A RANKING OF SELECTED HOUSING SERVICES

AND HOUSING ALTERNATIVES WITH PARTICULAR

REFERENCE TO CONVENTIONAL HOMES, CONDOMINIUM

APARTMENTS AND MOBILE HOMES

by

Kamran Izadpanah

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NAME: Kamran Izadpanah

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Examining Committee:

        Chairman: Dr. D. DeVortez

                        T. Var
                   Senior Supervisor

                   J.L. Knetsch

                R.B. Horsfall
            Department of Geography
            Simon Fraser University

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Author:

(signature)

KAMRAN IZADPANAH

(name)

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(date)

ABSTRACT

Three related questions regarding the quality of shelter
are (a) the components of quality, and (b) the extent to which
these may be associated with various types of housing, and (c)
whether certain classes of purchasers evidence differences in
quality demands. This study, in order to examine these questions,
treats shelter as a bundle of services purchased by the
consumer.

Interviews were conducted with 25 housing experts
(primarily from the real estate brokerage industry) and a
random sample of 100 home purchasers to identify the most
sought-after housing features. Fourteen variables were
identified as being most strongly associated with perceived
variations in quality. These were weighted, using a technique
developed by Churchman, Ackoff, and Arnoff (1957), and used
to develop a numerical scoring formula. The weighting technique
insures internal consistency Data were also collected on
selected buyer characteristics and on the potential investment
returns of housing, by type.

Results indicate that there is some correlation between
buyer characteristics and the demand for various types of
residential services. It was also determined that among
alternative shelter types (single-family-detached, condominium,
and mobile home), single-family detached dwellings provide the
most complete service bundle. There was also evidence to

suggest that this type of housing was better from an investment

point of view.

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I

INTRODUCTION

For centuries the word "shelter" merely implied a form
of protection against the elements. In keeping with the
general trend of change, however, people's expectation of a
"shelter" and of the residential services it provides have
changed. These changes have resulted in a bigger and more
extensive bundle of residential services.

The expanded bundle of residential services has changed
the image of housing from a place in which one "survives" to
a place in which one "lives". So one can argue that shelter
is a combination of various residential services. This
means ". . . that housing consumers demand not a homogeneous
good 'housing' but rather bundles of specific housing
attributes."[1] Thus it can be concluded that people purchase
a bundle of residential services when they purchase a "shel-
ter".

The growing importance attached to residential services
has increased the need for studies on this subject. It is
the primary intention of this paper to produce a useful and
relatively uncomplicated study of housing attributes which
can provide assistance particularly to those in the housing
industry.

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[1]John F. Kain and John M. Quigley. Housing Market and
Racial Discrimination: A Microeconomic Analysis.
National Bureau of Economic Research, New York, 1975, p. 190.

This study attempts to provide an index of specific residential services that housing consumers consider in choosing their "shelter". It also attempts to compare alternative types of shelter regarding the provision of the housing services. It then provides some testing of investment return to the types of shelter.

The study is divided into eight sections. Chapter II presents a brief survey of literature on the subject of housing attributes. Chapter III is concerned with the objectives and methodological aspects of this study. It introduces experts evaluation technique in determining average weights and ranks of housing attributes. Chapter IV defines alternative types of housing that are used in this study and their relative ranking. Chapter V concerns itself with the preferences of the actual shelter buyers for the residential services. It also attempts to determine the influence of variables such as income, age and number of children on the shelter buyer's preferences. Chapter VI concerns itself with the per square foot aspects of alternative types of shelter. It attempts to estimate the dollar value of residential services. Chapter VII concerns itself with the investment analysis of the alternative types of shelter. Finally, Chapter VIII gives the summary and conclusions to this study.

