with the conceptual construct. However in the curvilinear equation it is positive, and consequently, inconsistent with the conceptual construct.

In the linear equation and in the curvilinear equation the regression coefficients for price and education were significant at the 0.01 level. The coefficients for income and number of children were significant at the 0.10 level in the linear equation, however they were not significant in the curvilinear equation. In the linear equation all four variables are important in terms of explaining significant amounts of variation in per capita egg purchases, while in the curvilinear equation only

Table 6. Estimates of Partial Regression Coefficients, Standard Errors of Regression Coefficients and Coefficients of Determination of the Linear and Curvilinear Equations for Households Without Backyard Production of Eggs.

Equations	$\hat{Y}$ Inter-cept	Independent Variables[a]				R^2 Value
		X_1	X_2	X_3	X_4	
Linear	0.55618	-0.00699***	0.01055*	0.01824***	-0.01141*	0.702***
		(0.00126)	(0.00801)	(0.00633)	(0.00780)	
Curvilinear	7.04864	-4.81734***	0.06720	0.36892***	0.05690	0.542***
		(1.72359)	(0.38517)	(0.11930)	(0.11688)	

[a] The independent variables included in the linear equation are X_1 = price of eggs expressed in cruzeiros per dozen, X_2 = per capita disposable income expressed in thousand cruzeiros per month, X_3 = number of years of formal education of the housewife, and X_4 = number of children of eleven years of age and less. In the curvilinear equation the variables are the same, expressed in logarithms. One tailed tests of significance were used to test hypotheses about the individual regression coefficients. A single asterisk, (*), indicates a significant regression coefficient or R^2 at the 0.10 level, a double asterisk indicates significance at the 0.05 level and a triple asterisk indicates significance at the 0.01 level.

price and education level are important variables.

The coefficients of determination of the linear and curvilinear equations indicate that the linear relationship is the one which best fits the data on per capita purchases. The curvilinear equation explains approximately 54 per cent of the total variation in per capita purchases of eggs while the linear equation explains approximately 70 per cent. The two R^2 were significant at the 0.01 level.

The regression coefficient for price in the linear equation means that a change of 10 cruzeiros in the prices of eggs is expected to result in an inverse change of approximately 0.07 dozen of eggs purchased per week per capita. In the curvilinear equation it indicates that a change of 1 per cent in price is expected to result in an inverse change of approximately 4.8 per cent in purchases. The purchasing level of the group of households which do not have backyard production of eggs is very responsive to changes in the price of eggs.

The coefficient for the income variable in the linear equation means that a change of one thousand cruzeiros in per capita monthly disposable income is expected to result in a change of approximately 0.01 dozen of eggs purchased per week per capita. From the curvilinear equation, however, one cannot feel certain that this coefficient is different from zero. It must be emphasized that the average per capita disposable income of this group of households is very low[1] as is true for the whole population of Viçosa. Also since cross-sectional data are being used the differences in income levels among people are differences in income levels in a given time period rather than changes in the income levels of

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[1] The average per capita monthly disposable income for this group was Cr$ 2,107.30, roughly equivalent to U.S. $126 per year per capita.

people over time. It is assumed that the effects on per capita egg
purchases of changes in per capita income over time would be similar
to the effects of the differences in the per capita income levels
observed in the sample. Given that this assumption is valid, then the
estimates of the income coefficients are really indicators of the
responsiveness of purchasing levels to changes in income levels when
all other factors which might affect egg purchases are assumed constant.
For this group of households decreases in income levels would tend to
result in decreases in per capita purchases of eggs.

The coefficient for the education level of the housewife in the
linear equation means that a change of one year in formal education
is expected to result in a direct change of approximately 0.02 dozen
in per capita weekly purchases of eggs. For the curvilinear relationship
a change of 10 per cent in the education level is expected to result
in a direct change of approximately 3.7 per cent in purchases. The
average level of formal education of the housewives in this group is
3.02 years which is less than a primary school course. Increasing levels
of formal education of the housewives are expected to result in
substantial increases in purchasing levels in this group. Increased
education might also lead to more price and quality discrimination,
which could have indirect effects on the response of purchasing levels
to changes in education levels of the housewives of this group. It
is possible that the education level variable to some degree reflects
the effects of income levels. However, in this study the linear
association between income and education is not very high ($r = 0.50$).

