CONSUMER PATRONAGE BEHAVIOUR: AN ANALYSIS OF AN URBAN GROCERY SYSTEM

by

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ABSTRACT

Most marketers and retailers agree that the location of a particular retail outlet may be instrumental in that outlet's sales and profits. One of the proposed solutions to this problem of retail store location is Huff's gravity model.

Using Huff's gravity model as a structural guide, the major purpose of this thesis is to analyse consumer patronage behaviour within an urban grocery system so as to assist the retail grocery store location analyst.
The analysis centers around those consumer patronage behaviour variables suggested by the author as being important in the consumer's decision to patronize a retail grocery outlet.
The analysis will also serve as a guide to retail grocery location analysis in specific and to the possible effects of particular consumer patronage behaviour variables on retail outlets in general.

Relationships are tested using simple and multiple regression analyses and t-test analysis on data collected on all grocery stores in the Lower Mainland Area of Vancouver, British Columbia. Some of the more important findings are:

1) neither the number of customer checkouts nor the number of parking spaces provided can be employed to predict sales per square foot of supermarket selling area.

2) a discount price policy will not yield greater mean sales per square foot of supermarket selling area than a retail price policy.

3) in general a combination of good internal and external appearances yields greater mean sales per square foot of supermarket selling area than a combination of low internal and external appearances.

4) in general the addition of internal and/or external facilities yields greater mean sales per square foot of supermarket selling area than those encountered before the addition or additions of such facilities.

The study also indicates that in some specific cases supermarket size should be accounted for in the analysis.

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M. P. LEW

CHAPTER I

INTRODUCTION

The Importance of Retail Store Location

Poor selection of a retail store site may seriously hamper the most skillful of merchandisers, whereas a good location may greatly offset the deficiencies of mismanagement.

> Good location is essential to success in retailing. The location of a retail store plays a vital part in its success; this is because the location determines to a large degree the sales made and the profits realized. Some retailers, such as those selling variety store merchandise and women's apparel, consider location such an important factor that they prefer to pay a larger-than-usual rental to obtain desirable sites, even if this means they must restrict other expenses. [1]

Thus selection of a retail store site may be instrumental in the outcome of a particular business' operations.

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[1] D.J. Duncan and C.F. Phillips, Retailing Principles and Methods, Homewood, Illinois, Richard D. Irwin, Inc., 1963, page 93.

The Problem of Site Selection

The importance of retail site analysis has been recognized for many years. However, recognition of the problem does not automatically lead to its solution.

Marketers have yet to find the optimal solution to the problem of retail store location and consumer patronage behaviour. Through experience they have found that consumer patronage behaviour is, at best, difficult to measure. As a result they have found that one of the prime areas of difficulty in location analysis is the justification and measurement of relevant consumer behaviour variables.

In many cases the solution proposed by the academic is rejected by the retailer. Retailers argue that these proposals are impractical. They argue that such solutions are find in theory. However, they are too simplistic in their basic assumptions to be adapted to the "real world". They argue that the relevant variables have not been accounted for or properly measured.

Thus, the problem of location analysis and consumer patronage behaviour is one of providing for the retailer practical tools for the purpose of analysing consumer patronage behaviour.

Purpose of the Study

The purpose of this thesis is to analyze consumer patronage behaviour within an urban grocery system so as to assist the retail grocery store location analyst. The study is structurally centered around one of the proposed solutions to retail store location analysis, Huff's gravity model. The study suggests certain refinements which should be made to Huff's distance decay factor λ for the purpose of retail grocery store location analysis. It will also serve as a guide to the analyst investigating consumer patronage behaviour in general and in the field of retail grocery stores.

Prediction of consumer patronage behaviour in a metropolitan system is, in the least, difficult. The available data did not allow a complete analysis of the gravity model per se as there are ancilliary problems which could not be fully tested. Hence the validity of the gravity model per se was neither proved nor disproved. Rather, using the available data, specific consumer behaviour variables were hypothesized and tested and resulting proposals were made towards the improvement of the gravity model, and the analyst's knowledge of urban consumer behaviour in general.

Study Organization

The study is primarily organized into two sections, descriptive and analytical. It begins with a brief description of the deterministic models which preceded Huff's probabilistic gravity model. Huff's gravity model is then discussed, in detail, in regards to its direct inclusion of the variables store size and consumer distance to be travelled. Chapter II then ends with a discussion as to how one might apply the gravity model to the "real world".

Chapter III opens with a detailed discussion of Huff's distance exponent λ. An example illustrating the significance of λ is presented, followed by a discussion of the consumer behaviour components of λ. The study then turns to those consumer patronage variables which, in addition to those outlined by Huff, may have a significant effect upon a model designed for retail outlet location analysis and may be characteristic of consumer behaviour.

Having discussed the variables involved in retail store location in general the study turns to the specific problem of supermarket consumer behaviour patterns.

Chapter IV outlines and describes those specific store variables suggested by the author, which must be taken into account when dealing with the problem of supermarket patron analysis.

Chapter V begins the analytical section of the study. It is concerned with the setting of hypotheses regarding the effect of certain consumer patronage behaviour variables upon supermarket sales.

Chapter VI concerns itself with the statistical analysis of those hypothesized variables stated in Chapter V.

The concluding chapter, Chapter VII summarizes the study giving indications as to those additional variables which should be included for consideration in Huff's gravity model in general and for the specific problem of supermarket patron analysis. In addition it serves as a summary of the additional information provided by this study which will add to the marketer's knowledge of urban consumer behaviour.

CHAPTER II

THE DEVELOPMENT OF AN INTRA-REGIONAL LOCATION MODEL

THE GRAVITY MODEL

Introduction

With the passing of time and the growth of cities the problem of intra-regional, as opposed to inter-regional, location analysis has developed.

> The importance of new site evaluation and the analysis of existing and future distribution of consumer based activities is receiving growing attention and application. 2

Retailers, marketers and urban land developers, among others, are asking the following: "Is the present site optional or can an increase in revenue be brought about through a change in location?"; "What factors must be considered in evaluating retail store location?"; "How important is the location of

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[2] J.D. Forbes and A.G. Fowler, "Simmulation of a Gravity Model", The Annals of Regional Science, June, 1969, The Western Regional Science Association, page 86.

competitive retailers?"; and "Is location a factor to be reckoned with at all?".

> Retail store businesses are virtually all market-oriented ... The retailer must be accessible to people, and it is this fact that governs site selection. 3

At present, one of the principal tools under consideration concerning retail site analysis is the gravity model. Through the use of the gravity model, marketers are attempting to isolate those variables which they feel are of key importance in the consumer's decision to patronize a specific retail outlet.

William J. Reilly: The Laws of Retail Gravitation

In an attempt to measure the market areas of particular retail outlets, William J. Reilly developed the "laws of retail gravitation". Through the use of these "laws", Reilly was able to determine market areas, knowing only the population and central functions of particular centres and the distances between them.

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[3] R.L. Nelson, The Selection of Retail Store Locations, New York, F.W. Dodge Corporation, 1958, page 44.

Reilly developed the "breaking-point" equation which stated that the trading boundary between two areas, A and B, in miles from B is equal to

$$\frac{\text{Miles Between A and B}}{1 + \sqrt{\frac{\text{Size of A}}{\text{Size of B}}}}$$

> In most applications, Reilly used population as an index of size, but number of central functions can be used, since it is the fundamental measure of the attractiveness of a center. [4]

Digression: Frank A. Fetter: The Laws of Market Areas

Much like Reilly's "breaking-point" equation, Fetter stated that by substituting "attractiveness" or center size for market prices, and distances for freight rates, it is possible to determine the boundary line between two geographically competing markets for similar goods. The boundary line is the result of the continuum of points where the freight charges plus prices of goods of the two centres is equal. Hence, a reduction in price and/or freight charges increases the market area of a

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[4] Brian J.L. Berry, Geography of Market Centers and Retail Distribution, Englewood Cliffs, Prentice-Hall Inc. 1967, page 40.

given centre.

The Significance of Reilly's Laws

Reilly's equation loses its significance when applied to heavily populated areas. In rural areas, distance plays a major role in the time and cost allocation made by the consumer in his selection of a market center. However, due to the proximity of various retail outlets in heavily populated, urban areas and their respective varying degrees of attractiveness, the break-point becomes "fuzzy". One cannot say that on one side of a specific boundary consumers will patronize outlet A and on the other side they will patronize outlet B. A specific boundary, the break-point, does not exist. It is "fuzzy" due to the different degrees of attractiveness of centers for consumers. There are many centers, not just one or two, within the maximum distance the consumer is willing to travel.

> Within metropolitan regions there is no such thing as an absolute breaking-point. The break-point formula simply gives the point at which the proportion of consumers located around the breaking-point splits equally between two competing alternatives of differing attractiveness. [5]

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[5] Berry, op. cit., page 41.

It is in these densely populated urban areas that Reilly's original law of gravitation becomes applicable.

> Two centers attract trade from intermediate places approximately in direct proportion to the sizes of the centers and in inverse proportion to the square of the distances from these two centers to the intermediate place.
>
> $$\left(\frac{T_A}{T_B}\right) = \left(\frac{P_A}{P_B}\right)\left(\frac{D_B}{D_A}\right)^2$$
>
> where
>
> T_A, T_B = proportions of trade from the intermediate place attracted, by centers A and B
>
> P_A, P_B = sizes of centers A and B
>
> D_A, D_B = distances of A and B from the intermediate place. [6]

Reilly's original law of gravitation is deterministic in nature. It merely gives the analyst a means of calculating the line or breaking-point between trading areas. It is simply a measurement, generally in miles, of the distance between this line and the particular center in question. There is no consideration made for the number or types of consumers which

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[6] Berry, op. cit., page 41.

inhabit these areas. However, densely populated urban areas are characterized by many business centers, having different degrees of attractiveness, within the consumer's desired perimeter of travel. Thus, individual consumer behaviour within such densely populated areas is probabilistic rather than deterministic in nature. Hence, Reilly's model is inadequate for the study of consumer behaviour in such areas. This led to David L. Huff's development of "the gravity model".

David L. Huff: The Gravity Model

In general, when present day marketers speak of "the gravity model" they are referring to Huff's gravity model. As stated earlier, intra-regional marketers and location analysts are concerned with probability models of urban areas rather than deterministic models such as those proposed by Reilly and Fetter. As a result, Huff's gravity model has been widely discussed as a proposed answer to the problem of location analysis.

Huff states that the probability of consumer patronization is related to the expected utility which the consumer feels he will gain through patronization of a particular outlet. That is,

$$P_j = \frac{U_j}{\sum_{j=1}^{n} U_j}$$

where

P_j = the probability of consumer patronage of retail outlet j

U_j = the utility gained by the consumer through patronage of outlet j

and

$$\sum_{j=1}^{n} P_j = 1 \text{ with } 0 < P_j < 1.$$

In addition, Huff states that the ratio of selectivity between two locations is independent of the existence of other centers;

$$\left(\frac{P_{j1}}{P_{j2}}\right) = \left(\frac{U_{j1}}{U_{j2}}\right)$$

where

the dependent variable U_{ij} is composed of:

- the size of a given outlet j denoted by S_j, generally given in square footage of store floor space
- the distance from the consumer's initial base i to the center j denoted by D_{ij}.

Expected Consumer Utility vs. The Probability of Consumer Patronage

In developing his theories regarding the size of a particular retail outlet and the distance from the consumer base to that outlet, Huff makes no distinction between expected consumer utility and the probability of consumer patronage. Although these terms are highly related they are not synonymous.

In the discussion which follows, specific reference will be made to these two terms: expected consumer utility and the probability of consumer patronage. Both appear on the vertical axes of the illustrative figures which follow. However, the labelling of these axes is not random in nature as expected consumer utility differs from the probability of consumer patronage.

Expected consumer utility may be defined as;

> the expected ability of a specific retail store to satisfy the consumer's desires.

Whereas the probability of consumer patronage may be defined as;

> the likelihood of a consumer patronizing a specific retail store.

The probability of consumer patronage is determined, in part, by observing expected consumer utility. However, variables such as the "randomness of selection" (see Chapter III), and an error factor are also allowed for in the determination of the probability of consumer patronage.

Thus, the analyst employing Huff's gravity model should be aware of the fact that the probability of consumer patronage and expected consumer utility are not synonymous, as implied by Huff. They are, however, highly related.

Store Size and Distance to be Travelled

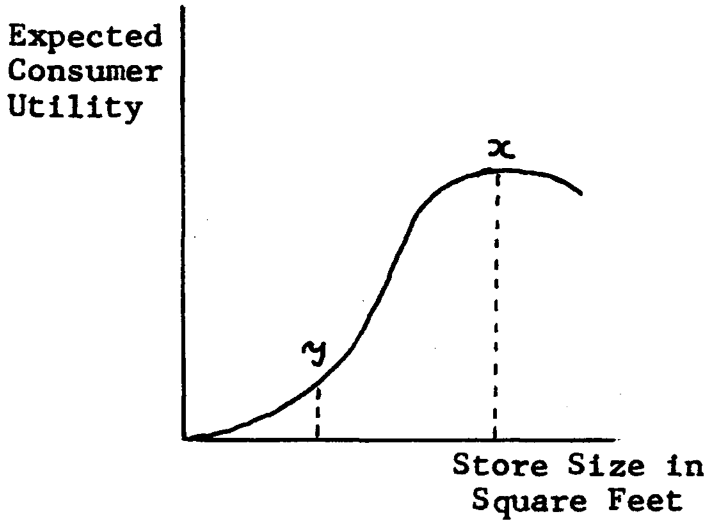
Huff states that the chief factors which influence consumer patronage of a particular retail outlet are;

1) the size of a particular retail outlet
2) the distance from the consumer base to that outlet.

He asserts that the greater the number and variety of items carried by an outlet, the greater the consumer's expectation that a particular shopping trip will be successful. For simplicity, Huff substitutes the number of square feet of selling space for the number and variety of items.

FIGURE 1

HUFF'S EXPECTED CONSUMER UTILITY - STORE SIZE RELATIONSHIP (A)



Notice the curve of expected consumer utility (Figure 1). At zero store size, the consumer expects zero utility. As store size increases from zero, expected consumer utility rises. However, it is intuitively felt that at some minimal store size "y" expected consumer utility will begin to increase at an increasing rate. It will continue to do so until the store reaches a maximum size "x" where it will initially begin to decrease. This maximum store size "x" is a result of confusion of the consumer. At this size, the consumer will become confused by the number and variety of products carried and hence he will suffer a decrease in utility.

However, one may argue that the consumer will eventually learn where all goods are located in a store which is initially regarded as being "too large" by the consumer. Hence, he does not experience the confusion which resulted in his disutility of a particularly large store size. Thus as the number of shopping trips to this store increases and confusion decreases, the consumer utility curve will then begin to rise, reaching a point of maximum utility and finally, levelling off (Figure 2).

FIGURE 2

HUFF'S EXPECTED CONSUMER UTILITY - STORE SIZE RELATIONSHIP (B)

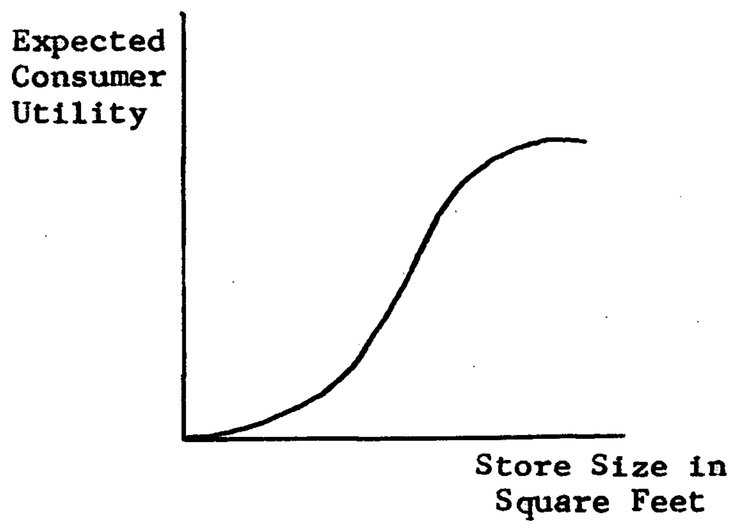
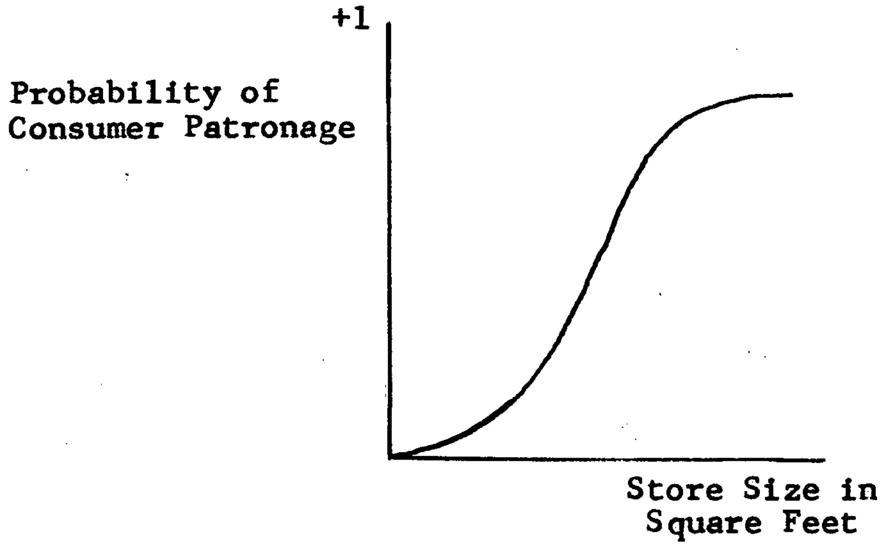


FIGURE 3

HUFF'S PROBABILITY OF CONSUMER PATRONAGE - STORE SIZE AND RELATIONSHIP

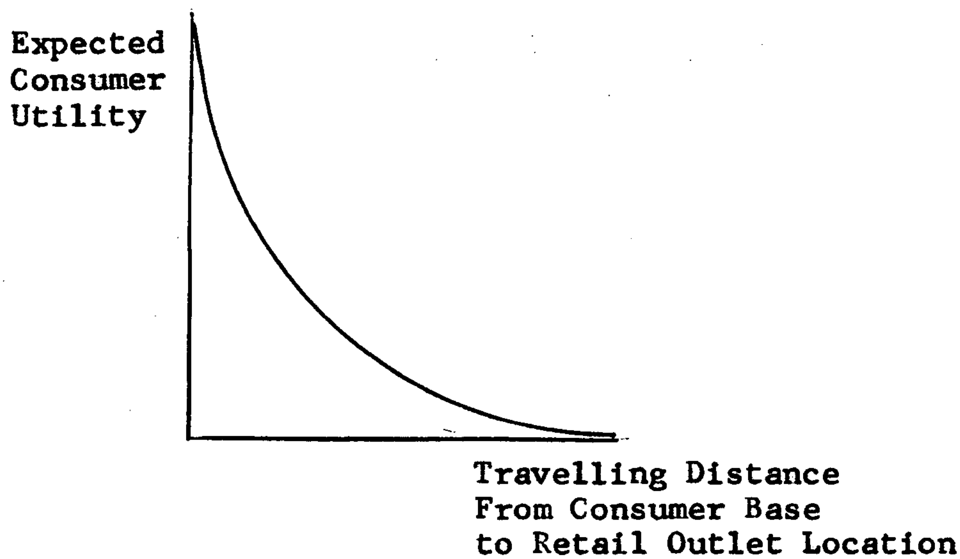


Note: It is assumed that all variables except store size are constant.