II

SURVEY OF LITERATURE

The importance of housing attributes has made them the subject of a variety of studies. Although these studies cover various methods and approaches, they may be classified in three categories:

    I.   Studies that are mostly concerned with listing and ranking housing attributes according to personal preferences;

    II.   Studies which are based on the statistical estimation of the effect of some housing attributes on the total value of residential services;

    III.   Studies which have attempted to estimate the demand for housing attributes.

A substantial body of literature has been written on the topic of the first category. As Paxton has stated: "There were, to be sure, any number of surveys and reports of one kind or another on people's likes and dislikes in housing."[1] This is equally true today, some twenty years later. For example, Paxton (1955) himself produced a list of considerations to which home buyers give particular attention in purchasing their home. His survey indicates

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[1] Edward T. Paxton. <u>What People Want When They Buy a House</u>. U.S. Department of Commerce, United States Government Printing Office, Washington, 1955, p. 1.

that the preferences of the buyers in order of importance, are location, price, size of house or rooms and characteristics of house or setting.

Zimmer and Hawley (1961) in another study focused upon the factors homebuyers were looking for in the suburb. Their study shows that some factors such as accessibility usually are being sacrificed in favour of factors such as privacy and space.

Steffens (1964) attempted to explore many of the locational factors that prospective homebuyers consider when selecting a new residential location . . ..[2] Through investigation of the respondents' previous location, he determined the major deficiency of the previous location. In this way, he not only determined why the respondent changed his location and what factors were being avoided in the present location, but also those factors that the respondent considered important in choosing a new location so as to avoid the previous negative factors. R. Deway (1948) explained the factors (i.e. best buy at the time) that people consider for moving to an incorporated area (specifically the various reasons given for moving to a particular site).

Ridker and Henning (1967), as an example of the works in the second category, investigated the effects of various

[2] Roger C. Steffens. Factors Influencing Consumer Choice of Residential Location: An Explanatory Study of the Preference of Owners of Newly Constructed Dwellings in the Greenborg Urban Fringe Area. University of North Carolina, Chapel Hill, 1964.

factors such as air pollution, accessibility to downtown, and quality of school in determining residential property value. Their study shows that the air pollution variable is relatively as important as is accessibility to highways in explaining residential property value. Kain and Quigley (1970), showed that the quality of a bundle of residential services, has at least as much effect on the price of a home as some factors such as the lot size and number of rooms.

In a later study, Kain and Quigley (1975) attempted to estimate the market value of a complete bundle of residential services, both physical and environmental. Their work constitutes one of the few attempts to estimate the demand for housing attributes. They presented single-equation estimates of household demands for housing attributes. The household consumption of some twenty-one housing attributes were considered, and the effect of some independent variables upon the consumption of residential space and neighborhood quality was shown.

Long before Kain and Quigley (1975), David (1961) attempted to study the demand for housing attributes. His study was not as complete and comprehensive as Kain's and Quigley's study. As they pointed out: "M. David gave limited recognition to the heterogeneity of both the housing

stock and household demand for housing services . . ."[3]
The results of David's study were obtained through ordinary
least-squares methods which analysed the consumption of
housing considering two measures: price per room for
measuring housing quality and number of rooms for measur-
ing housing quantity.

Kain and Quigley (1975) have achieved the most complete
study of demand for housing attributes. Due to its import-
ance, more discussion of their work is required. The
twenty-one housing attributes that were used as dependent
variables were classified into four groups of conceptually
similar attributes as are shown below:

Dwelling Quality

Interior
Exterior
Newness (Year Built)
Hot Water
Central Heating

Structure Type

Single Detached
Duplex
Rowhouse
Flat
Apartment

Dwelling-Unit Size

Rooms
Baths
First floor area(000's sq.ft.)
Parcel area (000's sq.ft.)

Neighborhood Attributes

Adjacent Units
Block face
Median schooling
Percent white
Miles from CBD
School quality
Crime

[3]John F. Kain and John M. Quigley. op. cit., p. 232.