The coefficient for number of children of eleven years of age or

less in the linear equation means that a change of one child of 11 years or under in the household composition is expected to result in an inverse change of approximately 0.01 dozen of eggs purchased per week per capita. For this group of households the number of children of eleven years or less as a proportion of the size of the household is very low, approximately 2:5. Also, the infant mortality is very high in the locality with approximately 50 per cent of the mortality rate being accounted for by children who are five years or less. Improved and expanded medical care is helping to reduce the rate of infant mortality. Changes in the family structure due to a higher proportion of children per family is expected to result in a decrease in per capita purchasing level but may result in an overall increase in total purchasing per household and total quantities purchased in the market.

The variable corresponding to household size which would complete the equation initially included in the theoretical model was not included in this final equation. The correlation between family size and number of children was relatively high ($r = 0.72$). Also the regression coefficient for family size was not significantly different from zero at the 0.10 level and the estimate of the coefficient in the linear equation was less than its standard error.[1]

Group of Households With Backyard Production

The group of households raising chickens for own consumption consists of the remaining 55 households of the main sample. All of these families are also of the native origin.

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[1] See Appendix D. Estimates of Alternative Equations.

The weekly per capita purchasing level of eggs was expressed as a function of the price of eggs in cruzeiros per dozen, per capita monthly disposable income in thousand cruzeiros per month, number of years of formal education of the housewives and number of children of eleven years of age or under. The estimates of regression coefficients, standard errors of regression coefficients, and coefficients of determination for the linear and curvilinear equations are presented in Table 7.

The signs of the estimated coefficients for the price and income variables are consistent with economic theory and indicate an inverse relationship between price and quantity purchased and a direct relationship between income and quantity purchased. In the linear model both of these coefficients were significant at the .01 level whereas for the curvilinear relationship the coefficient of the income variable was non-significant and the coefficient of price was significant at the .10 level. The coefficients of the education and number of children per family variables were not significant in either the linear or curvilinear equation. Furthermore, in the linear equation the coefficient of the education level of the housewife and in both the linear and curvilinear models the coefficients of the number of children per family were not consistent with the conceptual construct.

The coefficients of determinations for both equations are low indicating that a rather small proportion of the total variability in egg purchases is explained by these equations. The linear equation explains approximately 28 per cent of the total variation in purchases while the curvilinear explains only 10 per cent. Although small, the R^2 value for the linear equation was significant at the 0.01 level,

Table 7. Estimates of Partial Regression Coefficients, Standard Errors of Regression Coefficients and Coefficients of Determination of the Linear and Curvilinear Equations for Households with Backyard Production of Eggs.

Equations	$\hat{Y}$ Inter-Cept	Independent Variables[a]				R^2 Value
		X_1	X_2	X_3	X_4	
Linear	0.20955	-0.00345***	0.03184***	-0.002.5	0.00390	0.278***
		(0.00125)	(0.01075)	(0.00530)	(0.00792)	
Curvilinear	2.00512	-3.39266*	0.37513	0.15901	0.04426	
		(1.76901)	(0.6409)	(1.17716)	(0.33747)	0.104

[a] The independent variables included in the linear equation are X_1 = price of eggs expressed in cruzeiros per dozen, X_2 = per capita disposable income expressed in thousand cruzeiros per month, X_3 = number of years of formal education of the housewife, and X_4 = number of children of eleven years of age or less. In the curvilinear equation the variables are the same, expressed in logarithms. One tailed tests of significance were used to test hypotheses about the individual regression coefficients. A single asterisk, (*), indicates a significant regression coefficient or R^2 at the 0.10 level, a double asterisk indicates significance at the 0.05 level and a triple asterisk indicates significance at the 0.01 level.

however, the R^2 value for the curvilinear equation was not significant. These results suggest that the linear equation fits the data better than does the curvilinear equation.

The coefficient of the price variable in the linear equation implies that a change of 10 cruzeiros in the price of eggs is expected to result in an inverse change of approximately 0.03 dozen of eggs purchased per capita per week. Similarly, the curvilinear relationship suggests that a one per cent change in price is expected to result in an inverse change of approximately 3.4 per cent in per capita purchases. Both estimates imply that quantities of eggs purchased are fairly responsive to price changes.

Based on the income coefficient of the linear equation, a change of 1000 cruzeiros in the per capita income is expected to result in a direct change of approximately 0.03 dozen of eggs purchased per capita per week. As mentioned previously the average per capita income levels are extremely low. Assuming the differences in per capita incomes at this given point in time and equivalent changes in income levels over time similarly affect egg purchases, decreasing income levels are expected to yield reduction in the quantities of eggs purchased.