The distance variable D is a measure of the time and expense involved in travelling from the consumer's base to the retail outlet's location. As D increases, the utility of a particular location, u, decreases. That is, as the consumer devotes more time and expense towards travel, he does so at the expense of shopping time and travelling expenses which could have been spent at a more proximate location (Figure 4).

FIGURE 4

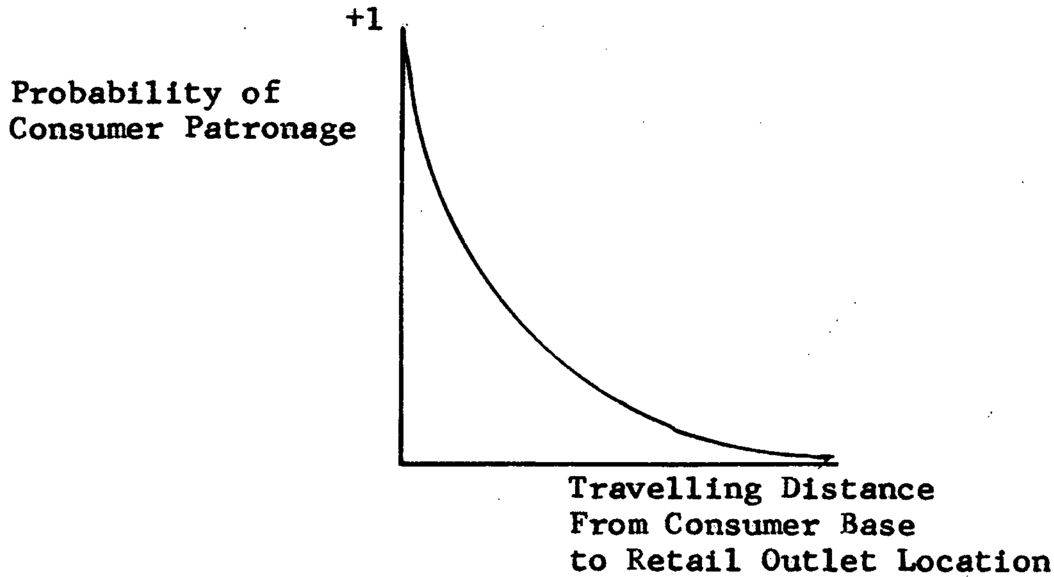
HUFF'S EXPECTED CONSUMER UTILITY - DISTANCE RELATIONSHIP



Huff's probability curve of consumer patronage with respect to travelling distance from the consumer's base to the retail outlet location is then;

FIGURE 5

HUFF'S PROBABILITY OF CONSUMER PATRONAGE -
DISTANCE RELATIONSHIP

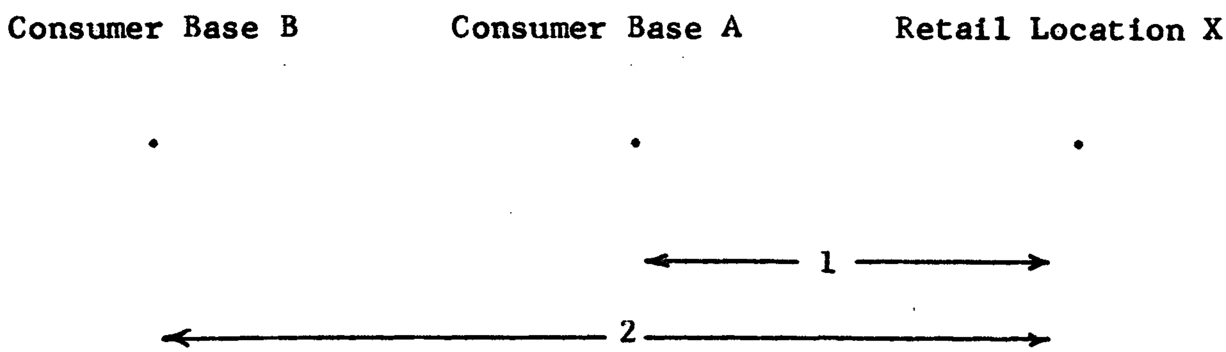


Note: it is assumed that all variables except travelling distance from the consumer base to the retail outlet location are constant.

In addition to the number and variety of goods offered, accounted for in the store size variable, and distance from the consumer base to a particular outlet, Huff includes the distance exponent λ . The distance exponent λ is inserted into the model to account for the non-linearity of the distance effect. The concept of non-linearity may be illustrated as follows;

FIGURE 6

CONSUMER BASE - DISTANCE ILLUSTRATED



Suppose that the distance from consumer base A to retail location X is one mile and that the distance from consumer base B to retail location X is 2 miles. If the probability of consumer patronage from base A to location X is .50, one cannot conclude that the corresponding probability of consumer patronage from base B to location X is .25. That is, if we double the distance factor we do not necessarily divide the probability of patronage by two.

There is a multitude of factors, other than the distance from the consumer base and the size of a particular retail outlet, which affect consumer patronage behaviour. The individual consumer's willingness to travel various distances in search of various products is not constant throughout the total consumer population. The attractiveness of a particular center varies from individual to individual. Hence, the consumer's willingness to travel particular distances varies and thus, the probability of consumer patronage varies. Because of these varying degrees of center attractiveness resulting in the consumer's willingness to patronize a particular center, the relationship between distance and patronization is not linear. In order to compensate for this, Huff has inserted the distance exponent into his model.

$$P_{ij} = \frac{U_{ij}}{\sum_{j=1}^{n} U_{ij}} = \frac{\dfrac{S_j}{D_{ij}^{\lambda}}}{\sum_{j=1}^{n} \dfrac{S_j}{D_{ij}^{\lambda}}}$$

where

- λ is an empirically estimated parameter chosen to reflect the effect of distance on various kinds of shopping trips.

For purposes of analysis, the initial base i is taken as an area comprised of many consumer bases or households. Therefore, the expected number of persons in area i which will patronize center j, denoted by E_{ij} is;

$$E_{ij} = P_{ij} \cdot C_{ij} = \frac{\dfrac{S_j}{D_{ij}^{\lambda}}}{\sum_{j=1}^{n} \dfrac{S_j}{D_{ij}^{\lambda}}} \cdot C_i$$

where

$E(C_{ij})$ = the expected number of consumers at center i that are likely to travel to retail center j.

C_i = the number of consumers in area center i.

The purpose of location analysis is to determine a particular site which will maximize the retail store owner's profit. In order to estimate the number of dollars received through locating at a particular site i from a particular product class k, B_{ik}, the percentage of income spent on product class k by residents of area i, is inserted into the model.

$$E(A_{ij}) = \frac{\dfrac{S_j}{D_{ij}}}{\sum_{j=1}^{n} \dfrac{S_j}{D_{ij}}} \cdot C_i \cdot B_{ik}$$

where

A_{ij} = expected average expenditures made by consumers located at consumer base i at retail outlet j for a particular good k.

Using Huff's gravity model the analyst is now able to determine the optimal location for a particular retail outlet. The procedures is as follows;

1) divide the area surrounding the actual or proposed outlet location into statistically significant units

2) determine the size of the selling area of the outlet in square feet

3) determine the distance from unit i to location j

4) empirically estimate a value for the parameter λ

5) apply the gravity model and determine the respective patronage probabilities from each consumer unit

6) calculate the number of consumers in each unit

7) calculate the percentage of consumer income spent on that particular product class by consumers residing in base i

8) calculate the resulting expenditures made by consumers at that particular location

9) apply the above procedure to alternative retail outlet locations

10) choose that location which maximizes the retail outlet owner's profit.

Chapter Summary and Conclusions

In this chapter we have been introduced to the origin and use of Huff's gravity model. A short history of the development of Huff's model was presented along with the basic underlying assumptions behind it. A detailed description of the model was then followed by a procedural outline for its practical application. Chapter II, is then, an attempt to familiarize the reader with the gravity model and its use as a tool for location analysis.

In the chapters which follow, the consumer behaviour variables which make up λ will be discussed, followed by the formulation and testing of hypotheses drawn on the various effects of these variables.

CHAPTER III

THE DISTANCE EXPONENT λ AND CONSUMER PATRONAGE BEHAVIOUR

Introduction

We have seen in Chapter II that a relatively simple model, the gravity model, has been developed and discussed as being a tool for location analysis. The model specifically takes into account two variables, the distance to be travelled by the consumer and the size of the store. In addition, the distance exponent λ is inserted into the model in order to account for the non-linearity of the distance effect.

Chapter III illustrates the significance of the distance exponent λ and its inclusion of specific consumer behaviour components as outlined by Huff. In addition, those variables outlined by Forbes as being critical in the analysis of consumer behaviour will be discussed. As mentioned in the Thesis Introduction, Chapter III and IV are centered around a discussion of the distance exponent λ and consumer patronage behaviour. Chapter III discusses those variables which are considered to be of a more general nature, whereas Chapter IV makes more specific reference to those variables concerning supermarket patron analysis. Following the discussion of these variables, Chapter V will establish various hypotheses regarding their relationships with sales, thus setting the stage for the analysis of actual data.

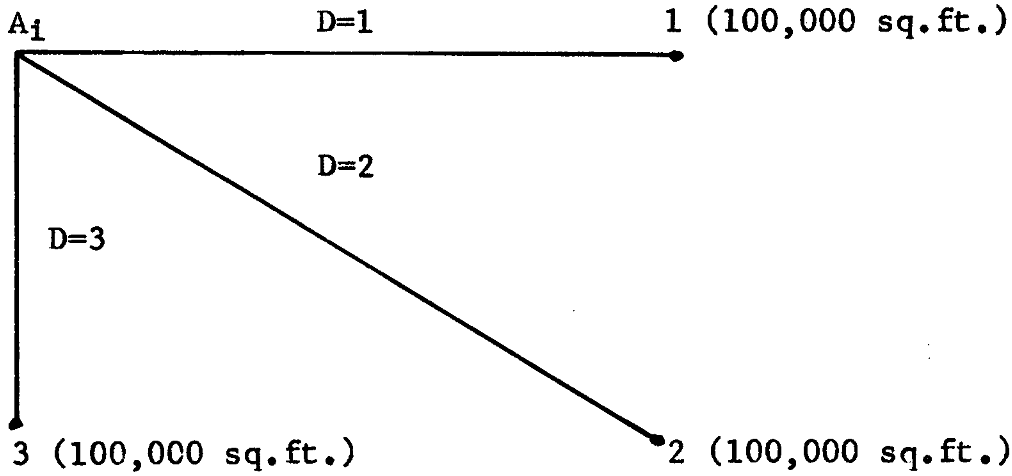
The Significance of λ

The symbol λ is then a "catch-all" exponent designed to take into account those consumer patronage variables, resulting in the effect of non-linearity, which are difficult to measure or not measurable at all. However, the exponent has great significance upon the outcome of gravity model calculations. Witness the following example.

Suppose we are looking at three locations each having a store of equal selling space, 100,000 square feet. The distances from consumer base A_i are as follows;

FIGURE 7

SIZE-DISTANCE EFFECT UPON λ ILLUSTRATED



Initially we set $\lambda = 1$

$$P_{ij} = \frac{\dfrac{S_j}{D_{ij}^{\lambda}}}{\sum_{j=1}^{n} \dfrac{S_j}{D_{ij}^{\lambda}}}$$

then

$$P_{A1} = \frac{\dfrac{100,000}{1}}{\dfrac{100,000}{(1)^2} + \dfrac{100,000}{(2)^2} + \dfrac{100,000}{(3)^2}}$$

$$= .5454$$

Changing $\lambda = 1$ to $\lambda = 2$ and holding size of outlet constant we have

$$P_{A1} = \frac{\frac{100,000}{(1)^2}}{\frac{100,000}{(1)^2} + \frac{100,000}{(2)^2} + \frac{100,000}{(3)^2}}$$

$$= .7346$$

Notice that by changing the exponent λ from 1 to 2 the probability of consumers at base A, travelling to location 1 rises from .5454 to .7346. This is a 35 percent increase in probability! Because such changes in the value of λ affect the outcome so markedly, it is desirable to have λ measurements as accurate as possible. In order to give the analyst a more feasible model, then, it is first necessary to determine all those variables concerned with the decay of the distance factor and consumer patronage behaviour.

The Components of λ : Consumer Patronage Behaviour

It is known that consumer patronage behaviour is dependent, not only upon the size of a particular retail outlet and its distance from the consumer base, but on a multitude of other factors.

> Consumers also display differences in terms of their willingness to travel various distances for different types of products. This accounts for the distance exponent λ. These variations can be attributed to the value differences that various goods and services possess to the consumer. Such values are based on:
>
> 1. the degree of substitutability of various products;
> 2. the expected absolute price differential between different products;
> 3. the absolute price of a product in relation to a consumer's income level; and,
> 4. the degree of "psychic income" anticipated from different products.[7]

In addition to the factors mentioned above, "social class, advertising and store variables"[8] all affect consumer patronage behaviour.

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[7] D.L. Huff, A Probabilistic Analysis of Consumer Spatial Behaviour, Real Estate Research Program, Graduate School of Business Administration, University of California, Los Angeles, page 19.

[8] J.D. Forbes, Consumer Patronage Behaviour, Presentation to the American Marketing Association Meetings, Denver, Colorado, August 29, 1968, page 1.

The Randomness of Selection

In introducing and describing the consumer patronage behaviour variables, which are pertinent to the analysis, the term "randomness of selection" will be used quite frequently. By this it is meant that in some cases consumer patronage is random in nature, ie. someone new to the neighbourhood or merely "travelling through", randomly selecting a retail outlet to patronize. These consumers, initially, are not aware of consumer "grapevines" with regards to "good and bad" retail outlets. Hence, retail outlet selection for this portion of consumers may initially be, random in nature.

Degree of Substitutability

The nature of the product itself is a determinant of consumer patronage behaviour. In the eyes of the consumer, there may be a certain degree of product substitutability. That is, ice-cream may be substituted for fresh strawberries as the dessert item for an evening's meal or packaged cakes for "bon-ton". Hence, the consumer may patronize that grocery outlet offering ice-cream, which is located nearest to his base, rather than travel a greater distance in order to patronize an outlet having a fresh produce section or a bakery shop, "all other things being equal". The consumer's willingness to travel to an outlet offering a specific item for purchase is affected by his willingness to substitute other items, offered at more proximate locations.

On the other hand, it may not be practical to substitute one good for another. Here the cost of substitution outweighs the benefits derived from a reduction in travelling costs and time. A Chevrolet distributor cannot be substituted with a Ford distributor, nor a Volkswagen rotor for a Chrysler rotor. The engine being repaired will not function. Hence, the savings benefits derived from patronizing a more proximate Ford or Volkswagen dealer are far outweighed by the ultimate costs. Thus the consumer must patronize his nearest Chevrolet or Chrysler parts dealer, not his nearest auto parts dealer, and he is willing to do so.

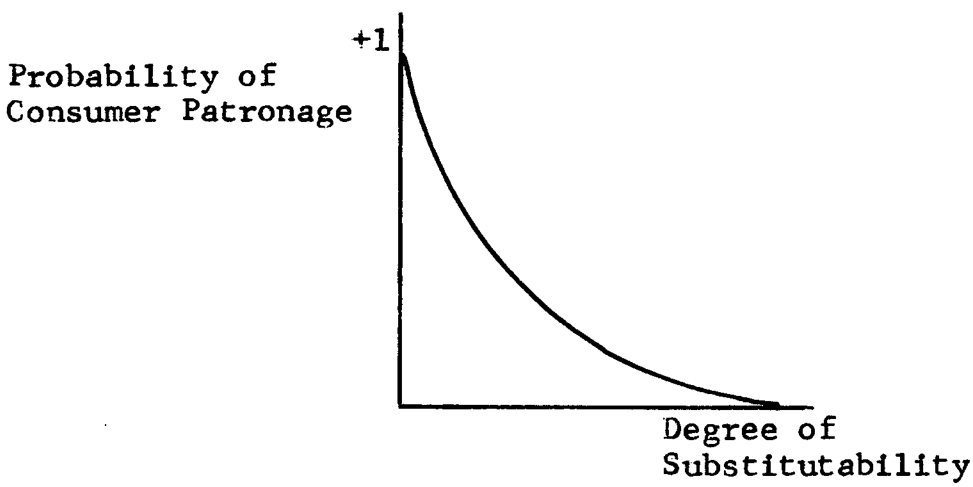
Brand preferences also enter into the determination of consumer behaviour. In shopping for bread, some housewives will choose any brand. They will patronize any supermarket or grocery store which handles bread in general. Others, in shopping for bread, are looking for a particular brand, e.g. Skylark. They have found through experience that they prefer Skylark and hence, are not willing to substitute other brands.

They are willing to travel longer distances in the search for Skylark rather than just any bread. As a result, they will patronize their nearest Safeway store, not just their nearest grocery store. Thus, depending upon the degree of both product type and brand substitutability which the consumer is willing to tolerate, the effect of distance to a particular retail outlet from the consumer base may be large or small.

The probability curve with respect to consumer patronage and the degree of substitutability of the products offered by a particular outlet would then be;

FIGURE 8

THE PROBABILITY OF CONSUMER PATRONAGE - PRODUCT SUBSTITUTABILITY RELATIONSHIP



Note: it is assumed that all variables except the degree of substitutability of the derived product are constant.

Here we see that for consumers in search of a product which cannot be substituted at all, a specialty good, the probability of consumer patronage of the only outlet which offers this good is one. That is, anyone desiring to purchase electricity in Vancouver and not wishing to generate his own by installing a private power plant will definitely become a customer of B.C. Hydro. This would be the case in all product and brand name monopolies. As the degree of product substitutability increases, the probability of consumer patronage, then, decreases, approaching zero. Zero probability is never reached, for even with a perfectly substitutable good there is still a random chance of consumer patronage.