The seventeen independent variables that they used to explain the demand for housing attributes are as follows:

Race   Income   Education
Years on current job   Retired   Non-employed
More than one employed

Families   Household Types

Number of persons   Single female $<$ 45 years
Female head $<$ 45 years   Single female $>$ 45 years
Female head $>$ 45 years   Single male $<$ 45 years
Male head $>$ 45 years   Single male $>$ 45 years
                           Couple, head $<$ 45 years
                           Couple, head $>$ 45 years

A least-squares technique was used in order to establish a single equation estimate for all the twenty-one housing attributes. As they stated:

> "The emperical analyses of the demand for individual housing attributes can be divided logically into two parts. First we present attributes demand equation for a pooled sample of owner and renter households. We include in this pooled sample all renters and all owners of multi-family units, as well as the owners of single detached housing. The second section considers the effect of housing market discrimination on the demand for housing attributes by black households."[4]

This study provided a farily complete coverage of households' selection of housing attributes. Their findings are summarized thus:

> "Households with larger incomes and more education seem to choose higher-quality dwelling units, located further from CBD. They also consume more of the attributes of neighborhood quality and prestige and unit of slightly larger physical size. In contrast,

[4]Ibid., p. 233.

at the same income, larger households consume substantially more of the attributes of physical size, particularly dwelling unit and residential quality."[5]

Dividing households according to race showed that blacks consumed less dwelling-unit quality and amenities and desirable neighborhood attributes in comparison to the white households with similar socio-economic characteristics.

[5]Ibid., pp. 254-255.

III

THE OBJECTIVE OF THIS STUDY

This explanatory study is to present a set of factors considered by shelter buyers in choosing a shelter. It is entirely an empirical study and it is hoped that the results can be used for different purposes, particularly in planning. In order to achieve this objective, an attempt will be made to determine:

a) The criteria for choosing a shelter;

b) The average weights and ranks of these criteria;

c) The final score for different types of shelter: conventional home, condominium apartment, mobile home;

d) The measure of investment return in different types of shelter.

3.1 Criteria for Choosing a Shelter

"In buying housing, families jointly purchase a wide variety of services at a particular location. These include a certain number of square feet of living space, different kinds of rooms, a particular structure type, an address, accessibility to employment, a neighborhood environment, a set of neighbors, and a diverse collection of public and quasi-public services including schools, garbage collection, and police protection."[1]

Thus, for choosing and purchasing a shelter, a complete

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[1]John F. Kain and John M. Quigley. <u>Measuring the Value of Housing Quality</u>. Journal of the American Statistical Association 70, No. 330, June, 1970, p. 532.

bundle of residential services should be taken into account.

A set of fourteen criteria has been selected as the most important factors for choosing a shelter. (These criteria do not provide a complete list of residential services since some services such as availability of hot water or electricity have been omitted with the belief that these services are necessary and available in almost every residential housing within the boundaries of metropolitan areas.) They suggested that choice of shelter "j" is a function of:

$$SHj = f(Cj, Lf, Fj, Sj)$$

where

SHj = choice of shelter j;

Cj = comfort factors;

Lj = location factors;

Fj = facility factors;

Sj = social factors.

Each of these four major groups, then, contains a number of criteria shown in Exhibit I. These fourteen criteria seemed to provide a reasonably complete set of considerations which would be useful in choosing a shelter. In choosing these criteria, the opinions of housing experts and people who were planning to purchase a shelter have been considered, although neither group directly participated in the selection of criteria. In order to make each criterion more understand-

EXHIBIT I

CRITERIA FOR CHOOSING A SHELTER

Group Heading	Criterion	Consideration
I. Comfort Factors	1. Privacy	noise, distance from other homes, from street, private entrance
	2. Size	number of rooms, size of the building, basement
	3. Quality of Construction	material used, insulation (against cold and heat)
	4. Attractiveness	style and design
II. Location Factors	5. Distance from Recreational Facilities	parks, swimming pool, playground, golf course, tennis court, wilderness area, ball field, cinema
	6. Distance from Shopping Centre	supermarket, bank, drug-store, restaurant, hospital
	7. Distance from School	kindergarten, primary school, high school
	8. Distance from Places of Employment and Business Sectors	factories, offices, company
III. Facility Factors	9. Ease of Maintenance	plumbing, electricity, painting, building repair
	10. Recreational Facilities (inside the house)	swimming pool, sauna, recreational room, play ground
IV. Social Factors	11. Neighbourhood	people of the district, cleanliness, economic future of the district, pollution
	12. Municipal Services	fire and police protection, snow removal, garbage collection, street maintenance
	13. Ease of Resale	appreciation, time needs for reselling
	14. Transport Facilities	public transport