Estimates of Elasticities

Price and income elasticities of demand for purchased eggs were estimated for the group of households without backyard production and for the group with backyard production. The results of these estimates from both the linear and curvilinear equations are presented in Table 8.

The estimated elasticities should be interpreted with caution.

Table 8. Estimates of Price and Income Elasticities of Demand for Purchased Eggs for Households Without Backyard Production of Eggs and Households With Backyard Production of Eggs, Estimated from Linear and Curvilinear Equations.

Type of Demand Elasticity	Group of Households[a]	Source of Estimation	Elasticity Coefficient
Price	Group A	Linear equation	-2.451
		Curvilinear equation	-4.817
	Group B	Linear equation	-2.925
		Curvilinear equation	-3.393
Income	Group A	Linear equation	0.121
		Curvilinear equation	0.067[b]
	Group B	Linear equation	0.925
		Curvilinear equation	0.375[b]

[a] Group "A" is group without backyard production of eggs. Group "B" is group with backyard production of eggs.
[b] Based on coefficients that were not significant at the 0.10 level.

Price differences may in part reflect differences in the size of eggs, quality, type of delivery and locational discrimination due in part to imperfect knowledge. However, these differences were not identified, due to lack of specific data. Differences in per capita income levels are differences in per capita income levels among families at a given point of time. However, it is assumed that these families will behave similarly when changes in per capita income levels occur over time. Under this assumption, the estimates are really elasticity coefficients of income.

The estimates derived from the two linear equations seem to be the better indicators of the true elasticity values. The regression

coefficients for price and income were significantly different from zero in both linear equations while only the coefficient for price was significant in the two curvilinear equations. In addition, the linear function has a relatively better goodness of fit than does the curvilinear function for the two groups of households.

The discussion of the elasticities will involve only the estimates derived from the linear functions of the groups without and with backyard production. The estimations are made at the mean values of per capita purchasing level and mean values of the independent variable. The other three variables are assumed to be constant.

The price elasticity of demand for purchased eggs in the group without backyard production is relatively high, $\varepsilon = -2.451$. A change of one per cent in the price of eggs is expected to result in an inverse change of approximately 2.5 per cent in the quantity purchased. For the group with backyard production its value is even higher. The price elasticity for this group is -2.923. A change of one per cent in price is expected to result in an inverse change of approximately 2.9 per cent in quantities purchased. This type of demand is more elastic for the group with backyard production than for the group without backyard production.

Income elasticity of demand for purchased eggs for the group without backyard production is relatively low, $\varepsilon = 0.121$. A 10 per cent change in income level is expected to result in a direct change of approximately 1.2 per cent in purchases of eggs. For the group with backyard production the elasticity is higher ($\varepsilon = 0.925$). A ten per cent change in income is expected to result in a direct change

of 9.25 per cent in purchases. The demand for purchased eggs is relatively inelastic with respect to income for the groups with and without backyard production.

Summary

The linear function is the one which best fits the data on per capita purchases of eggs for the two groups of households. For both groups a linear function explains larger amounts of the total variation in egg purchases than does a curvilinear function. The signs of the coefficients of all important variables are consistent with economic theory and/or with the conceptual construct used in this study. For the group of households without backyard production, the important variables explaining the variation in per capita purchases of eggs are prices paid for eggs, per capita monthly disposable income, education level of the housewife, and number of children of eleven years or less. Prices paid for eggs and per capita monthly disposable income are the important variables for the group with backyard production. Eggs are a price elastic and an income inelastic commodity for the groups with backyard production and without backyard production. The response to price changes is greater for the group with backyard production than for the group without backyard production, because eggs produced at home are nearly perfect substitution for eggs sold in the market. Also, the response to income changes is greater for the group with backyard production than for the group without backyard production.

CHAPTER VII

SUMMARY, IMPLICATIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

Summary

The general objective of this study is to identify the primary factors affecting the demand for purchased eggs in Vicosa, Minas Cerais, Brazil, and to determine how these factors affect the quantity of eggs purchased.

The basic sample for this research consisted of 100 households divided into two sub-samples of fifty households each. The first sub-sample was taken in the center of the town and the second was taken in the suburbs. One additional sample was taken from a minority group. This sample is composed of 15 households of Mideastern origin.

The one-way classification analysis of variance, and a weighted analyses of variance approximation were used to test difference in average per capita purchases between groups of social characteristics. The social characteristics investigated included racial groups, ethnic origins, living backgrounds, regional locations, and backyard production. Least squares multiple regression techniques were used to estimate a demand equation for purchased eggs. The functional relationship expressed the quantity of purchased eggs as a function of the price of eggs, disposable income, education level of the housewife, and the number of children that were 11 years or less. Both linear and

curvilinear relationships were estimated for families with backyard production and families without backyard production separately. Price and income elasticities of demand were estimated from the linear and curvilinear equations for both of the groups of families.