Expected Absolute Price Differentials

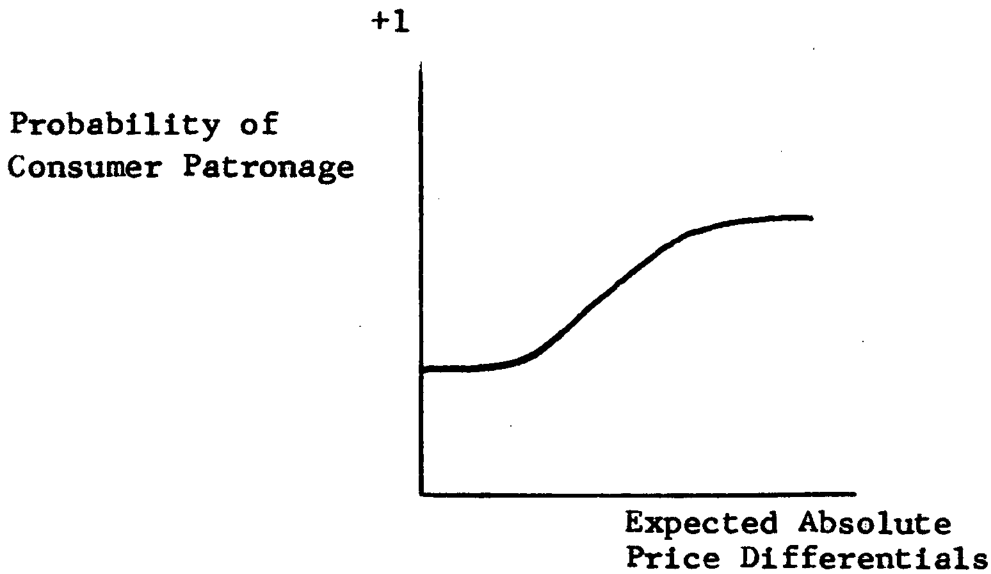
"Woodward's $1.49 Day", "Eaton's Trans-Canada Sale", "Bay Day". What draws the consumer to these respective sales? She expects to save money by purchasing sale goods. Some consumers will travel "half-way across town" in order to attend these sales. Absolute price differentials are important to them.

The "rational" consumer weighs travel costs against the absolute price of the item or items which she expects to purchase. Monetary savings must outweigh the additional travel costs suffered by the consumer in patronizing a less proximate retail location. Here we are not only concerned with the monetary increases in cost brought about through an increase in the distance to be travelled but also time and psychological expenses. There is an opportunity cost involved. The consumer is foregoing time which may be put to other uses, in order to travel this longer distance. At the same time she may be subjected to greater frustrations brought about by longer periods of traffic congestion, longer queuing times at the outlet which is holding the sale and the possibility that all the sale goods may have been sold upon her arrival. Thus expected absolute price differentials are of prime consideration to the rational consumer.

Plotting the probability of consumer patronage with respect to expected absolute price differentials we have the following;

FIGURE 9

THE PROBABILITY OF CONSUMER PATRONAGE - EXPECTED ABSOLUTE PRICE DIFFERENTIALS RELATIONSHIP



Note: it is assumed that all variables except expected absolute price differentials are constant.

At zero expected absolute price differentials we do not have a zero probability of consumer patronage. Here the consumer is indifferent as to the location which he will patronize, as all prices are equal. His choice of outlet patronization is then affected by some other variable or if they are all assumed to be constant, it is random and each store will have an equal probability of being visited.

As the expected savings in price differentials rise the difference between monetary savings and travel costs can be expected to increase. The more positive this difference, the greater the probability of rational consumer patronage. Hence, the probability curve rises. Holding all other variables constant, it should reach one for the "rational" consumer residing within "reasonable" distance of this particular retail outlet. Notice that it has been assumed that the consumer has, at his disposal, all of the information regarding product prices at particular outlets. He is in a state of perfect market knowledge.

The Absolute Price of an Article and Consumer Income

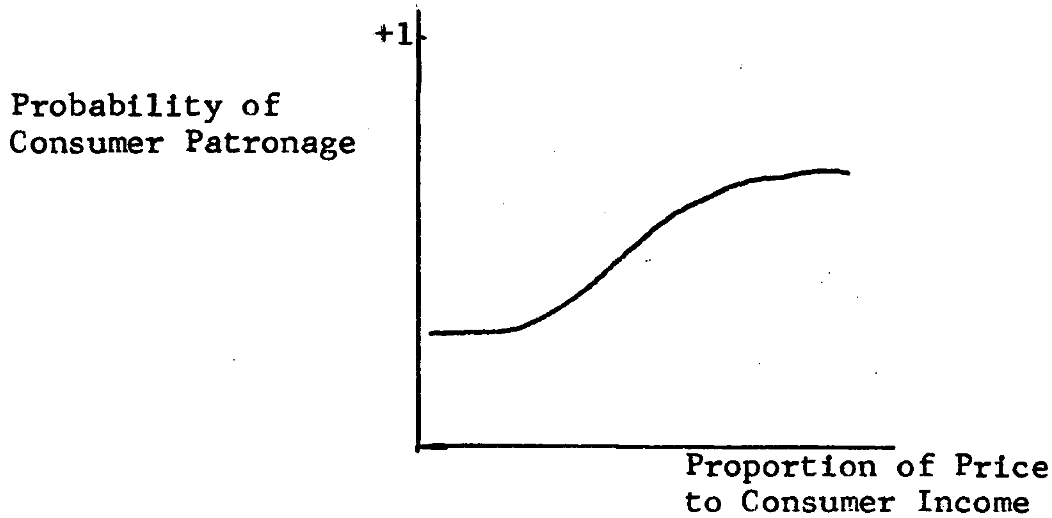
No consumer has an infinite income. Whether he is poor or rich, there is some article, which the consumer may wish to purchase, whose price is such that it will result in a considerable drain on his income. It may be an average wage earner wishing to purchase a new automobile or Howard Hughes looking for a new hotel in which to invest. Although the degree of the utility of money differs from individual to individual, monetary utility is common to all.

In each case, the potential purchaser becomes more cautious in his shopping patterns. He realizes that the purchase of such a good means the spending of a good proportion of his income. He is willing to "shop around", making many shopping trips without purchasing the desired item. He may return to a specific outlet many times, comparing its product quality, price and/or "psychic income" with the products of other outlets. He is willing to travel many miles in search of the "best" product.

One would intuitively guess that the greater the proportion of the "rational" consumer's income to be spent on a particular article, the greater the probability that he will visit all of the outlets in the area which offer this article. The following intuitive probability curve then results;

FIGURE 10

THE PROBABILITY OF CONSUMER PATRONAGE -
CONSUMER INCOME AND PRODUCT PRICE RELATIONSHIP



Note: it is assumed that all variables except the proportion of absolute price to consumer income are constant.

The preceding curve is much the same as that derived for the probability of consumer patronage and expected absolute price differentials, Figure 9. However, at zero proportion of price to consumer income the good is free. Hence, given the above assumption, the probability of patronage is one and the curve is discontinuous at this point.

As the proportion of income to be spent rises, the probability of consumer patronage rises. Notice that, as stated earlier, consumer patronage refers to the consumer's willingness to patronize a particular outlet. However, he does not necessarily have to buy anything. The probability curve then rises, approaching a probability of one. Here, where the "rational" consumer is spending a majority of his income on a particular good, he will visit as many outlets as he can justify using a cost-benefit type analysis.

"Psychic Income" and Social Class

For some, a shopping trip is more than a duty. It is an afternoon spent with "the girls". It is a chance to "get out of the house". It is an opportunity to meet new people or old friends. It is a change in atmosphere.

"Psychic income", in some ways, explains why the older Chinese in the Oakridge Area would rather shop in Vancouver's Chinatown Area for the same goods which may be purchased in Woodward's Food Department in Oakridge. Shopping in Chinatown gives these older people an opportunity to converse in their native language. They speak to both friends and clerks in Chinese. They meet old friends who live in the Chinatown Area or who are shopping there, as they are. They may arrange a "mah jong" game for the following week or talk about the "old country". They are more "comfortable" in this Chinese, rather than Western, atmosphere.

> Educational levels, family and ethnic background, income, education and other demographic characteristics have been used in various ways by sociologists to define an amorphic term called social class. 9

There is psychological value to be gained by the consumer through conforming. He is considered to be a member of a certain social class and he does what they do, shopping where they shop. "Psychic income" is gained through shopping where "everyone" does. In this way, the consumer reinforces his feeling of belonging and at the same time avoids ridicule or ostracization for not joining the group.

The social climber may, rather than shopping at an outlet compatible to his social level, patronize an outlet which is considered to be a class or classes above his own. He feels that he is better than the class to which he belongs and reinforces this through patronization of "upper class" stores. He gains psychological value through such practices.

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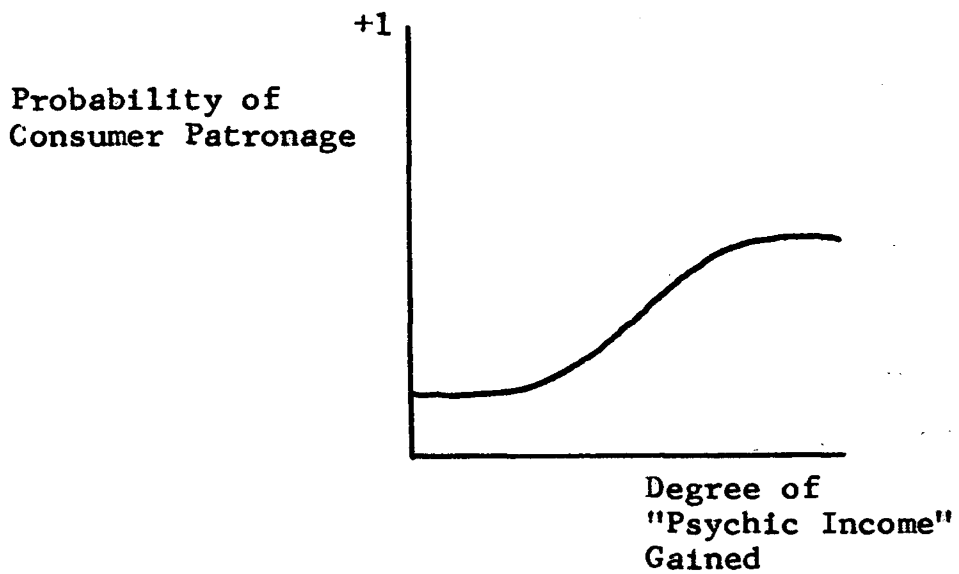
[9] Forbes, op. cit., page 5.

The "psychic income" and social class components of $\mathcal{S}$, although difficult to measure, may then account for the "irrational" shopping behaviour of many consumers.

Assuming that one is able to measure the degree of "psychic income" gained by the consumer during a shopping trip, it is intuitively felt that the probability curve of consumer patronage with regards to the degree of "psychic income" gained is as follows;

FIGURE 11

THE PROBABILITY OF CONSUMER PATRONAGE - "PSYCHIC INCOME" RELATIONSHIP



Note: it is assumed that all variables except the degree of "psychic income" gained are constant.

Much like the probability distribution derived for consumer patronage and expected absolute price differentials (Figure 9) we see that the above curve does not originate from the origin. At zero "psychic income", there is still a random chance of patronization. As the degree of "psychic income" rises, so rises the probability of consumer patronage. The curve continues to rise until an optimal degree of "psychic income" is reached. At this point it levels off, all other things equal.

Advertising

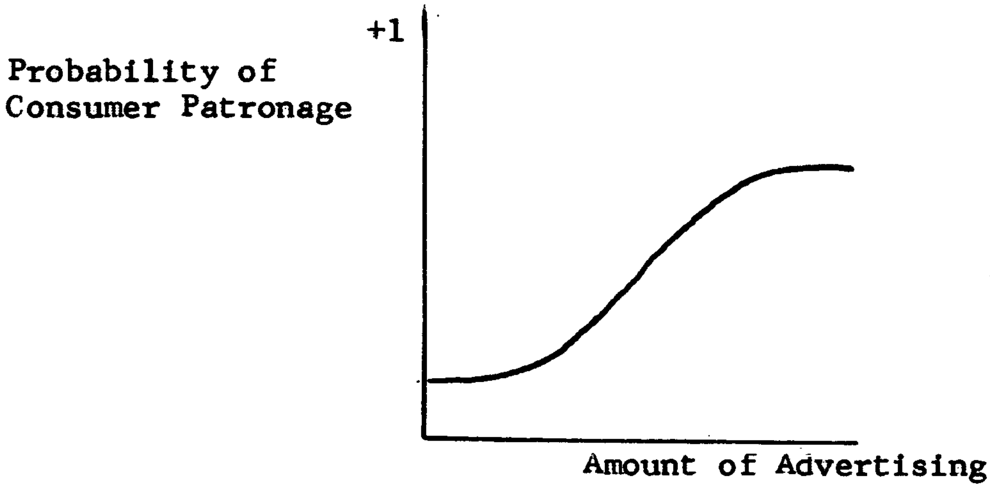
Retail stores advertise for one or both of the following reasons: to pass on information to the consumer concerning products and product prices and/or to build or create a store image. In either case the retailer is attempting to make the consumer aware of some advantage he can gain through shopping at a particular outlet. The consumer may be informed as to the date and nature of an upcoming sale. He may be made aware of the "fact" that "The Bay" deals only in "quality" goods. Such information may attract the consumer into travelling longer distances than he normally does on a shopping trip. He does so for he feels that the advantages to be gained through travelling longer distances outweigh the costs.

One should realize that it is not just the amount of advertising that we are concerned with, but also the subject matter of advertisements. The retailer must be informed as to what "advantages" the majority of his potential customers desire. Is it absolute price differences, the quality of goods, the social significance of patronizing a particular outlet, brand or product preference or a combination of all of these "advantages"?

Intuitively, then, one must say that advertising does affect consumer patronage behaviour. But like the "psychic income" and social class components of λ it is also difficult to measure the consumer effects of advertising. However, assuming that the retailer is advertising the "advantages" to patronizing his particular outlet which are consistent with those desired by a majority of probable consumers, one may assume the following probability curve;

FIGURE 12

THE PROBABILITY OF CONSUMER PATRONAGE - AMOUNT OF ADVERTISING RELATIONSHIP



At zero advertising, we do not assume a zero probability of consumer patronage as it is possible to learn of "advantages" to be gained through patronizing a particular outlet through word of mouth. We must also allow for randomness in the consumer patronage decision. With zero advertising and all other things equal, there is a random chance of selection for each outlet.

Assuming that advertisement content is that which is desired by the consumer, that is, price information, quality information, etc., the probability curve for the amount spent on advertising and the probability of consumer patronage will rise as more is spent on advertising. That is, with proper media selection and message content, a greater expense on advertising is assumed to bring about a greater spread of information to consumers, hence, a rise in the probability of consumer patronage, other things being equal. Taking these assumptions into account, one may conclude, then, that as advertising expenditures rise, the probability of consumer patronage rises to some point and then "levels off". This "leveling off" occurs because,

> first of all, at a given point in time, there tends to be an upper limit to the total potential demand for any particular product. The easier sales prospects are sold first; the more recalcitrant sales prospects remain. As the upper limit is approached it becomes increasingly expensive to stimulate sales. In the second place, as a company steps up its marketing effort, its competitors are likely to do the same, with the net result that each company experiences increasing sales resistance. [10]

Chapter Summary and Conclusions

In Chapter III we have seen, through example, the arithmetic significance of the distance exponent λ , and its affect upon the outcome of the gravity model. Holding the size and distance variables constant, the value of λ was changed from one to two. Thus, any change in probability was attributed to a change in the value of λ . The significance of these changes was then noted.

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[10] Philip Kotler, Marketing Management Analysis, Planning and Control, Prentice-Hall Inc., Englewood Cliffs, 1967, page 271.

Those consumer patronage variables which Huff described as being the components of λ were also outlined and explained. In addition, the social class and advertising factors mentioned by Forbes were outlined as being important to the consumer's decision to travel various distances for various products. Thus, the more general variables concerning consumer patronage behaviour and retail store location were covered.

Upon completing Chapter III, one begins to entertain the thought that the distance exponent λ plays an important role in gravity model calculations. Perhaps minute changes in λ may result in marked changes in the outcome of the gravity model. If so, it is important to attempt to isolate and quantify the relationships of the outlined components of λ wherever possible.

In addition to the variables mentioned in Chapter III Forbes mentions the factor of store variables. Because of their specific nature, store variables will be outlined in the chapter which follows.

CHAPTER IV

SPECIFIC STORE VARIABLES - THE SUPERMARKET

Introduction

Store variables differ in importance for various store types. Because of these differences it was decided that from this point on, reference will be made solely to the problem of retail supermarket patrons. Such specific references, in addition to assisting supermarket owners, may also serve as a procedural example for those analyzing consumer patronage behaviour for other store types.

Store variables include such things as the size of the store, the number of checkouts, the availability of parking, friendliness of personnel, etc. They differ in importance for various store types. The number of customer checkout installations is an important supermarket variable. Whereas in a men's clothing store, the number of checkouts provided is probably less important.

Chapter IV, then, will be concerned with those particular store values which are felt to be of prime concern in supermarket patron analysis. Like Chapter III it is strictly descriptive in nature. It is not until Chapters V and VI that hypotheses are formulated and tested using actual data.

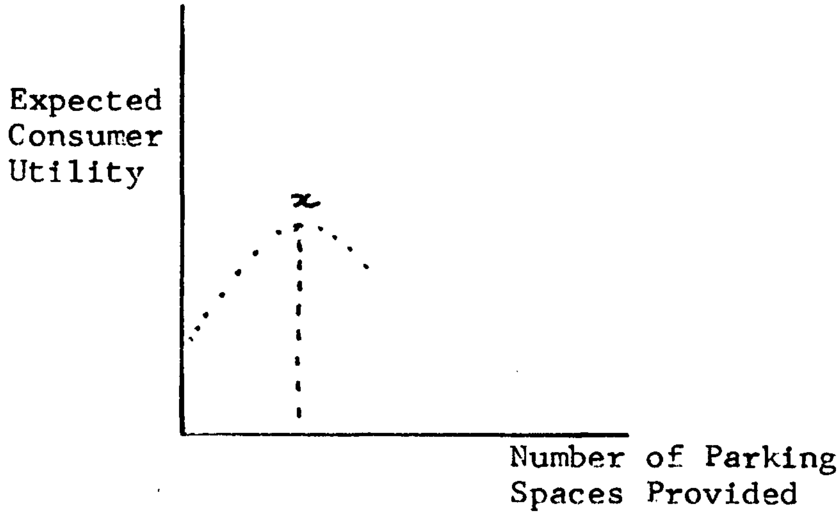
Number of Parking Spaces

It is intuitively felt that by adding parking facilities to a supermarket that consumers will look upon this as an increase in the conveniences provided by that particular outlet. The consumer no longer has to drive around looking for a place to park his automobile. He is no longer forced to "fight" traffic in order to find a parking space.

However, at certain times of the day, week, month and/or year these parking facilities may become crowded. Congestion mounts and customers find themselves parking on the perimeter of the parking lot. The larger the parking area, the further the walk for those who park on the perimeter of the lot. Initially, then, during certain shopping times, there is a point of diminishing consumer utility for larger parking areas, x, Figure 13.

FIGURE 13

THE EXPECTED CONSUMER UTILITY -
NUMBER OF PARKING SPACES PROVIDED RELATIONSHIP (A)



The curve is discrete in nature, as the addition of parking spaces is in whole, rather than in fractioned spaces. Notice that the curve does not begin at the origin. All other things held equal, a supermarket with zero parking facilities is still patronized and therefore has consumer utility.