able, a number of considerations defines each criterion.[2]
Special attention was given to assuring the independence
of these criteria from each other. For example, the
importance of one criterion to the shelter buyers does not
influence the importance of the other criteria. Having a
list of completely independent criteria is an ideal, but
rather impossible, since many of these criteria one way
or the other are related to each other. But as P. Fishburn
said: "it is better to proceed and recognize that the
results constitute an approximation rather than despair and
resort to inaction for failure to realize a condition theor-
etically desirable but practically impossible to establish."[3]

3.2 Methodology for Estimating Criteria Weight

Twenty-five experts in housing with different back-
grounds and viewpoints were selected for this part of the
study.[4] Table I shows the breakdown of the experts by
vocational class.

[2]Since Exhibit I was used as a questionnaire only in personal
interviews, explanation for each criterion was kept as brief
as possible.

[3]Peter C. Fishburn. Decision and Value Theory. Wiley, 1964,
Chapter 9, in Charles E. Gearing, William W. Swart and Turgut
Var, "Establishing a Measure of Touristic Attractiveness",
Journal of Travel Research, Spring, 1974, p. 2.

[4]The idea of using experts' views is taken from Gearing,
Swart and Var, op. cit.

Table I

Breakdown of the Experts by Vocational Class

Vocational Class	Number of Experts
Real estate salesmen and managers	11
Academic researchers in housing	2
Real estate researchers	4
Mobile home dealers	4
Mortgage Officers	4
Total	25

The experts' opinions were used in order to establish:

I. The relative importance of these criteria in

comparison with each other, as indicated by a

series of numerical weights.

II. A numerical weight for each of the three different

types of shelter; conventional home, condominium

apartment and mobile home, with reference to

availability of each of the above criteria.

Experts were asked to evaluate criteria as the represent-

ative of an average shelter buyer, e.g., a family with an

annual income of about $15,000 and at least one child at home.

Since experts were assumed to be familiar with the

attitudes and choices of the people planning to purchase a

shelter and also with alternative types of shelter, their

views were used as being representative of the shelter buyers

group. The main reasons for using experts' opinions are

firstly, saving in time and cost. Secondly, the number of

shelter buyers who have complete knowledge about different

types of housing are very limited. Thirdly, to reduce biases

in the results, since there could be some differences

between opinions expressed by people and their actual

behavior.[5] Experts do not show the same biases because

they are familiar with the <u>actual behavior</u> of the housing

consumer and thus their judgements reflect actual, not

anticipated behavior.

Problems arise since monetary scales are not usable in

many cases. For example, it would be difficult to directly

measure a dollar value of privacy or attractiveness or

neighborhood. Knowing the above problem and the fact that

this study is based on subjective views of the experts, a

reliable means of comparing their judgements is required.

With these objectives in mind, the method which was intro-

duced by Churchman, Ackoff and Arnoff (1957) was used in

each single expert's interview <u>in order</u> to evaluate the rela-

tive importance of the criteria as indicated by series of

<u>numerical weights</u>. This method is a means of building an

interval scale through a series of ordinal judgements. It

should be mentioned here that this method was successfully

used in several other studies.[6] A brief outline of the

[5]See Gearing, Swart and Var, <u>op. cit</u>., p. 2.

[6]See Turgut Var, R.A.D. Beck and Patrick Loftus, <u>Determination
of Touristic Attractiveness of the Touristic Areas in
British Columbia</u>, Forthcoming in the Journal of Travel
Research.

procedures involved in this method is given in Appendix A.