The social factors which were most important in terms of affecting per capita purchases and which resulted in significant differences in weekly per capita purchases of eggs were ethnic origin and backyard production of eggs.

The important variables explaining the variation in per capita weekly purchases of eggs for the group of households with backyard production are prices paid for eggs, per capita monthly disposable income, level of formal education of the housewife, and number of children of eleven years or less. Price and income were identified as the important variables for the group with backyard production. The signs of the coefficients of all important variables are consistent with economic theory and/or with the conceptual construct. For the two groups of households a linear relationship fitted the data better than did a curvilinear relationship.

Eggs were found to be price elastic and income inelastic for both groups of households. The group without backyard production was more responsive to price and income changes than was the group without backyard production. However, the average per capita purchases of the group without backyard production was over twice as much as for the group with backyard production.

Implications

The general low level of egg purchases indicates that opportunities for increasing per capita egg purchases in Vicosa exist. It would appear that an educational program aimed at familiarizing the housewife with the nutritive value of eggs could help bolster the per capita egg purchases. Grading and standardizing eggs to assure the consumers of quality and packaging eggs might also increase per capita purchases.

The families of Mideastern origin are increasing in number in the Vicosa market and the average per capita egg purchases of this group is higher than the average per capita egg purchases of families of native origin. Currently the Mideastern origin group is a small proportion of the population. However, if the number of families in this minority group continues to increase as in the recent past it may have a substantial impact on the average per capita purchasing level of the population and the total volume of eggs purchased in the Vicosa market.

The per capita egg purchases of families without backyard production was over twice that of the families with backyard production. Large changes in the proportion of families with backyard production could also result in a considerable change in the average per capita egg purchases and the total volume of eggs purchased in the market. Since very little investment is required to start and continue backyard production, proportion of families may change in a very short time period. The number of families with backyard production depends in part upon market conditions such as the quality, prices, and supply of eggs.

The differences in per capita egg purchases between families with a farm background and families with a city background were not significantly different and the continuous flow of rural people into the town of Vicosa is not expected to have much of an impact on future levels of per capita egg purchases. However, the increase in numbers of people due to the immigration of rural people will tend to increase the total quantity of eggs purchased. Changes in social characteristics such as racial classification, and regional location of households are not expected to affect average per capita purchases to any large degree.

The purchasing levels of eggs for the group of households without backyard production and the group with backyard production are very responsive to changes in prices of eggs. A decrease in the price of eggs is expected to result in an increase in the per capita quantity of eggs purchased. Since the price elasticity of demand is greater than unity, the total money outlay for eggs will also increase if the price of eggs decreases.

Changes in average per capita income levels are expected to have a large effect on the average per capita purchases of both groups of households. However, the purchasing level of the group with backyard production is expected to be more responsive to income changes than is the group without backyard production. Decreasing levels of per capita real income are expected to reduce per capita purchasing levels of eggs in a less than proportional rate. Lower levels of real per capita income could prevail in the near future, due to an expected continuation of the inflationary process. How this inflation will affect egg prices relative to consumer incomes in Vicosa cannot be predicted on the basis

of the data and model employed in this study. Consequently, the full effect of the dynamics of inflation on egg purchases and egg consumption will have meaning for the predictive worth of the model but not in a readily determined manner.

Rising education levels are expected to result in relatively large increases in the per capita purchases of eggs. However, the increases in education levels are only expected to have major effects on the purchases of the group without backyard production.

A larger proportion of children in the family composition is expected to result in a decrease in the per capita purchases of eggs, but in an increase in the per family and total purchases of eggs for the group of households without backyard production. The egg purchases of the group with backyard production are not expected to be affected by changes in the proportion of children in the family composition.

Suggestions for Further Research

The present study is the first to be conducted in the field of egg marketing in Vicosa. It has only touched the surface of several of problems. Opportunities exist for new and more informative research in this field. Specifically, four projects are suggested here:

(1) A study similar to this one but the variables, especially social characteristics need to be more precisely classified so that their separate effects may be more readily isolated.

(2) Large differences in prices of eggs exist in the Vicosa market. These differences may be reflecting differences in quality and possibly loyalty to producers. A study which identifies the major

factors which contribute to these price differences is needed. Also, there should be an investigation of the reasons why price information does not spread throughout the market area.