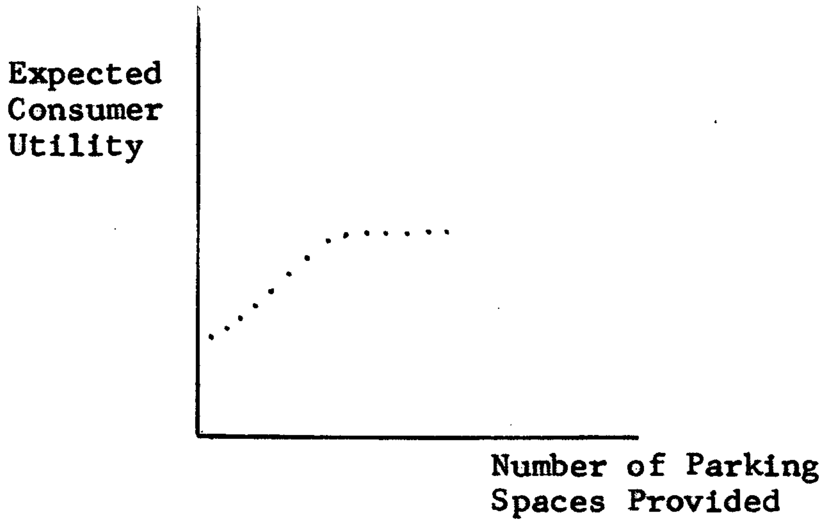
Every individual has the ability to learn. Hence, the initially frustrated customer finds that by altering her shopping times, she is able to avoid incurring the disutilities referred to above. However, in doing so, the consumer may be sub-optimizing aggregate shopping satisfaction. Holding all other factors constant, the consumer may now be shopping at a time which is less convenient for her. Thus, she is satisficing, rather than optimizing one of her consumer patronage goals in favour of available parking, Figure 14.

Satisficing may also occur in another form. Should the consumer find that it is inconvenient to patronize her most optimal choice of supermarkets at a different time, she may patronize a supermarket having a less congested parking area. In doing so, she has chosen a supermarket which is less than optimal in one or all of the remaining patronage factors, with the exception of parking. Here, she outweighs these less than optimal factors with the fact that there is less congestion and/or a shorter walking distance in the less attractive supermarket's parking area, Figure 14.

Therefore, the curve of consumer utility related to the number of parking spaces provided, is as follows;

FIGURE 14

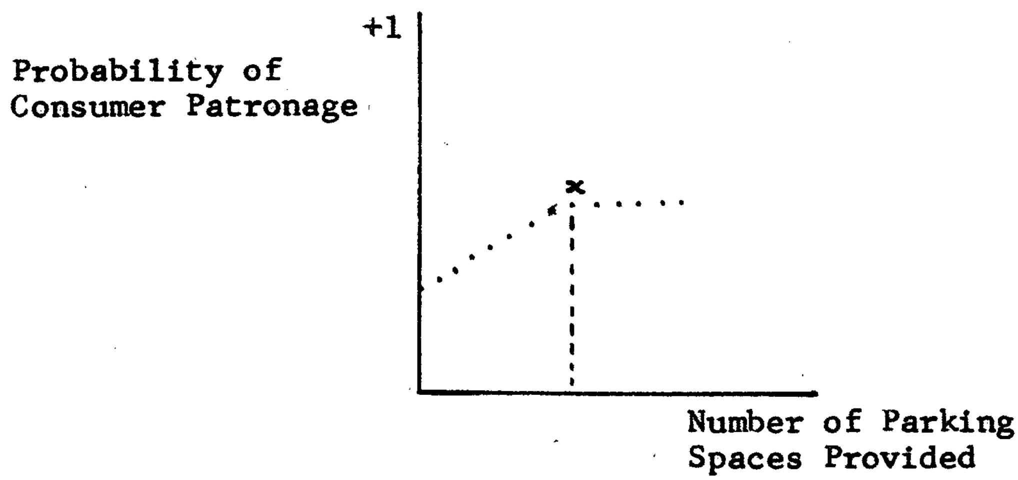
THE EXPECTED CONSUMER UTILITY -
NUMBER OF PARKING SPACES PROVIDED RELATIONSHIP (B)



The resulting consumer patronage probability curve is then;

FIGURE 15

THE PROBABILITY OF CONSUMER PATRONAGE -
NUMBER OF PARKING SPACES PROVIDED RELATIONSHIP



Note: it is assumed that all variables except the number of parking spaces provided are constant.

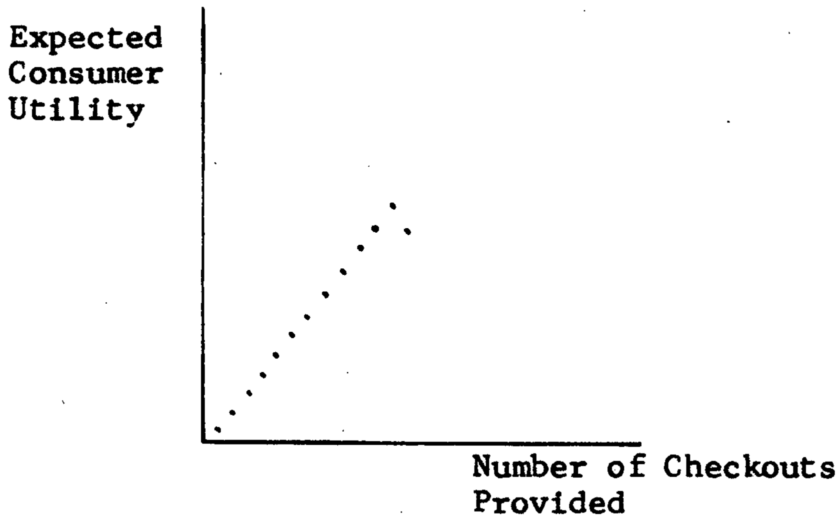
As stated earlier, there is no point of zero probability due to the randomness of selection, all other variables equal. Thus, the probability curve originates from a point greater than zero on the vertical axis. The curve rises to some point, x, where it then begins to level off. This levelling off is the result of the attainment of maximum consumer utility for parking upon the completion of the earlier mentioned learning process. It is discontinuous in nature due to the reasons given earlier.

Number of Checkouts

Like parking spaces, additional checkouts provide added convenience for the consumer. Waiting time is reduced and therefore, the disutility caused by such is reduced. Unlike parking facilities, however, the consumer receives no disutility from a greater than optimal number of checkouts. (One could argue that too many checkouts reduce potential selling space.) However, due to the cost of providing a greater than optimal number of checkouts, equipment costs, personnel costs, etc., it is felt that an over-supply of checkouts will not be provided.

FIGURE 16

THE EXPECTED CONSUMER UTILITY - NUMBER OF CHECKOUTS PROVIDED RELATIONSHIP

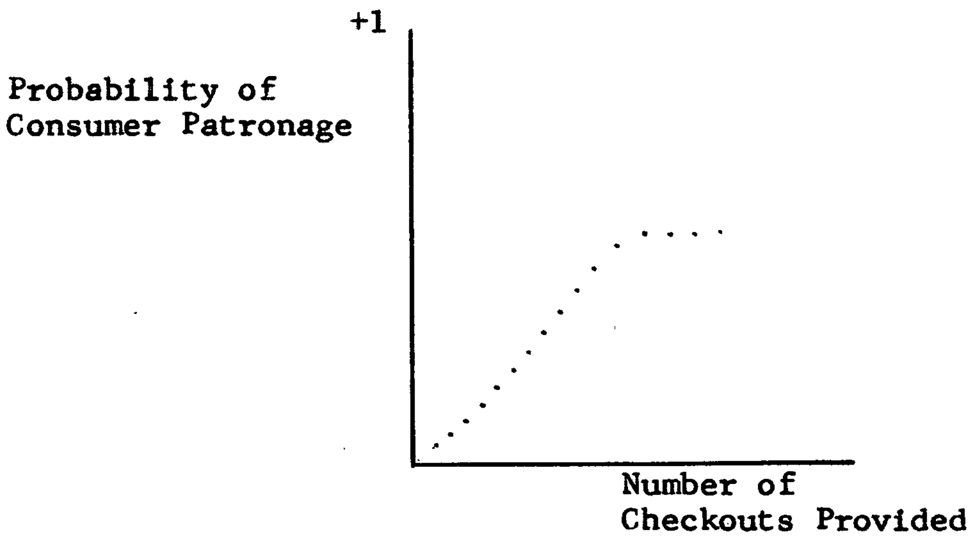


The preceding curve is again discontinuous, as the number of checkouts can be either 1, 2, 3 etc., not fractional units. Notice that the curve begins at the origin as a supermarket with zero checkouts will not function. The peak and corresponding downturn are merely illustrative of the point made in the previous paragraph.

The resulting probability curve would then be as follows;

FIGURE 17

THE PROBABILITY OF CONSUMER PATRONAGE - NUMBER OF CHECKOUTS PROVIDED RELATIONSHIP



Note: it is assumed that all other variables except the number of checkouts are constant.

Again, assuming that we are looking only at the upward sloping portion of the consumer utility curve, we have the probability curve rising and approaching one. The curve is discontinuous and begins at the origin for the reasons given above.

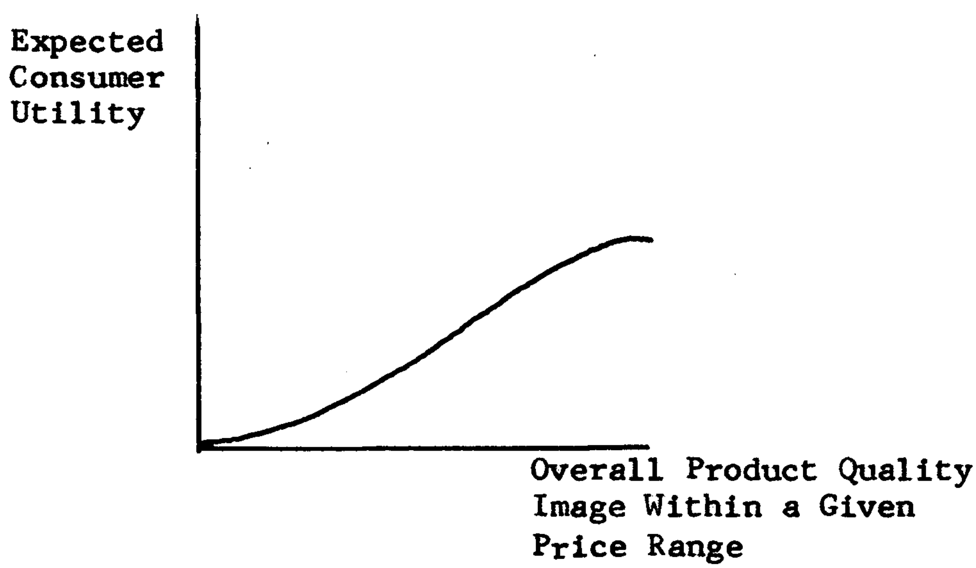
Product Quality Image

Product quality rather than price may be an important variable in the determination of consumer patronage behaviour. It is through this variable that consumer brand preferences may be recognized. In preferring one brand of a product to another, the consumer feels that she is getting the highest quality good within a particular grocery product's price range. Hence, for that portion of a supermarket's customers which is characterized by brand preferences, consumer utility rises as product quality rises within a given price range.

It is intuitively felt that the relevant consumer utility curve for a supermarket's product quality image within a given range of price is as follows;

FIGURE 18

THE EXPECTED CONSUMER UTILITY-PRODUCT QUALITY IMAGE RELATIONSHIP

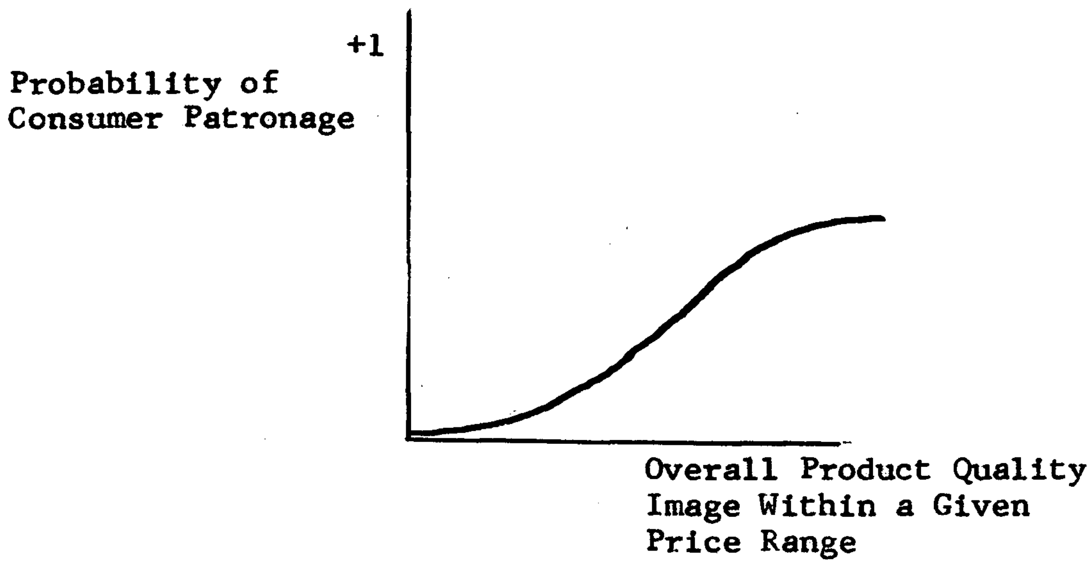


At a zero quality image, the consumer experiences zero utility. As the image rises, consumer utility rises, but at a slow rate. When an acceptable level of quality is attained, consumer utility rises at an increasing rate to the point of optimal utility where it levels off.

From the above curve, it is possible to intuitively determine the following probability of consumer patronage curve;

FIGURE 19

THE PROBABILITY OF CONSUMER PATRONAGE - PRODUCT QUALITY IMAGE RELATIONSHIP



Note: it is assumed that all variables except the overall product quality image within a given price range are constant.

The above illustrative probability curve is much the same as the preceding utility curve. However, at a zero product quality image, we have a minute positive probability of patronage due to the randomness of selection. As the product quality image rises, so rises the probability of patronage but at a far lower rate. Upon attaining an acceptable level of quality, the probability curve begins to rise at an increasing rate, leveling off at an optimal point which is at some level below a patronage probability of 1.0.

Store Image

In discussing store image, we are concerned with those store variables which are attributed to the store itself. We are especially concerned with those variables which appeal to the majority of supermarket patrons. We have seen two possibly effective store image variables; product price and product quality. We have also seen the expected effect of advertising these "attributes" to the consumer. In addition to these general image variables of product price and product quality, one may also hypothesize about the importance of cleanliness and friendliness of personnel images of a supermarket.

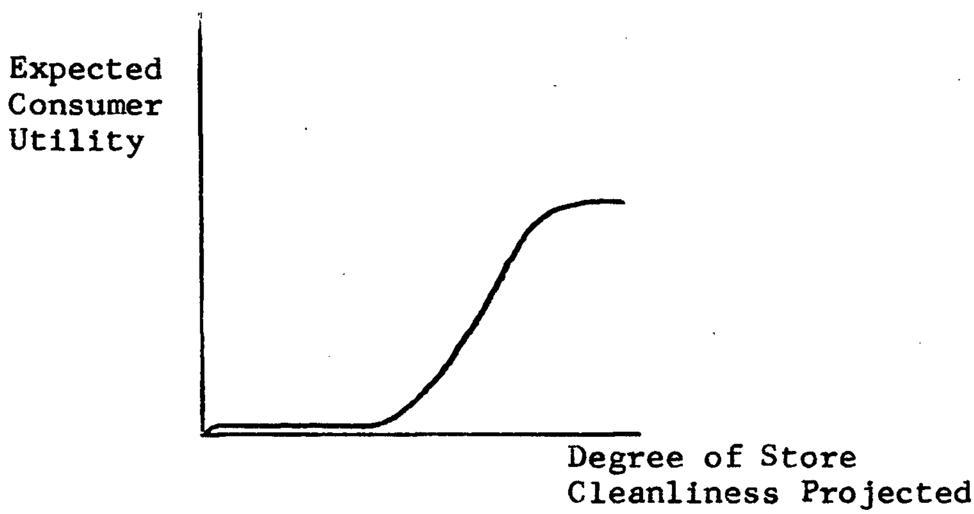
Store Cleanliness Image

For a majority of supermarket patrons, store cleanliness is an important criterion for store selection. The Western World stresses cleanliness in cooking and eating habits. This ultimately begins at the place of food purchase, the supermarket. Whether consciously or subconsciously, a majority of Western World supermarket patrons would probably rather shop at supermarkets which have an image of cleanliness.

In this vein, it is possible to intuitively derive the following consumer utility curve for store cleanliness;

FIGURE 20

THE EXPECTED CONSUMER UTILITY - STORE CLEANLINESS IMAGE RELATIONSHIP

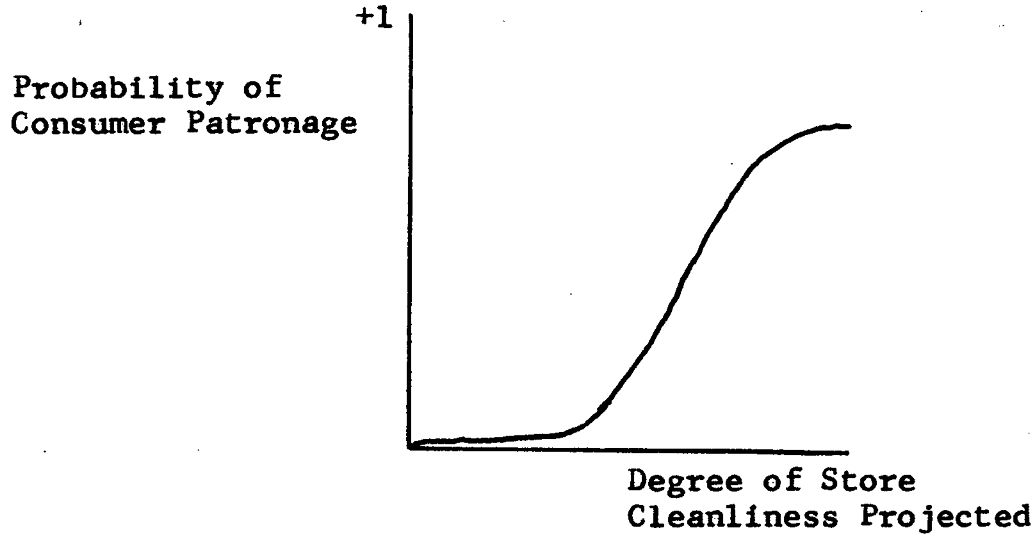


The consumer group illustrate here is that which puts primary interest on store cleanliness, all other things equal. In the Western World, it is assumed that this group would also form a majority. At zero cleanliness, consumer utility is zero. The curve then begins to rise but at a very slow rate, until some minimum level of cleanliness is reached. As the degree of cleanliness then continues to rise, it is felt that consumer utility will also rise but at an exponential rate. After reaching an "acceptable" degree of cleanliness the curve continues to rise but at a very slow rate.