3.3 Experts' Opinions Results

Each expert was interviewed following the procedure outlined in Appendix A. The final weights were derived by taking sample means for each criterion.[7] The results are shown in Table II.

Table II

Rank and Average Weights of Criteria for Choosing
A Shelter, Experts' Evaluation

	Criteria	Weight	Rank
1.	Privacy	.080	6.5
2.	Size	.089	4
3.	Quality of construction	.065	8
4.	Attractiveness	.065	8
5.	Distance from recreational facilities	.045	13
6.	Distance from shopping centre	.090	3
7.	Distance from school	.106	1
8.	Distance from places of employment and business sectors	.094	2
9.	Ease of maintenance	.080	6.5
10.	Recreational facilities	.047	12
11.	Neighborhood	.081	5
12.	Municipal services	.051	11
13.	Ease of resale	.065	8
14.	Transport facilities	.042	14

Coefficient of concordance	0.3993	
Chi-squared statistic	129.7879	
Probability of exceeding chi-squared	0.0000	

[7] Although Appendix A has sufficiently explained the method of establishing weights, a brief explanation is recommended here. The figures representing weights (Wj in Appendix A) are numbers between 0 and 1, which are the product of the normalized value of each criterion (Uj, in Appendix A) multiplied by the normalized value of each major group (Xi, in Appendix A).

A question may arise concerning the extent of agreement among the respondents. A statistical measure that captures the extent of agreement would strengthen our belief in the results. In order to describe the extent to which members of a set of M distinct rank ordering of n criteria are in agreement, a single measure was required. For this purpose Kendall's coefficient of concordance was employed.[8] The coefficient of concordance in this study suggests agreement among experts. To reinforce this evidence the technique of hypothesis testing was employed. The chi-squared statistic (129.7879) and probability of exceeding chi-squared (0.0000) of the data under consideration indicates that there is little possibility that the agreement between experts has occured by chance alone.

The results of the ranking indicate that location was felt to be the most important factor of the bundle of residential services for choosing a shelter. This is neither new nor surprising. Several earlier studies have already explained the importance of residential location. For example, Haig (1926), stated: "The theoretically perfect site for the

[8] $$W = \frac{12S}{M^2(n^3-n)}$$

Where W = coefficient of concordance
    S = Sum of squares of the actual deviations.

Value of W ranging between 0 and 1. W = 1 indicates total agreement in ranking and W = 0 is an indication of total randomness. See Maurice G. Kendall, Rank Correlation Methods, Charles Griffin and Company Limited, 1948, Ch. 6, or William L. Hays, Statistics for the Social Science, Second edition, Holt, Rinehart and Winston, Inc., 1973, p. 801.

activity is that which furnishes the desired degree of accessibility at the least cost of friction."[9] Paxton (1955) also indicated that location of the dwelling is the most important factor influencing consumer choice. He specified that shelter buyers considered location in terms of the closeness to places of employment, stores, school and public transportation.[10] It should be noted here that several other studies did not consider accessibility, particularly distance from places of employment, as an important criterion for choosing a shelter.[11]

The suitable location of a shelter provides convenience by saving time and reducing transportation costs. To an average income family, transportation costs are an important part of the family budget, as evidenced by Table III. This is particularly the case in British Columbia, where transportation costs are higher than the national level.

Closeness to places of employment, schools and shopping centers maximizes households' utility subject to lower transportation costs. In the case of proximity to schools, the

[9] Robert M. Haig, _Toward an Understanding of the Metropolis_, Quarterly Journal of Economics, Vol. XL, No. 3, May 1926, p. 418.

[10] Edward T. Paxton, _op. cit._, p. 11.