(3) Some further research needs to be done with the group with backyard production to determine major factors which cause these people to have backyard production of eggs, quantities produced, and factors which cause them to liquidate these flocks.

(4) Practically no information is available on the supply response of eggs and other agricultural commodities. More research needs to be done in the area of estimating supply equations and identifying the major factors which cause quantities supplied to change. This type of work needs to be done not only for eggs but other agricultural commodities.

Finally, the type of information provided by this study is not available for other markets in the country and for other commodities. The procedure for estimating the demand functions .   in this study could easily be applied to other commodities and extended to other markets of the country. In future work careful consideration should be given to the differences between actual consumption and purchasing levels since this seems to be one of the most important features of underdeveloped markets for similar commodities.

BIBLIOGRAPHY

Anderson, R.L. and T.A. Bancroft, Statistical Theory in Research, (McGraw Hill Book Company, Inc., N.Y., July 1952).

Aplin, R.D., Consumer Demand for High-Quality Eggs, Cornell University A.E.S. Bulletin 834, Ithaca, N.Y., August 1952.

Baker, L. and R.A.S. Goldman, Habits, Preferences and Demands of Des Moines Eggs Consumers, Poultry Science, Vol. 38, No. 4, pp 323-338.

Bilkey, W.J., The Basic Relationships in Consumer Expenditure Behavior, Harvard Studies in Marketing Farm Products Nol 4-H, Cambridge, Mass., October 1951.

Brady, D.S. and H.A. Barber, The Pattern of Food Expenditures, Review of Economics and Statistics, 30: 198-206, August 1948.

Brandt, S.A., Aquisicao e Consumo de Hortalicas e Frutas em Vicosa, M.C., 1958. Revista Seiva, Brazil, Vol. 53, March-April 1958.

Burk, M.C., Measures and Procedures for Analysis of U.S. Food Consumption U.S.D.A., Agricultural Handbook No. 206, Wash. D.C., June 1961.

Bylund, H.B. and R.L. Baker, A Community Program to Increase Egg Consumption, The Pennsylvania State University Progress Report No. 145, University Park, Penn., March 1956.

Foote, R.J., Analytical Tools for Studying Demand and Price Structures, U.S.D.A. Agricultural Handbook No. 146, Wash. D.C., August 1958.

Fox, K.A., The Analysis of Demand for Farm Products, U.S.D.A. Technical Bulletin No. 1081, Wash. D.C., September 1953.

Friedman, M., A Theory of the Consumption Function, (Princeton University Press, Princeton, N.J., 1957).

Gartner, J., L. Kolmer and E.B. Jones, Consumer Decision Making, Iowa State University Consumer Marketing Bulletin No. I., Ames, Iowa, November 1960.

Cerra, M.J., The Demand, Supply, and Price Structure for Eggs, U.S.D.A. Technical Bulletin No. 1204, November 1959.

Jasper, A.W., Some Highlights from Consumer Egg Studies, U.S.D.A. Agricultural Information Bulletin No. 110, Wash. D.C. June 1953.

Kuznetz, C.M., Measurement of Market Demand With Particular Reference to Consumer Demand for Food, Journal of Farm Economics, Vol. 35.

Leftwich, R.H., The Price System and Resource Allocation, (Holt, Rinehart and Winston, New York, 1960).

Nordhauser, F., A Statistical Estimate of the Short-Run Price Elasticity of Demand for Fryers, Unpublished M.S. Thesis, Purdue University, 1959.

Nordin, J.A., G.G. Judge and O. Wahby, Application of Econometric Procedures to the Demands for Agricultural Products, Iowa State College Research Bulletin No. 410, Ames, Iowa, July 1954.

Quackenbush, G.G., Some Demand and Price Characteristics for Eggs – M.S. U. Consumer Panel, Quarterly Bulletin of the Michigan Agricultural Experiment Station, Vol. 42, No. 4, May 1960.

Rockwell, Jr., G.R., Income and Household Size – Their Effects on Food Consumption, U.S.D.A. Marketing Research Report No. 340, Washington, D.C., June 1959.

Saunders, R.F., Differences Between High and Low Level Users of Eggs, Maine Agricultural Experiment Station, Miscellaneous Publication No. 646, Orono, Maine, March 1961.

Schultz, H., Theory and Measurement of Demand, (Chicago, University of Chicago Press, 1938).

Scitovsky, T., Welfare and Competition, (Richard D. Irwin, Inc., Chicago, 1951).