From this curve, it is possible to derive a probability of consumer patronage curve;

FIGURE 21

THE PROBABILITY OF CONSUMER PATRONAGE - STORE CLEANLINESS IMAGE RELATIONSHIP



Note: it is assumed that all variables except the degree of store cleanliness, projected through advertising and "word-of-mouth", are constant.

Taking the above assumption into consideration, we find that, once again, due to the randomness of selection at zero cleanliness, the probability curve does not begin at the origin. From its point of origin, the probability curve rises much the same as the utility curve, meeting a suitable level of cleanliness before rising. The curve then begins to "level out" after reaching an "acceptable" degree of cleanliness.

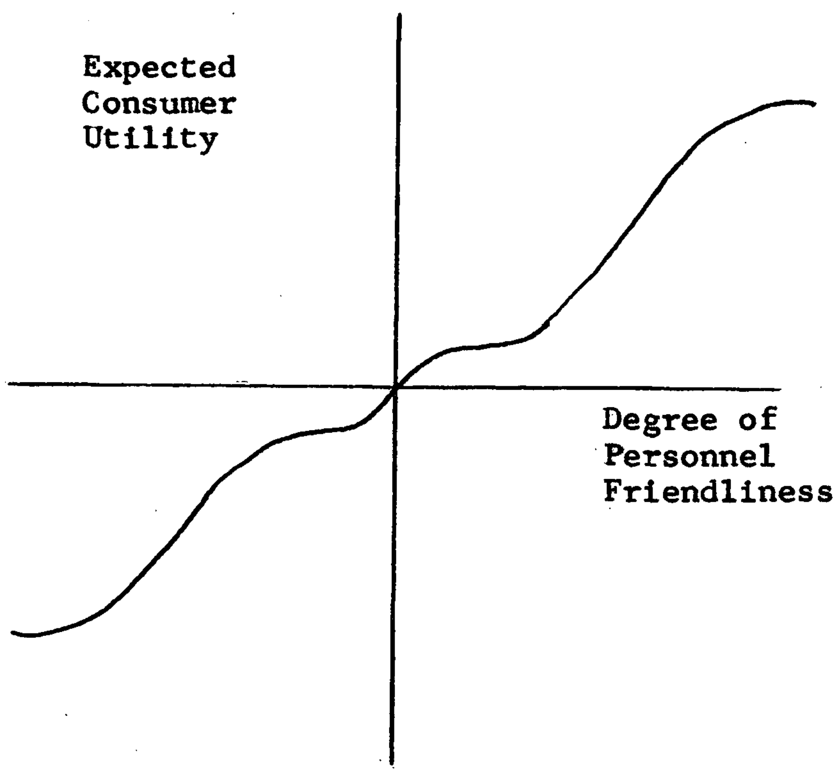
Friendliness of Store's Personnel Image

Turning now to the friendliness of personnel employed at a particular outlet, we find that the consumer utility curve can take on a negative, as well as a positive aspect. Because man is a socially oriented animal, we find friendliness to be important to his social well being. "No man can live alone". Although the degree of social orientation differs among individuals, it does exist, no matter how minutely, in all men.

For that fraction of the population which puts prime concern on friendliness of personnel, we have the following consumer utility curve;

FIGURE 22

THE EXPECTED CONSUMER UTILITY - PERSONNEL FRIENDLINESS IMAGE RELATIONSHIP

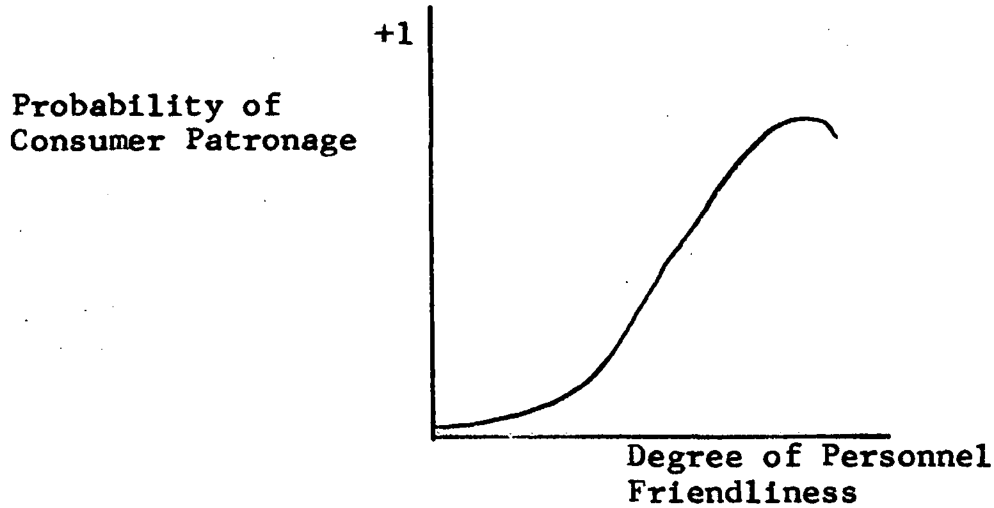


Notice that it is quite possible to have negative consumer utility. This would be the case for surliness of personnel. As the degree of surliness declines, so declines the degree of negative consumer utility. At zero friendliness and surliness of personnel, the consumer gathers zero utility, all other factors held constant. As the degree of friendliness rises, so does consumer utility. However, this utility curve "peaks out" as store patrons become suspicious or annoyed with clerks who are too friendly.

The resultant probability curve is;

FIGURE 23

THE PROBABILITY OF CONSUMER PATRONAGE - PERSONNEL FRIENDLINESS IMAGE RELATIONSHIP



<u>Note</u>: it is assumed that all variables with the exception of the degree of personnel friendliness are constant.

We are assuming here that the consumer is concerned with the personnel image put forth by the outlet in general. It is intuitively felt that although the friendliness of personnel is considered in the patronage decision, it is not as important as, for example, the availability of parking. Hence, the consumer, in this case, does not wish to satisfice all other variables in order to optimize the degree of personnel friendliness.

Because of the randomness of selection, the curve does not begin at the origin. Similar to the store cleanliness curve, it rises exponentially to a point where it begins to "level off". However, due to the assumption that personnel can be "too" friendly, the curve forms a peak, indicating a decrease in consumer utility.

As stated earlier, it is difficult to imagine the friendliness of personnel as a prime consideration of retail store selection. It is felt, however, that it plays, at the least, a secondary position in the consumer patronage decision. For this reason, the above utility and patronage probability curves were intuitively derived.

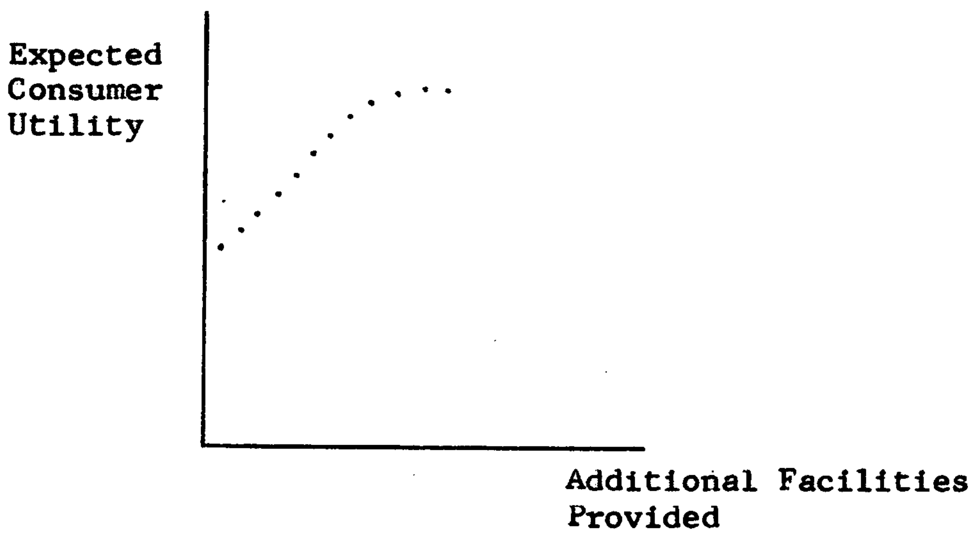
Additional Facilities

In addition to selling groceries, supermarket owners are now opening bakery shops, butcher shops and/or delicatessens within their stores. In doing so, supermarket owners are attempting to increase the attractiveness of their particular stores. The consumer is now able to purchase not only groceries, but baked goods and/or fresh meat in one store.

Consumer utility then increases as the number of facilities, provided at a single location, rises. This is one of the theories behind the shopping center where there are many facilities in the immediate area. The consumer utility curve for additional store facilities is then;

FIGURE 24

THE EXPECTED CONSUMER UTILITY - ADDITIONAL FACILITIES PROVIDED RELATIONSHIP

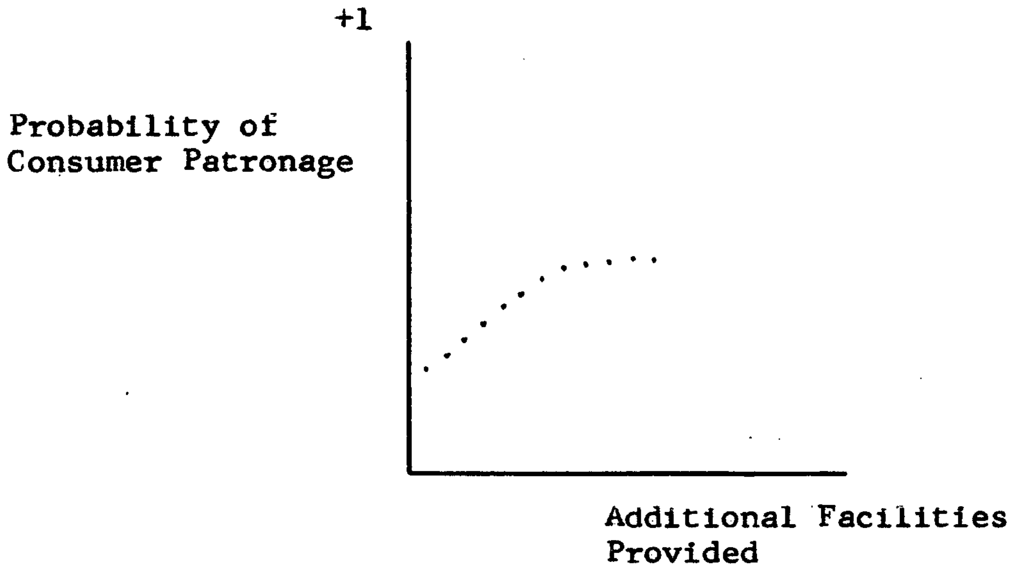


Like the consumer utility curve for the number of checkouts provided, this curve is discontinuous in nature. The supermarket can either add a bakery shop or not. Differences in bakery size, product price, product quality, etc. appear as increases or decreases on the vertical consumer utility axis. The curve originates at a point above the beginning of a curve which is initially characterized by randomness. This is because the consumer gains some utility from a supermarket handling groceries alone, be it product price differentials, store cleanliness, product quality, etc. The utility curve rises as facilities are added, "leveling off" at some optimal number of additional facilities. Such a "leveling off" occurs as there is only so much a consumer can do in one shopping trip, after which any other facilities cannot be utilized due to a lack of time.

The curve of the probability of consumer patronage with respect to additional store values can be illustrated as follows;

FIGURE 25

THE PROBABILITY OF CONSUMER PATRONAGE - ADDITIONAL FACILITIES PROVIDED RELATIONSHIP



Note: it is assumed that all other variables with the exception of additional facilities are constant.

The probability curve, with the assumption of all other things remaining equal, originates at the point of random selection as illustrated earlier. It is discontinuous, as outlined through the illustration of consumer utility, and its vertical position is determined by the same reasoning. The "leveling off" of the probability curve is a result of the lack of utility to be gained from those facilities which are not utilized.

Chapter Summary and Conclusions

This chapter specifically outlined those store variables, described by Forbes, which are applicable to supermarket patron analysis and distance decay. Thus, in supermarket consumer behaviour analysis, the analyst must take into account the relevant general variables described in Chapter III and the specific variables described in Chapter IV.

The previous chapters have presented the background and theoretical portion of the thesis. The gravity model has been outlined and additional variables have been postulated as having a marked effect upon the model's outcome and needing further consideration when studying supermarket customer behaviour.

The chapters which follow are more practical in nature. They involve the setting of various hypotheses concerning the effect or effects of the previously described variables upon sales, and hypotheses testing.

CHAPTER V

THE ESTABLISHMENT OF WORKING HYPOTHESES

Introduction

Chapter V concerns itself with the formulation of hypotheses regarding the possible effect, or effects of various consumer behaviour variables upon supermarket sales. In addition to Huff's suggested product price variable, hypotheses regarding specific consumer behaviour variables and supermarket buying habits, other than those allowed for in $\mathcal{L}$, will be made.

Chapter V will be concerned with the establishment of testable hypotheses. That is, hypotheses which can be tested using currently available data. As a result, some of the variables discussed in the preceding theoretical portion of the thesis will be omitted. In each case the criteria for omission will be discussed. It is hoped that as data collection techniques improve, one will be able to fully test all consumer behaviour variables and their effects upon retail store patronage in general.

In the chapters which follow, hypotheses will be established and tested using currently available data. Testing will include simple and multiple regression techniques and T-test analyses. Upon completion of the various tests, thesis conclusions will be drawn.

The Available Data

The testing of hypotheses is constrained by the availability of appropriate data. Hence, Chapter IV opens with a description of the available data. The data was collected under the following sub-sections;

1. Annual Sales
2. Selling Area (Square Feet)
3. Parking Spaces - Car Spaces
4. Complementary Area - The evaluation of retail stores and services in the immediate area.
5. Bakery
   - A. Full
   - B. Bake-off, Service Bakery
6. Delicatessen - yes or no
7. Discount Prices - yes or no
8. External Appearance

9. Internal Appearance

10. Number of Customer Checkouts

11. Store Opening Year (Limited Data)

The establishment of testable hypotheses is, then, constrained by the above form of data.

The Setting of the Hypotheses

As stated earlier, hypotheses will be set, so as to be tested in the following chapter using the currently available data. In each case, a particular relationship between the chosen variable and store sales will be hypothesized. In addition, the null hypothesis will be stated so as to establish a basis for hypothesis testing.

Degree of Product Substitutability

The consumer's willingness to travel to a supermarket offering specific food items or products for sale is affected by his willingness to substitute other products, offered at more proximate locations. Within the classification of groceries, with the exception of specialty goods, we find that many products can be substituted for one another at little expense to the consumer. Packaged rolls may be substituted for fresh rolls. Canned, frozen and fresh vegetables are interchangeable as meal supplements. Products themselves may be interchanged, peas for corn, potatoes for rice, and oranges for apples.

Therefore, product substitutability, as such, was not allowed for in the formulating of hypotheses.

Expected Absolute Price Differentials

The inclusion of price policy information in the collected data allows the formulation of the following hypothesis;

hypothesis: the mean sales per square foot of selling area of a supermarket employing a discount price policy will be significantly different from those of a supermarket employing a retail price policy

null hypothesis: the mean sales per square foot of selling area of a supermarket employing a discount price policy will not be significantly different from those of a supermarket employing a retail price policy

The Absolute Price in Relation to Consumer Income

The absolute price of groceries in relation to consumer income may play an important role in the consumer's decision to patronize a particular supermarket. However, it will not be directly allowed for, and tested in the analysis.

Should the consumer's perceived subsistance level of food in relation to other goods "required" by her, require excess consumer expenditures, the consumer may become aware of absolute prices in relation to her income. If this is the case, it is felt that the majority of such consumers will begin to "search out" lower price image supermarkets.

Thus, if the absolute price in relation to consumer income is prevalent in the consumer patronage decision, it should be accounted for by the variable expected product price differentials.

"Psychic Income" and Social Class

As stated in Chapter III, both the "psychic income" and social class variables of consumer patronage behaviour are, in the least, difficult. Although it is intuitively felt that both variables play some role in the patronage of supermarkets, measurement by marketers of the degree and effect of each has not really been successful. Hence, due to the lack of a tool of analysis, both the "psychic income" and the social class variables will be omitted from variable tests.

Advertising

The advertising variable will not be included in variable tests for two reasons;

1. marketers have not been very successful in quantifying nor determining the effects of advertising in general

2. the amount of advertising done in the supermarket trade for the area to be studied and simulated, Vancouver, British Columbia, is roughly equal among the major outlets in the area.

Number of Parking Spaces

It was postulated in Chapter IV that an increase in the number of parking spaces provided at a particular supermarket would result in an increase in supermarket sales. Formulating a hypothesis, then, results in the following;

hypothesis: an increase in the portion of a parking space per square foot of supermarket selling space will result in an increase in sales per square foot of supermarket selling space.

null hypothesis: an increase in the portion of a parking space per square foot of supermarket selling space will not result in an increase in sales per square foot of supermarket selling space.

Number of Checkouts

As postulated in Chapter IV, the hypothesis regarding the number of customer checkouts is;

hypothesis: an increase in the portion of a customer checkout per square foot of supermarket selling space will result in an increase in sales per square foot of supermarket selling space.

null hypothesis: an increase in the portion of a customer checkout per square foot of supermarket selling space will not result in an increase in sales per square foot of supermarket selling space.

Product Quality Image

Much like the advertising variable, the store product quality image will not be tested, as;

1. it is very difficult to measure how the consumer perceives product quality

2. within a given price range, product quality is roughly equal for goods offered at supermarkets in the area.

Store Cleanliness Image

Using the internal and external ratings for store appearance as a means of judging the store cleanliness image, the hypothesis is as follows;

hypothesis: the mean sales per square foot of selling area of a supermarket with an overall, high, internal-external appearance rating will be significantly different from those of a supermarket with an overall, low, internal-external appearance rating.

null hypothesis: the mean sales per square foot of selling area of a supermarket with an overall, high, internal-external appearance rating will not be significantly different from those of a supermarket with an overall, low, internal-external appearance rating.

Friendliness of Store Personnel Image

As discussed in Chapter IV, the friendliness of personnel image of a particular supermarket may be a factor considered by the consumer in her decision to patronize that particular outlet. However, due to the difficulty of measuring, and hence, the lack of sufficient data, hypotheses will not be formulated in regards to this particular consumer patronage variable.

Additional Facilities

Using the data provided, it is possible to include additional facilities within a particular supermarket, ie. bakery, meat counter, etc., and those in the immediate area, ie. liquor store, clothing store, hardware store, etc. in this variable. The hypothesis is then;

> hypothesis: the mean sales per square foot of selling area of a supermarket with additional facilities within, or in the immediate area of the premises, will be significantly different from those of a supermarket without such facilities within, or in the immediate area of the premises.

null hypothesis: the mean sales per square foot of selling area of a supermarket with additional facilities within, or in the immediate area of the premises, will not be significantly different from those of a supermarket without such facilities within, or in the immediate area of the premises.

Store Sales and the Probability of Consumer Patronage

One might theorize that an increase in a particular store's sales is a result of a rise in the probability of consumer patronage. Such a theory may arise from the following;

1. a greater number of customers patronizing the outlet
2. the same number of customers spending a greater share of their income at the particular outlet.

In either case, one could assume that because store sales have risen, the probability of consumer patronage has also risen.

The above may be a valid theory. However, a lack of sufficient data makes it impossible to test at this time.

Chapter Summary and Conclusions

In this chapter, working hypotheses have been formulated in regards to the relationships between many of the previously discussed consumer behaviour variables and supermarket sales. However, all previously discussed variables were outlined and if needed, justifications of omissions from hypotheses formulation were presented.

The criterion for omission, a lack of testable data, was also discussed and an outline of the currently available data was presented.

In addition, a digression regarding store sales and the probability of consumer patronage was presented.

In the chapter which follows, the hypotheses formulated in Chapter V will be tested, and either the hypothesis or the null hypothesis accepted.

One may conclude from Chapter V that the practical analyst will be hampered by;

1. a lack of currently suitable data
2. a lack of currently available tools of analysis.

The hypotheses to be tested by the data in the next chapter are:

hypothesis: an increase in the portion of a parking space per square foot of supermarket selling space will (will not) result in an increase in sales per square foot of supermarket selling space

hypothesis: an increase in the portion of a customer checkout per square foot will (will not) result in an increase in sales per square foot of supermarket selling space

hypothesis: the mean sales per square foot of selling area of a supermarket employing a discount price policy will (will not) be significantly different from those of a supermarket employing a retail price policy

hypothesis: the mean sales per square foot of selling area with an overall, high, internal-external appearance rating will (will not) be significantly different from those of a supermarket with an overall, low, internal-external appearance rating

hypothesis: the mean sales per square foot of selling area of a supermarket with additional facilities within, or in the immediate area of the premises, will (will not) be significantly different from those of a supermarket without such facilities within, or in the immediate area of the premises.

CHAPTER VI

HYPOTHESES TESTING

Introduction

Chapter VI is concerned with the statistical analysis of the hypotheses stated in Chapter V. The analysis was carried out in order to test the validity of the hypotheses. The analysis also served to enlighten the analyst's knowledge of consumer shopping habits in a metropolitan area.

Testing the hypotheses involved t-tests and simple and multiple regression analysis, using the University of British Columbia SIMCORT and TRIP (Triangular Regression Package) computer programs. The SIMCORT program was utilized in order to perform t-tests on the data provided. SIMCORT was chosen as it allows the analyst to carry out a t-test upon two variable means for which the number of observations per variable differs. TRIP was utilized to calculate means, standard deviations, correlation coefficients and, to perform both simple and multiple regression analyses.

Chapter VI begins with a description of the data which was earlier outlined. Following this, the analyses and their respective results are presented.

The chapter analysis is divided into two sections; the first, involving those hypotheses tested using a t-test to test the difference between two means and the second involving those hypotheses tested using simple and multiple regression techniques. In each case, the hypotheses to be tested will be stated, the results presented and the conclusions drawn.

Several computer programs utilized in data transformation in preparation for the main analysis appear in Appendices.

The Data

The data outlined in Chapter V was accumulated for supermarkets and grocery stores ranging in estimated annual sales of less than $300,000 to greater than $9,000,000. Hence, the data includes all grocery stores located in the Lower Mainland Area of Vancouver, British Columbia.

The complete census consisted of 1283 grocery stores and included the following, earlier described data;

1. <u>Annual Sales</u>

2. <u>Sales Area</u> (Square Feet)

3. <u>Parking Spaces</u> - Car Spaces

4. <u>Complementary Area</u> - the evaluation of retail stores and services in the immediate area.

Excellent	8
Very Good	6
Good	5
Fair	4
Poor	3
Bad	2
None	0

5. <u>Bakery</u>

Full	1
Bake-off, Service Bakery	2
None	0

6. <u>Delicatessen</u> - yes 1
   - no 0 or blank

7. <u>Discount Prices</u> - yes 1
   - no 0 or blank

8. <u>External Appearance</u> - same scale as Complementary Area

9. <u>Internal Appearance</u> - same scale as Complementary Area

10. <u>Number of Customer Checkouts</u>

11. <u>Store Opening Year</u> (Limited Data)

The subjective evaluations of appearance and complementary area were kept as consistent as possible through the minimization of the number of observers and evaluators. Cross-checks of evaluations showed very consistent results.

It was felt that the evaluation of internal and external appearance should be tested as single, rather than separate parameters. In this way, the consumer's overall opinion of a particular appearance would be simulated.

The consumer, in looking at the appearance and cleanliness of a supermarket, is initially drawn or repelled by the external projection of each. Should this external projection meet the consumer's standards, she will enter the supermarket. If not, assuming that this variable plays a major role in her decision to patronize a particular supermarket, she will choose to patronize another outlet. Should she enter and find that the internal appearance and cleanliness projections are unsatisfactory, she will again choose to patronize another establishment. Hence, it is a combination of both the internal and external appearance and cleanliness projections which attracts this particular form of consumer.

This single parameter was determined through the averaging of the internal and external appearance evaluations.

In each case, the evaluations involving appearance and complementary area were grouped on the following basis;

1) "good or better" (an average evaluation greater than or equal to 5.0)

2) "fair or worse" (an average less than 5.0)

Those supermarkets which were classified as having a bakery were defined as;

> supermarkets in which the "raw" bakery dough was prepared, formed and baked into the final product within the premises.

Those supermarkets which were classified as having a bake-off were defined as;

> supermarkets in which the "raw" bakery dough was prepared and formed outside the premises and baked into the final product within the premises.

The effect of having a bakery or bake-off within the store was taken to be equivalent, as in each case, the goods are freshly baked on the premises. Hence, there was no distinction made between these two and the analysis was carried out on a bakery or bake-off and a no bakery or bake-off basis.

t-Test Analysis

The Hypotheses Tested

Utilizing t-test techniques three hypotheses were tested;

1. the mean sales per square foot of selling area of a supermarket employing a discount price policy will (will not) be significantly different from those of a supermarket employing a retail price policy

2. the mean sales per square foot of selling area of a supermarket with an overall, high, internal-external appearance rating will (will not) be significantly different from those of a supermarket with an overall, low, internal-external appearance rating

3. the mean sales per square foot of selling area of a supermarket with additional facilities within, or in the immediate area of the premises, will (will not) be significantly different from those of a supermarket without such facilities within, or in the immediate area of the premises.

TABLE I

OVERALL MEAN SALES PER SQUARE FOOT t-TEST RESULTS

VARIABLE	n#	MEAN SALES/SQ.FT.	t-PROB.*
Retail Price Policy	1264	124.10	0.4741
Discount Price Policy	17	142.30	
High Overall Appearance Image	561	144.70	0.0000
Low Overall Appearance Image	720	108.50	
No Bakery or Bake-off	1239	123.00	0.0041
Bakery or Bake-off	42	164.30	
No Delicatessen	1257	123.80	0.0059
Delicatessen	24	154.90	
Good Complementary Area	78	183.50	0.0000
Poor Complementary Area	1203	120.50	

* a t-probability of .05 or less indicates a 5% or less chance of the difference between the tested means being a result of randomness

\# the total number of valid observations equals 1281

Price Policy

The analysis thus illustrated that the overall mean sales per square foot of selling area of a supermarket with a retail price policy ($124.10) was not significantly different from the mean sales per square foot of selling area of a supermarket with a discount price policy ($144.70) (t-Prob. = 0.4741) (Table I).

Further testing yielded the results displayed in Table II. A discount price policy did not result in significantly different mean sales/sq. ft. for all size ranges tested. However these differences were in the right direction for the 0-12,000 sq. ft. and 12,000 - 15,000 sq. ft. ranges.

Such results may indicate one, or a combination of the following;

a) as far as expected absolute price differentials are concerned, a majority of supermarket customers may be rational in their decision to patronize a specific outlet. That is, the majority of supermarket customers may weigh travel costs against the absolute price and hence, savings for the item or items which they expect to purchase.

b) as a result of inadequate advertising procedures, the price conscious sector of supermarket patrons may not be kept well informed as to price differentials.

c) there may be a large sector of socially conscious supermarket customers who strive for "psychic income" rather than dollar savings.

d) absolute price differentials may not be sought by a majority of supermarket customers.

e) the less able supermarket operators may resort to a discount price policy which is apparently not an effective competitive tool in the market situation.

f) at the time the study was performed the number of discount supermarkets was limited as this concept of marketing had only recently been implemented in the Vancouver area. Thus, the data for the tests was limited to the first discounters in the area. Since the data was collected the trend to discounting has been strong. Data collected now may produce different results.

TABLE II

PRICE POLICY t-TEST RESULTS (WITHIN A GIVEN SIZE RANGE)

PRICE POLICY	STORE SIZE (SQ.FT.)	n#	MEAN SALES/SQ.FT.	t-PROB.*
Retail Discount	0-12,000	1229 7	123.00 151.30	0.4232
Retail Discount	12,000-15,000	8 6	130.00 163.90	0.5945
Retail Discount	15,000-18,000	15 1	136.50 51.95	-0.0000
Retail Discount	18,000- above	12 3	197.90 108.30	0.1471

* a t-probability of .05 or less indicates a 5% or less chance of the difference between the tested means being a result of randomness

\# the total number of valid observations equals 1281

Overall Internal-External Appearance Image

The overall mean sales per square foot of selling area of a supermarket with a high overall appearance average ($144.70) was significantly different from that of a supermarket with a low overall appearance average ($108.50) (t-Prob. = 0.0000) (Table I).

Testing the hypothesis on a given size basis produced interesting results. Only in the 0-12,000 sq. ft. of store selling space was a significant difference in mean sales/sq. ft. recorded. In the 15,000 - 18,000 sq. ft. range the difference was insignificant due to the number of observations recorded. In the remaining two size ranges; 12,000 - 15,000 sq. ft. and 18,000 - above sq. ft. the differences were insignificant and in the wrong direction. Such may have come about as a result of one, or a combination of the following;

a) a majority of supermarket customers may be highly conscious of both the internal and external appearance images projected by small supermarkets

b) such stores may be those sought out by customers seeking "psychic income" or social image and this sector of the market may be in the majority

c) when a store's sales are not satisfactory and profits are low, its appearance may not be maintained. Therefore, appearance may be a result of, rather than a cause of poor sales.

TABLE III

OVERALL INTERNAL-EXTERNAL APPEARANCE IMAGE t-TEST RESULTS (WITHIN A GIVEN SIZE RANGE)

OVERALL INTERNAL-EXTERNAL APPEARANCE IMAGE	STORE SIZE (SQ.FT.)	n#	MEAN SALES/SQ.FT.	t-PROB.*
High Appearance Image Low Appearance Image	0-12,000	524 712	144.20 108.00	-0.0000
High Appearance Image Low Appearance Image	12,000-15,000	10 4	140.70 154.20	0.7971
High Appearance Image Low Appearance Image	15,000-18,000	15 1	136.50 51.95	-0.0000
High Appearance Image Low Appearance Image	18,000- above	12 3	179.60 181.40	.9267

* a t-probability of .05 or less indicates a 5% or less chance of the difference between the tested means being a result of randomness

\# the total number of valid observations equals 1281

Additional Facilities (Internal)

Bakery or Bake-off

The overall mean sales per square foot of selling area of a supermarket with a bakery or bake-off ($164.30) was significantly different from that of a supermarket without a bakery or bake-off ($122.00) (t-Prob. = 0.0041) (Table I).

The results of testing for differences between mean sales of supermarkets with or without bakeries or bake-offs appear in Table IV. With the exception of the 12,000 - 15,000 sq. ft. range, significantly higher mean sales/sq. ft. were recorded for supermarkets with bakeries or bake-offs. However, the difference in mean sales/sq. ft. within this size range was in the right direction.

These results may indicate one, or a combination of the following;

a) the supermarket customer, when shopping for groceries, may also wish to purchase bakery goods, and may patronize that supermarket which offers such goods for the sake of travelling convenience

b) the supermarket customer may prefer freshly baked goods to pre-packaged ones and in deciding to purchase such goods, they may choose a convenient outlet which offers both freshly baked goods and groceries on the premises

c) the ability to form fresh "raw" dough on the premises allows the baker to make specialty goods which cannot be purchased in the pre-packaged form, thus adding to the attractiveness of the supermarket

d) there may be "psychic income" or social image gained through patronizing a supermarket with a bakery or bake-off.

TABLE IV

BAKERY OR BAKE-OFF t-TEST RESULTS (WITHIN A GIVEN SIZE RANGE)

BAKERY OR BAKE-OFF	STORE SIZE (SQ.FT.)	n#	MEAN SALES/SQ.FT.	t-PROB.*
No Bakery or Bake-off	0-12,000	1224	123.00	.0505
Bakery or Bake-off		12	157.50	
No Bakery or Bake-off	12,000-15,000	8	137.00	.7445
Bakery or Bake-off		6	154.70	
No Bakery or Bake-off	15,000-18,000	4	106.10	.0150
Bakery or Bake-off		12	139.60	
No Bakery or Bake-off	18,000- above	3	97.17	.0114
Bakery or Bake-off		12	200.70	

* a t-probability of .05 or less indicates a 5% chance or less of the difference between the tested means being a result of randomness

\# the total number of valid observations equals 1281

Delicatessen

The overall mean sales per square foot of selling area of a supermarket with a delicatessen ($159.90) was significantly different from that of a supermarket without a delicatessen ($123.80) (t-Prob. = .0059) (Table I).

Testing on a more specific basis proved interesting. A fairly significant difference in mean sales/sq. ft. was recorded in the 0-12,000 sq. ft. range and in the 15,000 - 18,000 sq. ft. range is shown in Table V. The difference in the 12,000 - 15,000 sq. ft. range was in the right direction but not significant. Notice the 18,000 - above sq. ft. range, the difference is not significant and in the wrong direction.

These results may indicate one, or a combination of the following;

a) there may be "psychic income" or social image derived from patronizing a supermarket with a delicatessen

b) those customers who patronize a supermarket for its delicatessen may find disutility in large size stores.

TABLE V

DELICATESSEN t-TEST RESULTS (WITHIN A GIVEN SIZE RANGE)

DELICATESSEN	STORE SIZE (SQ.FT.)	n#	MEAN SALES/SQ.FT.	t-PROB.*
No Delicatessen	0-12,000	1227	123.10	.0837
Delicatessen		9	157.00	
No Delicatessen	12,000-15,000	13	144.30	.2494
Delicatessen		1	147.50	
No Delicatessen	15,000-18,000	8	117.10	.0443
Delicatessen		8	145.40	
No Delicatessen	18,000- above	9	189.50	.4693
Delicatessen		6	165.70	

* a t-probability of .05 or less indicates a 5% chance or less of the difference between the tested means being a result of randomness

the total number of valid observations equals 1281

Additional Facilities (External)

The mean sales per square foot of store selling area of a supermarket with a high complementary area rating ($183.50) was significantly different from that of a supermarket with a low complementary area rating ($120.50) (t-Prob. = 0.0000). That is, supermarkets with other complementary stores nearby had higher sales per square foot than stores without such additional shopping opportunities nearby (Table I).

The results of more specific testing appear in Table VI. Significantly higher mean sales/sq. ft. were recorded in all size ranges except the 18,000 - above range. However the difference in this range was in the right direction.

These results may indicate that;

a) the consumer may strive to maximize the utility of a shopping trip through patronizing as many retail outlets as possible in one trip

b) the consumer may find the concept of a "one stop shopping center" convenient, as it maximizes her exposure to all the types of goods she desires and minimizes travelling time

c) the complementary area appearance may be a reflection of the general economic conditions in the area and this may be reflected in the sales of supermarkets located in these areas.

TABLE VI

COMPLEMENTARY AREA t-TEST RESULTS (WITHIN A GIVEN SIZE RANGE)

COMPLEMENTARY AREA	STORE SIZE (SQ.FT.)	n#	MEAN SALES/SQ.FT.	t-PROB.*
Good Complementary Area Poor Complementary Area	0-12,000	41 1195	165.70 120.60	-0.0000
Good Complementary Area Poor Complementary Area	12,000-15,000	9 5	175.90 88.10	.0043
Good Complementary Area Poor Complementary Area	15,000-18,000	15 1	131.50 127.40	.0005
Good Complementary Area Poor Complementary Area	18,000- above	13 2	189.40 118.60	1.0000

* a t-probability of .05 or less indicates a 5% chance or less of the difference between the tested means being a result of randomness

the total number of valid observations equals 1281

Conclusions: T-test Analyses

From the t-tests which were performed, one must conclude that in general;

1. the mean sales per square foot of selling area of a supermarket employing a discount policy are not significantly different from those of a supermarket employing a retail price policy

2. the mean sales per square foot of selling area of a supermarket with an overall, high internal-external appearance rating are significantly different from those of a supermarket with an overall, low, internal-external appearance rating

3. the mean sales per square foot of selling area of a supermarket with additional facilities within, or in the immediate area of the premises are significantly different from those of a supermarket without such facilities within, or in the immediate area of the premises.

However on a more specific basis store size must be considered in the analysis of supermarket appearance and additional facilities within and in the immediate area of a particular outlet.

The Correlation Matrix

Prior to the regression analyses, a correlation matrix was produced from the data and is presented in Table VII. The matrix yields a correlation coefficient, r, which is a measure of the linear association between two variables. The value of r ranges from -1 to +1; -1 indicates a perfectly negative linear relationship between two variables and +1 indicates a perfectly positive linear relationship between the variables. The closer r is to zero, the weaker the linear relationship between the variables.

TABLE VII

THE CORRELATION MATRIX

	Estimated Annual Sales	Square Feet of Store Selling Area	Estimated Annual Sales per Square Feet of Selling Area	Number of Customer Parking Spaces	Number of Customer Checkouts	Number of Parking Spaces per Square Feet of Selling Area
Square Feet of Store Selling Area	.8570a					
Estimated Annual Sales per Square Foot of Selling Area	.1610a	.0147e				
Number of Customer Parking Spaces	.7837a	.7047a	.1021a			
Number of Customer Checkouts	.4738a	.5801a	.0448e	.1021a		
Number of Parking Spaces per Square Foot of Selling Area	.7486a	.6909a	.1073a	.9184a	.4236a	
Number of Checkouts per Square Foot of Selling Area	.0683c	.0801b	.0556d	.0395e	.2970a	.0726b

* n = 1283 observations

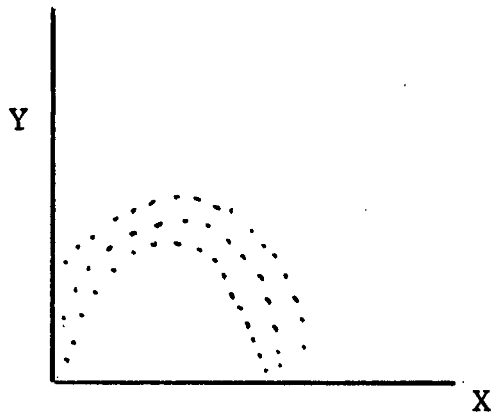
** the significance of the r values was determined using the Student t-Test

(a) significant to the .001 level
(b) significant to the .01 level
(c) significant to the .02 level
(d) significant to the .05 level
(e) significant to the .1 level

It is important to remember that the correlation coefficient between two variables is a measure of their linear relationship, and a value of r = 0 implies a lack of linearity and not a lack of association. Hence, if a strong quadratic relationship exists between X and Y, Figure 26, we still obtain a zero correlation to indicate a nonlinear relationship. 11

FIGURE 26

ZERO CORRELATION - STRONG QUADRATIC RELATIONSHIP ILLUSTRATED



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11 R.E. Walpole, Introduction to Statistics, New York, The MacMillan Company, 1968, page 285.