Sherr, H., The Household Market for Poultry Products in the United States, U.S.D.A. A.M.S. – 340 (9), Washington D.C., February 1961.

Slocum, W.L. and H.S. Swanson, Egg Consumption Habits, Purchasing Patterns and Preferences of Seattle Consumers, State College of Washington, Bulletin 566, Seattle, Washington, April 1954.

Snedecor, G.W. and W.G. Cochran, Statistical Methods, (The Iowa State College Press, Ames, Iowa, Fifth Edition, June 1956).

Steel, R.G.D. and J.H. Torrie, Principles and Procedures of Statistics, (McGraw-Hill Book Company, New York, 1960).

Stigler, G.J., The Theory of Price, (Rev. Ed.; The MacMillan Company, New York, 1952).

Straw, K.W., Some Preliminary Results of a Survey of Income and Consumption Patterns in a Sample of Households in Barbados, Social and Economic Statistics, No. 4, 5-40, August 1953.

Tax, S., _Changing Consumption in Indian Guatemala_, (in Consumer Behavior, Research in Consumer Reactions, Ed. by Lincoln H. Clark, Harper & Brothers Pub., New York, 1958).

Taylor, F.R., A.L. Owens and A.W. Jasper, _Consumer Egg Buying, Consumption, and Preference Patterns_, University of Rhode Island Bulletin 321, Kingston, Rhode Island, May 1954.

APPENDIX A

APPENDIX A

SAMPLING PROCEDURE

The basic sample for this research consisted of one hundred households divided into two sub-samples of fifty households each. The first sub-sample consisted of families living in the center of the town and the second sub-sample consisted of families living in the suburban areas. In addition to the basic sample, one additional sample was taken from a minority group. This sample is composed of 15 households whose familes had a Middle eastern origin. (Table A 1)

Table A 1. Population and Samples, Vicosa, M.G., Brazil, 1961.

Sections and groups	Population		Sample	
	Number of people	Number of households	Number of people	Number of households
Center	6,781	1,043	325	50
Suburbs	4,691	754	311	50
Total	11,472	1,797	636	100
Middle easterners	163	26	94	15

The specific questionnaire was pretested with ten different families situated in the several categories, and after a correction of the imperfections and points of misunderstanding, a final questionnaire was developed. The translation of this questionnaire is presented below:

Institute of Rural Economics
Rural University of the State of Minas Gerais
Research on Purchasing Level of Eggs

CONFIDENTIAL

Questionnaire to be answered by the housewife

1. Name: Center _____

2. Street: Number: Suburbs _____

3. How many eggs did you buy last week?   Dozens

4. How many eggs do you buy each time?   Dozens

5. What is the frequency you buy eggs?

    ( ) two times a week

    ( ) once a week

    ( ) two times a month

    ( ) once a month

    ( ) others (explain how) _____

    ( ) don't buy eggs

6. How much did you pay for the last amount of eggs you bought?

    Cr$ _____ per dozen

7. Do you have a backyard production of eggs for family use?

    Yes _____ No _____

8. How many persons have meals at your home?

    ( ) $<$ 11 years: _____

    ( ) $>$ 11 years: _____

    ( )   Total: _____

9. What is the educational level of the homemaker?

    ( ) none

    ( ) primary school (until ____ year)

( ) grammar school (until ____ year)

( ) high school (until ____ year)

( ) college (until ____ year)