Conclusions: The Correlation Matrix

Summarizing the results of the correlation matrix on an independent event basis, one finds that;

1. there is no significant correlation between supermarket sales per square foot of selling area and supermarket sales (.1610)

2. there is no significant correlation between supermarket sales per square foot of selling area and supermarket selling area (.0147)

3. there is no significant correlation between supermarket sales per square foot of selling area and either the number of parking spaces provided (.1021) or the number of parking spaces provided per square foot of supermarket selling area (.1073)

4. there is no significant correlation between supermarket sales per square foot of selling area and either the number of customer checkouts provided (.0448) or the number of customer checkouts provided per square foot of supermarket selling area (.0556)

5. there is a strong, significant, positive correlation between supermarket sales and the supermarket selling area (.8570)

6. there is a strong significant correlation between supermarket sales and the number of parking spaces provided (.7837), and supermarket sales and the number of parking spaces provided per square foot of supermarket selling area (.7486)

7. there is a relatively significant correlation between supermarket sales and the number of customer checkouts provided (.4738), however, there is no correlation between supermarket sales and the number of customer checkouts provided per square foot of supermarket selling area (.0683)

8. there is a significant correlation between supermarket selling area and the number of parking spaces provided (.7047)

9. there is a significant correlation between supermarket selling area and the number of customer checkouts provided (.5801).

However, upon observing the complete correlation matrix, we find that some interdependency occurs between several of the variables as shown in Table VIII. The correlation between supermarket sales and parking spaces provided (.7837) is probably not a significant finding as supermarket sales correlates with area (.8570) and parking spaces provided correlates with area (.7047). Similarly, the correlation between supermarket sales and parking spaces per square foot (.7486), sales correlates with area (.8570), and parking spaces per square foot correlates with area (.6909) is a similar type of co-linear relationship. The correlation coefficient of .4738 between sales and the number of customer checkouts provided, sales with area (.8570), and the number of checkouts provided and area (.5801), again is most likely a co-linear relationship, not a finding of significance.

Thus, one may conclude from the correlation matrix that sales are related to selling area, parking is related to selling area and checkouts are related to selling area. Hence, the number of parking spaces provided and the number of customer checkouts provided are a function of store area. The decision, on behalf of management, then, as to parking and/or checkouts, is dependent upon store area and is not solely made on the basis of each having a direct effect upon sales.

TABLE VIII

INTERDEPENDENT CORRELATION RESULTS

VARIABLE	CORRELATION COEFFICIENT	VARIABLE	CORRELATION COEFFICIENT	VARIABLE	CORRELATION COEFFICIENT
Sales Parking Spaces	.7837	Sales Area	.8570	Parking Spaces Area	.7047
Sales Pk. Sp./ Sq. Ft.	.7486	Sales Area	.8570	Pk. Sp./ Sq. Ft. Area	.6909
Sales Checkouts	.4738	Sales Area	.8570	Checkouts Area	.5801

* n = 1283 observations

Correlation - Regression Analysis

The Hypotheses Tested

Correlation - regression techniques were used to test two of the hypotheses formulated in the previous chapter:

1. an increase in the portion of a parking space per square foot of supermarket selling space will (will not) result in an increase in sales per square foot of supermarket selling space
2. an increase in the portion of a customer checkout per square foot of supermarket selling space will (will not) result in an increase in sales per square foot of supermarket selling space.

In addition, the ability to predict sales per square foot by observing either sales area, parking spaces, or checkouts was tested. Tests were also performed using sales as the dependent variable and either sales area, parking spaces, checkouts, the number of parking spaces per square foot of selling area, or the number of customer checkouts per square foot of selling area as the independent variable. A multiple regression analysis was then employed in order to test the ability to predict sales by observing sales area, the number of parking spaces provided and that portion of a parking space provided per square foot of selling area.

Initial Analysis

The basis of regression analysis is "how well a straight line explains the relationship between variables".[12] The degree to which a straight line explains this relationship and hence the predictability of the dependent variable is given by r^2. The value r^2, is then, the proportion of the dependent variable which is explained by the independent variable; that is, the percent of the variance of the dependent variable explained by the independent variable. An r^2 value of 1.0 indicates a perfectly linear relationship between the data concerning the dependent and independent variables and hence, perfect predictability. An r^2 value of 0.0 indicates no linear relationship between the data concerning the dependent and independent variables and hence, zero predictability.

As the r^2 value may be obtained through "squaring" the correlation coefficient found in the correlation matrix, it is necessary only to accept the null hypotheses for several of the hypothesised relationships by observing the values for r in the correlation matrix:

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[12] M.R. Spiegel, Theory and Problems of Statistics, New York, Schaum Publishing Co., 1961, page 242.

1. an increase in the portion of a parking space per square foot of supermarket selling space will not result in an increase in sales per square foot of supermarket selling space (correlation coefficient=.1073, hence, r^2=0.0115)

2. an increase in the portion of a customer checkout per square foot of supermarket selling space will not result in an increase in sales per square foot of supermarket selling space (correlation coefficient=.0556, hence, r^2=0.0031).

In addition one must conclude from observing the correlation matrix that;

1. one cannot employ simple regression techniques to predict sales per square foot of supermarket selling space by observing either estimated annual sales (correlation coefficient=.1610, r^2=0.0259), supermarket sales area (correlation coefficient=.0147, r^2=0.0002), the number of parking spaces provided, (correlation coefficient=.1021, r^2=0.0104), or the number of checkouts provided (correlation coefficient=.0448, r^2=0.0020)

2. one cannot employ simple regression techniques to predict sales by observing either the number of customer checkouts provided (correlation coefficient=.4738, r^2=0.2245), the sales per square foot of supermarket selling space (correlation coefficient=.1610, r^2=0.0259) or the number of customer checkouts provided per square foot of supermarket selling space (correlation coefficient=0.0683, r^2=0.0047).

In the form of an overall statement, then, one may conclude that the number of customer parking spaces and the number of customer checkouts provided are linearly related to sales area rather than sales per square foot of selling area. This is due to the way people plan supermarkets where there is complete control over facilities. The planning of sales is not as controllable, much to the chagrin of the supermarket operators.

The Regression Analyses

Three simple regression analyses were performed, and the results reported in Table IX. Using sales as the dependent variable and either sales area, the number of parking spaces provided, or the number of parking spaces provided per square foot of selling area as the independent variable, respective r^2 values of 0.7344, 0.6142 and 0.5605 were found.

As sales area correlates significantly with the number of parking spaces provided (.7047) and the number of parking spaces provided per square foot of selling area (.6909), a problem of multi-collinearity arises. As a result, a multiple regression analysis was performed in order to test the predictability of sales through observing sales area and the number of parking spaces provided (Table X) (r^2=.7988).

TABLE IX

RESULTS: SIMPLE REGRESSION ANALYSIS: SALES CORRELATED WITH -

PREDICTOR	CONSTANT (A)	REGRESSION COEFFICIENT (B)	F-PROB.# (B)	R^2	F-PROB. (R^2) ##
1. Sales Area	-0.4304×10^{-5}	153.9	0.0	0.7344	0.0
2. Number of Parking Spaces	0.1174×10^{6}	6373.0	0.0	0.6142	0.0
3. Parking Spaces / Sq. Ft.	0.9491×10^{5}	0.1023×10^{9}	0.0	0.5602	0.0

* n = 1283 observations

\# if the F-probability is less than .05 it is concluded that B is significantly different from zero

\## due to the manner in which TRIP calculates the F-ratios and corresponding F-probabilities of the simple regression coefficients the F-probability associated with B also applies to R^2. If the F-probability of R^2 is less than .05 it is concluded that R^2 is significantly different from zero

TABLE X

RESULTS: MULTIPLE REGRESSION ANALYSIS: SALES CORRELATED WITH -

VARIABLE	REGRESSION COEFFICIENT	F-PROB. (B)#	CONSTANT	R^2	F-PROB." (entire equation)
1. Sales Area	108.4466	0.0			
2. Number of Parking Spaces	2805.4754	0.0	-0.1170×10^{-5}	0.7989	0.0

* n = 1283 observations

\# if the F-probability is less than .05 it is concluded that B_i is significantly different from zero

" if the F-probability of the entire equation is less than .05 it is concluded that R^2 is significantly different from zero

Although the regression analysis itself was not helpful in testing the hypotheses the above interesting statistics were brought to light. This inability to successfully employ regression analysis using sales per square foot as a dependent variable may have arisen as a result of one, or a combination of the following;

1. the inconsistency of the variances at either end of the distribution
2. the amount of variation throughout the distribution
3. the "built in" bias of assuming a linear relationship where such does not exist.

Conclusions: Regression Analyses

In summarizing the results of the regression analyses one must conclude that;

1. it is possible to employ simple regression techniques to predict supermarket sales by observing supermarket selling area (r^2=0.7344)

2. it is possible to employ multiple regression techniques to predict supermarket sales by observing supermarket selling area and the number of parking spaces provided.

Digression: Sales per Square Foot

The analysis presented in this chapter may also lead one to the conclusion that sales per square foot is a poor measurement of the various, physical, store variables which were tested. Observation of the correlation matrix (Table VII) yields the following;

1. neither parking spaces nor parking spaces per square foot of selling area, nor checkouts per square foot of selling area correlated with sales per square foot of selling area

2. however both parking spaces and checkouts correlated with sales area (.7047 and .5801 respectively) and with sales (.7937 and .4738 respectively).

Such results occur because of the following;

1. there are a number of small stores included in the data which display unique store characteristics such as no parking facilities and/or a greater number of checkouts than is necessary

2. the observation that sales are not completely, linearly related to sales area and hence, changing at a constant rate throughout.

From the correlation matrix of Table I, we also see that there is no significant correlation between supermarket sales per square foot of selling area and supermarket sales. This is indicative of the research performed by the Super Market Institute[13] which found that as store size rises at a steady rate, store sales per square foot rise to a point and then decline. That is, although aggregate sales rise, sales per square foot of selling area decline.

Thus, sales per square foot may be a poor measurement of the effect of various consumer patronage behaviour variables upon store revenue. Perhaps these measurements of effectiveness should be analysed under various size ranges rather than as a whole. Such is indicated by the t-test analyses carried out under various given size ranges.

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[13] Research Division of Super Market Institute, Super Market Institute, Chicago, Library of Congress.

T-tests were performed to test for significant differences in mean sales per square foot of supermarket selling area between specific store variables. It was concluded from the analyses that;

1. a discount price policy does not yield higher sales per square foot of supermarket selling area than a retail price policy in the market and with the data available for analysis.

2. <u>in general</u> the mean sales per square foot of selling area of a supermarket with a high overall appearance average is significantly higher than that of a supermarket with a low overall appearance average.

3. <u>in general</u> the mean sales per square foot of selling area of a supermarket with a bakery is significantly higher than that of a supermarket without a bakery.

4. <u>in general</u> the mean sales per square foot of selling area of a supermarket with a delicatessen is significantly higher than that of a supermarket without a delicatessen.

5. <u>in general</u> the mean sales per square foot of selling area of a supermarket with a high complementary area rating is significantly higher than that of a supermarket with a low complementary area rating

6. in specific cases store size may be an important independent variable for prediction.

Chapter Summary and Conclusions

Chapter VI presented various statistical tests of characteristics of grocery stores and the hypotheses outlined in Chapter V. It was primarily concerned with the testing of various consumer patronage behaviour variables and their possible use in predicting sales of supermarkets and the behaviour of the supermarket patrons in a metropolitan area.

The tests included t-tests, a correlation matrix and simple and multiple regression analyses on grocery store data.

It was concluded from the correlation matrix that;

1. supermarket sales correlated significantly with supermarket selling area (.8570)
2. supermarket selling area correlated significantly with the number of parking spaces provided (.7047)
3. supermarket selling area correlated significantly with the number of customer checkouts provided (.5801).

Hence, decisions regarding parking and/or checkouts are a function of area and are not solely made in order to increase sales.

It was concluded from the simple and multiple regression analyses that;

1. it is possible to employ simple regression techniques to predict supermarket sales by observing supermarket selling area (r^2 = 0.7344)

2. it is possible to employ multiple regression techniques to predict supermarket sales by observing supermarket selling area and the number of parking spaces provided (r^2=.7988).

After an overview of the complete analysis, it was suggested that perhaps overall sales per square foot is not a good measure of consumer patronage. It was also suggested that further analysis be carried out upon sales per square foot per given size range before this measurement of consumer patronage is completely discarded.

One can conclude from these tests that when faced with the problem of supermarket location analysis and/or studying supermarket patron buying habits in a metropolitan area, one may be well advised to consider overall store appearance, additional internal facilities, such as a bakery or delicatessen, complementary area, and store size in the analysis.

CHAPTER VII

STUDY SUMMARY AND CONCLUSIONS

Purpose of the Study

The selection of a retail site is critical in the outcome of a particular business' operations. Site location may mean the difference between a net gain and a net loss for many retail outlets.

The purpose of this study was to analyse consumer patronage behaviour within an urban grocery system so as to assist the location analyst and consumer patronage behaviour analysis in general. The study was structurally centered around Huff's gravity model so as to provide a framework of analysis.

Huff's Gravity Model

Huff's gravity model is probabilistic in nature. Huff states that;

$$P_{ij} = \frac{\dfrac{S_j}{D_{ij}^{\lambda}}}{\sum_{j=1}^{n} \dfrac{S_j}{D_{ij}^{\lambda}}}$$

where

P_{ij} = the probability of a consumer at consumer base i patronizing retail outlet j

S_j = the size of retail outlet j

D_{ij} = the distance from the consumer base i to retail outlet j

λ = a distance exponent inserted into the model to account for the consumer's willingness to travel a specific distance, as this may be non-linear in nature, and includes product substitutability, expected absolute price of product in relation to consumer's income level and the degree of "psychic income" attained from different products.

Additional Consumer Behaviour Variables

As the distance exponent λ has a marked effect upon the outcome of the model, it was suggested that there are variables, other than those discussed by Huff, which should be considered in the determination of λ and in the study of consumer patronage behaviour. Those variables which were discussed as possible candidates for inclusion into the general world, were consumer social class and advertising.

On a more specific basis, suggestions as to those variables which may be instrumental in the consumer's decision to patronize a retail grocery outlet were then discussed. These included the availability of customer parking, the number of customer checkouts, product quality image, store cleanliness image, friendliness of personnel image and additional facilities such as a bakery, a delicatessen or additional facilities in the immediate area of the premises.

The Data

Data on all grocery stores in the Lower Mainland area of British Columbia was provided by Kelly Douglas and Company Limited, updated and cross-checked by the author. This data was, in effect, the data on a complete system of grocery shopping in a metropolitan area. It included the following data:

1. Annual Sales
2. Sales Area
3. Parking Spaces
4. Complementary Area - the evaluation of retail stores in the immediate area
5. Bakery - full
- bake-off
- none
6. Delicatessen - yes
- none
7. Discount Prices - yes
- none
8. External Appearance
9. Internal Appearance
10. Number of Customer Checkouts
11. Store Opening Year (limited data)

The Hypotheses

Using the availability of current data as a constraint, hypotheses were stated in regards to the probable outcome of various consumer patronage behaviour variables upon a model for retail grocery store location analysis. The following were hypothesized;

hypothesis: an increase in the portion of a parking space per square foot of supermarket selling space will (will not) result in an increase in sales per square foot of supermarket selling space

hypothesis: an increase in the portion of a customer checkout per square foot will (will not) result in an increase in sales per square foot of supermarket selling space

hypothesis: the mean sales per square foot of selling area of a supermarket employing a discount price policy will (will not) be significantly different from those of a supermarket employing a retail price policy

hypothesis: the mean sales per square foot of selling area with an overall, high, internal-external appearance rating will (will not) be significantly different from those of a supermarket with an overall, low, internal-external appearance rating

hypothesis: the mean sales per square foot of selling area of a supermarket with additional facilities within, or in the immediate area of the premises, will (will not) be significantly different from those of a supermarket without such facilities within, or in the immediate area of the premises.

Statistical Analysis

The hypotheses involving price policy, overall appearance, internal and external additional facilities were tested using t-test techniques. From the analysis, it was concluded that, in general, a discount price policy did not result in significantly higher mean differences in sales per square foot of selling area from a retail price policy. In general, a high internal-external appearance rating yielded higher mean sales per square foot than a low internal-external appearance rating. In general the addition of extra facilities, both within, and in the immediate area of a supermarket, resulted in higher mean sales per square foot of selling area. It was also shown that in some cases the analyst should take store size into account when analyzing these supermarket consumer behaviour variables.

Correlation regression analyses were used to test those hypotheses concerned with customer checkouts and parking spaces. It was concluded from the correlation matrix that neither an increase in the portion of a parking space per square foot of selling space nor an increase in the portion of a customer checkout per square foot of selling space would result in an increase in the sales per square foot of selling space of a retail grocery outlet (correlation coefficients of .1072 and

.0556 respectively). Hence, the null hypotheses were accepted.

Simple regression analyses were then performed, correlating sales with sales area (r^2 = 0.7344), number of parking spaces (r^2 = 0.6142) and parking spaces per square foot of selling space (r^2 = 0.5605). As both parking spaces and parking spaces per square foot of selling area correlated with area, (correlation coefficients of .7047 and .6909 respectively), a multiple regression analysis was performed in order to eliminate multi-collinearity. Correlating sales with sales area and parking spaces provided yielded an r^2 value of 0.7988. From this analysis, it was concluded that is was possible to employ simple regression techniques to predict supermarket sales by observing supermarket selling area, and multiple regression techniques to predict supermarket sales by observing supermarket selling area and parking spaces provided.

Conclusions

A lack of sufficient data made it impossible to test the locational model per se. Hence, the model was neither proven nor disproven. Rather, hypotheses involving supermarket consumer patronage behaviour were tested and the analyst's knowledge in this field was increased.

It was concluded from the study that the supermarket location analyst and/or the marketer interested in urban supermarket patronage, would be well advised to include store appearance, additional facilities, both internal and external, and store size in his analysis.

It was also suggested that those interested in locational models in general, and/or consumer patronage behaviour in general, include social class, advertising, and specific store variables in their analyses.

However, the main conclusion to be drawn is that the shopping patterns of people are complex. This paper has shown that there are some very interesting and intuitively satisfying, statistical relationships which come from the data. A complete answer as to how consumers shop for groceries, has not been provided by this study. Some illumination has been provided on this complex problem but there is still room for further research.