( ) others (explain) _____

10. What is the racial type of the homemaker?

( ) white

( ) mulatto

( ) negro

( ) others (explain) _____

11. Where the homemaker lived her early years?

( ) farm

( ) town or city

12. Besides the head, are there some other people who use to help the family with money? Yes ____ No ____

Note: If the answer is "yes", fill question 14

13. How much do they earn?

(a) Spouse   Cr$ _____ a _____

(b) Son   Cr$ _____ a _____

(c) Daughter   Cr$ _____ a _____

(d) Others   Cr$ _____ a _____

14. How much does the head earn? Cr$ _____ a _____

15. What is the ancestry of the homemaker?

( ) Middle easterner

( ) Other (expain) _____

16. Do you raise chickens in the backyard? Yes ____ No ____

17. In which days of the week do you buy larger quantities?

_____

18. Why do you buy larger quantities in those days?

_____

19. How many eggs do you buy in those days? _____ dozens

20. In which months of the year do you buy larger quantities?

_____

21. Why do you buy larger quantities in those months?

_____

22. How many eggs do you buy in those months? _____ dozens

23. Where do you buy eggs?

    ( ) at the door

    ( ) at the little stores

    ( ) at the large stores

    ( ) at the bars

    ( ) do not buy

    ( ) others (specify) _____

24. What type of eggs do you buy?

    ( ) "Peasant" eggs

    ( ) Commercial eggs

    ( ) Do not buy

25. Why do you buy eggs of that type? _____

_____

26. Why do you raise chickens in the backyard? _____

_____

27. What is the type of eggs you like best?

 ( ) "Peasant" eggs

 ( ) Commercial eggs

 ( ) No preference

 ( ) Others (specify) _____

28. Why do you prefer eggs of this type? _____

_____

29. What color shell do you like best?

 ( ) White

 ( ) Brown

 ( ) No preference

30. Why do you prefer eggs of that color? _____

_____

31. Do you think that eggs with a brown shell have darker yolks?

 ( ) Yes

 ( ) No

 ( ) Do not know

 ( ) Never thought about it

32. What color do you like best for the yolk?

 ( ) Dark yellow

 ( ) Light yellow

 ( ) No preference

33. Why do you prefer yolks of that color? _____

_____

34. Why don't you buy larger quantities of eggs? _____

Note: Only the first sixteen questions of this questionnaire were used in the present study. The other eighteen questions were used in a study on preferences and habits of the consumers.

The whole survey was started in the beginning of July, 1941, and it required about 20 days to be completed. Two college students were used in the collection of the data. The best period for visitation was selected after an observation of the routines and schedules of the housewives. After 2:00 p.m. most housewives has nearly completed their housework for the day and it was assumed that they would be in a more favorable mood for answering the questionnaire.

Revisitations were made to clarify the responses to solve questions and to obtain information for questions which for one reason or another were not answered during the previous visitation. The question regarding family income, undoubtedly, caused the most difficulty. Frequently the husband or head of the household was the only person who could answer this and he was not present when the interview was being conducted. Moreover, the people were not accustomed to being asked a question of this nature and at first they were reluctant to respond to this question. However, after additional conversation the interviewers were able to persuade the people to respond.

The problem of determining the "race" of the people was left to the discretion of the interviewers. Race classification really involves as uniform a criteria as possible on the basis of judgment. Giving the interviewer this responsibility, avoided in the case of doubt, having to ask a socially-accepted "white " person the ridiculous and very impolite question if he or she were really of that type. Again circumstances of wealth or social status tend to influence the color classification of people, even for government census purposes. That is, a negro is no longer a negro if he is educated or wealthy.

Housewives were the respondents in 99 per cent of the cases for all questions except the above mentioned income level question. In the upper and average income brackets many of the housewives did not have any idea about their husband's income earnings. In the lower income bracket, however, a good many of them were able to give answers to this question.

In only one case a household was found to be managed and taken care of by a male. But even in this exceptional circumstance, the reception was good and fairly good answers were obtained for the questionnaire, because this man could speak authoritatively on his subject.

Generally a fluent conversation was stimulated between the interviewers and the housewives. This proved to be a good policy, as from it we were able to learn interesting facts about the people who were being interviewed. Also it helped to clear doubts people might have when receiving such exceptional vistors.

APPENDIX B

APPENDIX B

CHARACTERISTICS OF THE HOUSEHOLDS INCLUDED IN THE STUDY

The average values of education level of the housewife, per capita monthly disposable income and household size are presented in Table B 1.

Table B 1.   Characteristics of the Households Included in the Study.

Characteristic	Per Capita Monthly Disposable Income (Cr$1,000 Per Month)	Level of Formal Education of the Housewife (years)	Household Size(Number of Persons)
White	2.740	4.54	6.59
Mulatto	0.930	2.56	6.44
Negro	1.233	0.73	5.20
Mideastern	8.335	5.53	6.26
Native	2.262	3.65	6.36
City background	2.431	3.10	6.25
Farm background	2.099	4.06	6.50
Downtowners	2.907	4.92	6.50
Suburbanites	1.558	2.38	6.22
Without backyard production	2.502	3.02	5.88
With backyard production	2.091	4.16	6.74

APPENDIX C

APPENDIX C

Table C 1. Bartlett's Test of Homogeneity of Variances.

Groups	d.f.	s^2	$\log s^2$	$(n-1)\log s^2$	$1/(n-1)$
Whites	68	0.0380	-2.57978	-97.42504	0.0147
Mulattoes	15	0.0200	-2.30103	-26.51545	0.0667
Negroes	14	0.0090	-3.95424	-29.35936	0.0714
Total	97	--	--	-151.38985	0.1528
Pooling	--	0.03103	-2.49178	-147.70266	--

$$X^2 = 2.3026 \left[-147.70266 - (-151.38985) \right] = 8.49012$$

$$C = 1 + \frac{1}{3(2)} \left[0.1528 - \frac{1}{97} \right] = 1.0236$$

$$\text{Corrected } X^2 = \frac{8.49012}{1.0236} = 8.294*$$

APPENDIX D

APPENDIX D

Table D 1. Snedecor's Test for Weighted Mean Squares.

Sample Size (n_i)	Mean $\bar{x}_i$	Mean Square s_i^2	Weight $w_i = \frac{1}{s_i^2}$	Deviations $\bar{x}_i - \bar{x}_w$	$(5)^2$	$\frac{(4)}{\Sigma(4)}$	$\left[1-(7)\right]^2$	$\frac{(8)}{(1)-1}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
60	0.134	0.038	1,815.789	0.0402	0.001616	0.424006	0.331769	0.004879
16	0.074	0.020	800.00	-0.0198	0.000392	0.186808	0.661281	0.041330
15	0.065	0.009	1,666.667	-0.0288	0.000829	0.389184	0.151464	0.010819

$a = 3$ $\qquad \bar{x}_w = \frac{\Sigma(2)(4)}{\Sigma(4)} = 0.0938$ $\qquad$ Weighted S.S. $= \Sigma(4)(6) = 4.629582$

$F' = 2.282$ $\qquad$ with $(f_1 = 2)$ and $(f_2 = 46)$ d.f.

APPENDIX E

Table E 1. Estimates of Partial Regression Coefficients, Standard Errors of Regression Coefficients, and Coefficients of Determination of Alternative Equations.

Equation	Ŷ inter-cept	Independent Variables[a]					R² Value
		X_1	X_2	X_3	X_4	X_5	
All Households (n = 100)							
Linear	0.3?630	-0.00549*** (0.00102)	0.02565*** (0.00767)	C.00295 (0.00483)	0.00070 (0.00642)	0.00163 (0.00835)	0.402***
Households With Backyard Production (n = 45)							
Linear	0.55627	-0.00705*** (0.00134)	0.01074 (0.00819)	0.01781** (0.00701)	0.00125 (0.00825)	0.01252 (0.01073)	0.702***
Linear	0.59280	-0.00734*** (0.00134)		0.22000*** (0.00629)	-0.00032 (0.00824	-0.01226 (0.01083)	0.669***
Curvilinear	7.28834	-4.79234*** (1.77648)		0.38148*** (0.11318)	-0.93980 (0.90400)	0.06066 (0.14139)	0.542***
Linear	0.59301	-0.00736*** (0.00124)		0.02131*** (0.00574)		-0.01255 (0.00782)	0.669***
Curvilinear	7.29843	-4.83868*** (1.69880)		0.37787*** (0.10642)		0.05187 (0.11193)	0.541***
Households With Backyard Production (n = 55)							
Linear	0.19318	-0.00373*** (0.00128)	0.00332*** (0.00108)	-0.00423 (0.00568)	0.00780 (0.00678)	-0.00229 (0.00999)	0.293***
Curvilinear	1.85082	-3.94146* (1.97718)	0.40940 (0.58429)	0.18204 (0.14433)	1.23273 (1.11677)	-0.13460 (0.14910)	

[a] The independent variables are X_1 = price of eggs in cruzeiros per dozen; X_2 = per capita disposable income in thousand cruzeiros per month; X_3 = years of formal education of the housewife; X_4 = size of household in number of persons; X_5 = number of children of eleven years of age or less per household. One tailed tests of significance were used to test hypothesis about the regression coefficients. A single asterisk (*) means significant at the 0.10 level; a double asterisk means significant at the 0.05 level, and a triple asterisk means significant at the 0.01 level.

APPENDIX F

APPENDIX F

Table F 1. Single Correlation Coefficients of the Linear Function for Households Without Backyard Production.

Variables[a]	X_1	X_2	X_3	X_4	X_5
X_1	1.000	-0.411	-0.400	0.245	0.158
X_2		1.000	0.523	-0.053	-0.039
X_3			1.000	0.314	0.198
X_4				1.000	0.721
X_5					1.000

[a] The independent variables are: X_1 = price of eggs in cruzeiros per dozen; X_2 = per capita monthly disposable income in thousand cruzeiros; X_3 = years of formal education of the housewife; X_4 = size of household in number of persons; X_5 = number of children of eleven years of age or less per household. ($n = 45$)