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APPENDIX A

The TRIP (TRIANGULAR REGRESSION PACKAGE) COMPUTER PROGRAM

```
$RUN      -LØAD#+*TRIP
 INMSDC
 SIMREG
 MULREG
$ENDFILE
$SIGNØFF
```

where

INMSDC - reads in a set of data cards or a tape for the first run of TRIP and produces an array of sums and sums of products according to a predetermined coding system. From the array it computes means, standard deviations and correlation coefficients.

SIMREG - computes regression equations of the form $y = a + bx$ from a correlation array choosing the dependent variable according to a specific coding system.

MULREG - computes regression equations of the form $y = b_o + b_1x_1 + b_2x_2 + \dots b_mx_m$ from an uninverted or partially inverted correlation matrix using a predetermined coding system. 15

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15 Bjerring, Dempster, Hall, U.B.C. TRIP (Triangular Regression Package), Unpublished Computer Manual, University of British Columbia, February, 1969, pages 3-4.

APPENDIX B

THE COMPUTER PROGRAM SUBROUTINE UTILIZED IN
THE SIMPLE AND MULTIPLE REGRESSION ANALYSES

```
$RUN    FØRTRAN

        SUBRØUTINE  TDATA  (X,N,*)

        DØUBLE PRECISIØN  X(120)

  10    READ  (4,1, END=20)  (X(I), I=1,4)

        IF  (X(2).EQ.0.0)  GØ TØ 10

   1    FØRMAT  (/37X, F9.0, F5.0, 5X, F5.0, 8X, F2.0)

C   SALES PER SQUARE FØØT ØF SUPERMARKET SELLING SPACE
        X (5) = X(1)/X(2)

C   THE PØRTIØN ØF A CUSTØMER PARKING SPACE PER SQUARE FØØT
        X (6) = X(3)/X(2)

C   THE PØRTIØN ØF A CUSTØMER CHECKØUTS PER SQUARE FØØT
        X (7) = X(4)/X(2)

        RETURN

  20    RETURN 1

        END

$ENDFILE
```

where

x(1) = estimated annual sales

x(2) = store selling area

x(3) = the number of parking spaces provided

x(4) = the number of customer checkouts provided

APPENDIX C

THE SIMCORT COMPUTER PROGRAM

```
$RUN    -LØAD#+*SIMCØRT   4= *TAPE*
 TITLE CARD
 PARAMETER CARD
$ENDFILE
$SIGNØFF
```

where

SIMCORT - computes means, standard deviations, and simple correlation coefficients for variables which contain missing values in the data. T-tests within the same set are optional. 16

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16 Hall, U.B.C. SIMCORT, Unpublished Computer Manual, University of British Columbia, June, 1969, page 1.

APPENDIX D

THE COMPUTER PROGRAM SUBROUTINE UTILIZED IN THE t-TESTS INVOLVING OVERALL MEAN SALES PER SQUARE FOOT

```
      SUBRØUTINE DATA (X,NV,*)
      DIMENSIØN X(180)
 1001 DØ 2000 I=9,50
      X(I)=-1.0
 2000 CØNTINUE
      READ (5,2,END=105) (X(I),I=1,8)
    2 FØRMAT (/37X,F9.0,F5.0,11X,2F1.0,1X,4F1.0,2X)
      IF (X(2).EQ.0.0) GØ TØ 1001
C   EXPECTED ABSØLUTE PRICES
      IF (X(6).EQ.0.0) GØ TØ 20
      IF (X(6).EQ.1.0) GØ TO 30
      WRITE (6,77) X(6)
   77 FØRMAT (1X,G16.8,'INVALID')
      GØ TØ 1001
C   RETAIL PRICE PØLICY
   20 (X(9)=X(1)/X(2)
      X(10)=-1.0
      GØ TØ 40
C   DISCØUNT PRICE PØLICY
      30 X(10)=X(1)/X(2)
      X(9)=-1.0
      GØ TØ 40
C   CLEANLINESS IMAGE
C   AVERAGING INTERNAL-EXTERNAL APPEARANCE
   40 X(11)=(X(7)+X(8))/2.0
      IF (X(11).GE.5.0) GØ TØ 50
      IF (X(11).LT.5.0) GØ TØ 60
      WRITE (6,88) X(11)
   88 FØRMAT (1X,G16.8,'INVALID')
      GØ TØ 1001
C   HIGH INTERNAL-EXTERNAL AVERAGE (GE.5.0)
   50 X(12)=X(1)/X(2)
      X(13)=-1.0
      GØ TØ 70
C   LØW INTERNAL-EXTERNAL AVERAGE (LT.5.0)
   60 X(13)=X(1)/X(2)
      X(12)=-1.0
      GØ TØ 70
C   ADDITIØNAL FACILITIES
C   INTERNAL
C   BAKERY ØR NØ BAKERY
   70 IF (X(4).EQ.0.0) GØ TØ 80
      IF (X(4).GT.0.0) GØ TØ 90
      WRITE (6,99) X(4)
   99 FØRMAT (1X,G16.8,'INVALID')
      GØ TØ 1001
```

```
C  NØ BAKERY
   80  X(14)=X(1)/X(2)
       X(15)=-1.0
       GØ TØ 100
C  BAKERY
   90  X(15)=X(1)/X(2)
       X(14)=-1.0
       GØ TØ 100
C  DELICATESSEN ØR NØ DELICATESSEN
   100 IF (X(5).EQ.0.0) GØ TØ 110
       IF (X(5).GT.0.0) GØ TØ 120
       WRITE (6,55) X(5)
   55  FØRMAT (1X,G16.8,'INVALID')
       GØ TØ 1001
C  NØ DELICATESSEN
   110 X(16)=X(1)/X(2)
       X(17)=-1.0
       GØ TØ 130
C  DELICATESSEN
   120 X(17)=X(1)/X(2)
       X(16)=-1.0
       GØ TØ 130
C  EXTERNAL
C  NEIGHBØURHØØD (CØMPLIMENTARY AREA)
   130 IF (X(3).GE.5.0) GØ TØ 140
       IF (X(3).LT.5.0) GØ TØ 150
       WRITE (6,11) X(3)
   11  FØRMAT (1X,G16.8,'INVALID')
       GØ TØ 1001
C  GØØD NEIGHBØURHØØD
   140 X(18)=X(1)/X(2)
       X(19)=-1.0
       RETURN
C  PØØR NEIGHBØURHØØD
   150 X(19)=X(1)/X(2)
       X(18)=-1.0
       RETURN
   105 RETURN 1
       END
```

APPENDIX E

THE COMPUTER PROGRAM SUBROUTINE UTILIZED IN THE t-TESTS INVOLVING MEAN SALES PER SQUARE FOOT (WITHIN A GIVEN SIZE RANGE)

```
      SUBRØUTINE DATA (X,NV,*)
      DIMENSIØN X(180)
 1001 DØ 2000 I=9,50
      X(I)=-1.0
 2000 CØNTINUE
      READ (5,2,END=105) (X(I),I=1,8)
    2 FØRMAT (/37X,F9.0,F5.0,11X,2F1.0,1X,4F1.0,2X)
      IF (x(2).EQ.0.0) GØ TØ 1001
C EXPECTED ABSØLUTE PRICES
C PRICE SIZE SØRT
      IF (X(6).EQ.0.0.AND.X(2).GT.0.0.AND.X(2).LE.12000.0) GØ TØ 3
      IF (X(6).EQ.0.0.AND.X(2).GT.12000.0.AND.X(2).LE.15000.0)
                                                             GØ TØ 4
      IF (X(6).EQ.0.0.AND.X(2).GT.15000.0.AND.X(2).LE.18000.0)
                                                             GØ TØ 5
      IF (X(6).EQ.0.0.AND.X(2).GT.18000.0) GØ TØ 6
      IF (X(6).EQ.1.0.AND.X(2).GT.0.0.AND.X(2).LE.12000.0) GØ TØ 7
      IF (X(6).EQ.1.0.AND.X(2).GT.12000.0.AND.X(2).LE.15000.0)
                                                             GØ TØ 8
      IF (X(6).EQ.1.0.AND.X(2).GT.15000.0.AND.X(2).LE.18000.0)
                                                             GØ TØ 9
      IF (X(6).EQ.1.0.AND.X(2).GT.18000.0) GØ TØ 10
      WRITE (6,100) X(6)
  100 FØRMAT (1X,G16.8,'INV')
      GØ TØ 1001
 C RETAIL PRICE PØLICY
 C SIZE LE 12000
    3 X(9)=X(1)/X(2)
      X(13)=-1.0
      GØ TØ 11
 C SIZE GT 12000 LE 15000
    4 X(10)=X(1)/X(2)
      X(14)=-1.0
      GØ TØ 11
 C SIZE GT 15000 LE 18000
    5 X(11)=X(1)/X(2)
      X(15)=-1.0
      GØ TØ 11
 C SIZE GT 18000
    6 X(12)=X(1)/X(2)
      X(16)=-1.0
      GØ TØ 11
```

```
C DISCØUNT PRICE PØLICY
C SIZE LE 12000
   7  X(13)=X(1)/X(2)
      X(9)=-1.0
      GØ TØ 11
C SIZE GT 12000 LE 15000
   8  X(14)=X(1)/X(2)
      X(10)=-1.0
      GØ TØ 11
C SIZE GT 15000 LT 18000
   9  X(15)=X(1)/X(2)
      X(11)=-1.0
      GØ TØ 11
C SIZE GT 18000
  10  X(16)=X(1)/X(2)
      X(12)=-1.0
      GØ TØ 11
C CLEANLINESS IMAGE
C AVERAGING INTERNAL-EXTERNAL APPEARANCE
  11  X(17)=(X(7)+X(8))/2.0
C APPEARANCE SIZE SØRT
      IF (X(17).GE.5.0.AND.X(2).GT.0.0.AND.X(2).LE.12000.0)
                                                     GØ TØ 12
      IF (X(17).GE.5.0.AND.X(2).GT.12000.0.AND.X(2).LE.15000.0)
                                                     GØ TØ 13
      IF (X(17).GE.5.0.AND.X(2).GT.15000.0.AND.X(2).LE.18000.0)
                                                     GØ TØ 14
      IF (X(17).GE.5.0.AND.X(2).GT.18000.0) GØ TØ 15
      IF (X(17).LT.5.0.AND.X(2).GT.0.0.AND.X(2).LE.12000.0)
                                                     GØ TØ 16
      IF (X(17).LT.5.0.AND.X(2).GT.12000.0.AND.X(2).LE.15000.0)
                                                     GØ TØ 17
      IF (X(17).LT.5.0.AND.X(2).GT.15000.0.AND.X(2).LE.18000.0)
                                                     GØ TØ 18
      IF (X(17).LT.5.0.AND.X(2).GT.18000.0) GØ TØ 19
      WRITE (6,101) X(17)
 101  FØRMAT (1X,G16.8,'INV')
      GØ TØ 1001
C HIGH INTERNAL-EXTERNAL APPEARANCE AVERAGE (GE.5.0)
C SIZE LE 12000
  12  X(18)=X(1)/X(2)
      X(22)=-1.0
      GØ TØ 20
```

```
C   SIZE GT 12000 LE 15000
     13  X(19)=X(1)/X(2)
         X(23)=-1.0
         GØ TØ 20
C   SIZE GT 15000 LE 18000
     14  X(20)=X(1)/X(2)
         X(24)=-1.0
         GØ TØ 20
C   SIZE GT 18000
     15  X(21)=X(1)/X(2)
         X(25)=-1.0
         GØ TØ 20
C   LØW INTERNAL-EXTERNAL APPEARANCE AVERAGE (L.T.5.0)
C   SIZE LE 12000
     16  X(22)=X(1)/X(2)
         X(18)=-1.0
         GØ TØ 20
C   SIZE GT 12000 LE 15000
     17  X(23)=X(1)/X(2)
         X(19)=-1.0
         GØ TØ 20
C   SIZE GT 12000 LE 15000
     18  X(24)=X(1)/X(2)
         X(20)=-1.0
         GØ TØ 20
     19  X(25)=X(1)/X(2)
         X(21)=-1.0
         GØ TØ 20
C   ADDITIØNAL FACILITIES
C   INTERNAL
C   BAKERY ØR BAKE-ØFF
C   BAKERY SIZE SØRT
     20  IF (X(4).EQ.0.0.AND.X(2).GT.0.0.AND.X(2).LE.12000.0)
                                                        GØ TØ 21
         IF (X(4).EQ.0.0.AND.X(2).GT.12000.0.AND.X(2).LE.15000.0)
                                                        GØ TØ 22
         IF (X(4).EQ.0.0.AND.X(2).GT.15000.0.AND.X(2).LE.18000.0)
                                                        GØ TØ 23
         IF (X(4).EQ.0.0.AND.X(2).GT.18000.0) GØ TØ 24
         IF (X(4).GT.0.0.AND.X(2).GT.0.0.ANDX(2).LE.12000.0)
                                                        GØ TØ 25
         IF (X(4).GT.0.0.AND.X(2).GT.12000.0.AND.X(2).LE.15000.0)
                                                        GØ TØ 26
         IF (X(4).GT.).).AND.X(2).GT.15000.0.AND.X(2).LE.18000.0)
                                                        GØ TØ 27
         IF (X(4).GT.0.0.AND.X(2).GT.18000.0) GØ TØ 28
         WRITE (6,102) X(4)
```

```
  102  FØRMAT (1X,G16.8.'INV')
       GØ TØ 1001
C NØ BAKERY
C SIZE LE 12000
   21  X(26)=X(1)/X(2)
       X(30)=-1.0
       GØ TØ 29
C SIZE GT 12000 LE 15000
   22  X(27)=X(1)/X(2)
       X(31)=-1.0
       GØ TØ 29
C SIZE GT 15000 LE 18000
   23  X(28)=X(1)/X(2)
       X(32)=-1.0
       GØ TØ 29
C SIZE GT 18000
   24  X(29)=X(1)/X(2)
       X(33)=-1.0
       GØ TØ 29
C BAKERY
C SIZE LE 12000
   25  X(30)=X(1)/X(2)
       X(28)=-1.0
       GØ TØ 29
C SIZE GT 12000 LE 15000
   26  X(31)=X(1)/X(2)
       X(27)=-1.0
       GØ TØ 29
C SIZE GT 15000 LE 18000
   27  X(32)=X(1)/X(2)
       X(28)=-1.0
       GØ TØ 29
C SIZE GT 18000
   28  X(33)=X(1)/X(2)
       X(29)=-1.0
       GØ TØ 29
C DELICATESSEN ØR NØ DELICATESSEN
C DELICATESSEN SIZE SØRT
   29  IF (X(5).EQ.0.0.AND.X(2).GT.0.0.AND.X(2).LE.12000.0)
                                                    GØ TØ 30
       IF (X(5).EQ.0.0.AND.X(2).GT.12000.0.AND.X(2).LE.15000.0)
                                                    GØ TØ 31
       IF (X(5).EQ.0.0.AND.X(2).GT.15000.0.AND.X(2).LE.18000.0)
                                                    GØ TØ 32
```

```
      IF (X(5).EQ.0.0.AND.X(2).GT.18000.0) GØ TØ 33
      IF (X(5).GT.0.0.AND.X(2).GT.0.0.AND.X(2).LE.12000.0)
                                                      GØ TØ 34
      IF (X(5).GT.0.0.AND.X(2).GT.12000.0.AND.X(2).LE.15000.0)
                                                      GØ TØ 35
      IF (X(5).GT.0.0.AND.X(2).GT.15000.0.AND.X(2).LE.18000.0)
                                                      GØ TØ 36
      IF (X(5).GT.0.0.AND.X(2).GT.18000.0) GØ TØ 37
      WRITE (6,103) X(5)
  103 FØRMAT (1X,G16.8,'INV')
      GØ TØ 1001
C NØ DELICATESSEN
C SIZE LE 12000
   30 X(34)=X(1)/X(2)
      X(38)=-1.0
      GØ TØ 38
C SIZE GT 12000 LE 15000
   31 X(35)=X(1)/X(2)
      X(39)=-1.0
      GØ TØ 38
C SIZE GT 15000 LE 18000
   32 X(36)=X(1)/X(2)
      X(40)=-1.0
      GØ TØ 38
C SIZE GT 18000
   33 X(37)=X(1)/X(2)
      X(41)=-1.0
      GØ TØ 38
C DELICATESSEN
C SIZE LE 12000
   34 X(38)=X(1)/X(2)
      X(34)=-1.0
      GØ TØ 38
C SIZE GT 12000 LE 15000
   35 X(39)=X(1)/X(2)
      X(35)=-1.0
      GØ TØ 38
C SIZE GT 15000 LE 18000
   36 X(40)=X(1)/X(2)
      X(36)=-1.0
      GØ TØ 38
C SIZE GT 18000
   37 X(41)=X(1)/X(2)
      X(37)=-1.0
      GØ TØ 38
C EXTERNAL
```

```
C NEIGHBØURHØØD (CØMPLIMENTARY AREA)
C NEIGHBØURHØØD SIZE SØRT
   38   IF (X(3).GE.5.0.AND.X(2).GT.0.0.AND.X(2).LE.12000.0)
                                                   GØ TØ 39
        IF (X(3).GE.5.0.AND.X(2).GT.12000.0.AND.X(2).LE.15000.0)
                                                   GØ TØ 40
        IF (X(3).GE.5.0.AND.X(2).GT.15000.0.AND.X(2).LE.18000.0)
                                                   GØ TØ 41
        IF (X(3).GE.5.0.AND.X(2).GT.18000.0) GØ TØ 42
        IF (X(3).LT.5.0.AND.X(2).GT.0.0.AND.X(2).LE.12000.0)
                                                   GØ TØ 43
        IF (X(3).LT.5.0.AND.X(2).GT.12000.0.AND.X(2).LE.15000.0)
                                                   GØ TØ 44
        IF (X(3).LT.5.0.AND.X(2).GT.15000.0.AND.X(2).LE.18000.0)
                                                   GØ TØ 45
        IF (X(3).LT.5.0.AND.X(2).GT.18000.0) GØ TØ 46
        WRITE (6,104) X(3)
  104   FØRMAT (1X,G16.8,'INV')
        GØ TØ 1001
C GØØD NEIGHBØURHØØD (GE.5.0)
C SIZE LE 12000
   39   X(42)=X(1)/X(2)
        X(46)=-1.0
        RETURN
C SIZE GT 12000 LE 15000
   40   X(43)=X(1)/X(2)
        X(47)=-1.0
        RETURN
C SIZE GT 15000 LE 18000
   41   X(44)=X(1)/X(2)
        X(48)=-1.0
        RETURN
C SIZE GT 18000
   42   X(45)=X(1)/X(2)
        X(49)=-1.0
        RETURN
C PØØR NEIGHBØURHØØD (LT.5.0)
C SIZE LE 12000
   43   X(46)=X(1)/X(2)
        X(42)=-1.0
        RETURN
C SIZE GT 12000 LE 15000
   44   X(47)=X(1)/X(2)
        X(43)=-1.0
        RETURN
```

```
C SIZE GT 15000 LE 18000
   45  X(48)=X(1)/X(2)
       X(44)=-1.0
       RETURN
C SIZE GT 18000
   46  X(49)=X(1)/X(2)
       X(45)=-1.0
       RETURN
  105  RETURN 1
       END
```