[11] For example, Allan L. Backler, _A Behavioral Study of Locational Changes in Upper Class Residential Location Area: The Detroit Example_, Department of Geography, Indiana University, p. 61, who refers to John Lansing, Eva Muller and Nancy Barth, _Residential Location and Urban Mobility_, Ann Arbor: Survey Research Centre, Institute for Social Research, University of Michigan, 1964, p. 38.

non-financial convenience that households would receive is
more important than just cost and time saving motives.
Among location factors, "distance from recreational
facilities" has received a lower rank. This is due to the
fact that trips to recreational facilities are usually
weekly or bi-monthly trips and as a result not an important
part of the family budget. The criteria "size" and "neigh-
borhood" have received the highest ranking next to distance
factors. The suitable size and neighborhood, as we will see
in Chapter V are important criteria for choosing a shelter
regardless of characteristics of the shelter buyers. The
criteria "quality of construction", "attractiveness" and
"ease of resale" have received an equal medium ranking.
The criteria "recreational facilities" (C_{10}), "distance
from recreational facilities" (C_5), and "transport facili-
ties" have received the lowest ranking. This is due to the
fact that although their availability is required to make a
shelter a better place to live, the existence of these
services is not very important.

Table III

Pattern of Expenditure by Province
All Urbanization Classes
All Families and Unattached Individuals

	All Classes		British Columbia	
	Average $ Expenditure	Percentage Distribution	Average $ Expenditure	Percentage Distribution
Food	1523.5	18.7	1418.7	17.6
Shelter	1239.7	15.2	1247.1	15.5
Rental Living Quarters	420.0	5.1	428.3	5.3
Owned Living Quarters	503.3	6.2	505.8	6.3
Other Housing	62.8	.8	55.7	.7
Water	253.6	3.1	257.3	3.2
Household Operation	331.2	4.1	327.3	4.1
Furnishings and Equipment	372.6	4.6	401.3	5.0
Household Appliances	95.9	1.2	98.7	1.2
Other	276.7	3.4	302.6	3.8
Clothing	664.0	8.1	574.8	7.1
Personal Care	175.0	2.1	157.1	1.8
Medical and Health Care	274.8	3.4	235.5	2.9
Smoking and Alcoholic Beverages	308.2	3.8	282.1	3.5
Travel and Transportation	1068.6	13.1	1117.2	13.9
Automobile (and Truck)	881.8	10.8	903.8	11.2
Purchase	410.2	5.0	408.0	5.1
Operation	471.6	5.8	495.8	6.2
Other	186.8	2.3	213.4	2.6
Recreation	280.9	3.4	331.1	4.1
Reading	50.7	.6	54.0	.7
Education	69.4	.9	68.7	.9
Miscellaneous Expenses	126.7	1.6	151.6	1.9
TOTAL CURRENT CONSUMPTION	6485.4	79.5	6366.6	79.0
Personal Taxes	1104.2	13.5	1129.3	14.0
Security	354.6	4.3	339.5	4.2
Gifts and Contributions	217.8	2.7	223.4	2.8
TOTAL EXPENDITURE	8161.1	100.0	8058.8	100.0

Source: Statistics Canada, Family Expenditure in Canada, Vol. 1, 1969, 62535, P. 64.

IV

HOUSING, A HETEROGENEOUS GOOD

Treating shelter as a combination of differently weighted attributes changes its image of being a homogeneous good. The availability of housing attributes at different levels in various types of housing makes shelter a heterogeneous commodity.

4.1 Alternative Types of Housing

In order to show this heterogeneity, three different types of shelter - conventional home, condominium apartment and mobile home - were selected for evaluation by the same experts. Before proceeding any further, it is necessary to define these three different types of shelter.

Conventional Home:

"This type is commonly called a 'single house'. It contains only one dwelling unit which is completely separated on all sides from any other dwelling or structure."[1] Construction materials are combined by skilled labourers at the site in order to complete the dwelling unit.

Condominium Apartment:

An individual unit in a multiple unit structure with

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[1]Statistics Canada, Housing Starts and Completions, Catalogue #64-002, monthly, September 1976, p. 7.

common elements. Common elements are "those parts of the property that are owned in common by the unit owners, i.e. halls and passageways, parking area, swimming pool, etc."[2]

Mobile Home:

"It is a movable or portable dwelling constructed for year round living and is towed on its own chassis, connected to utilities and designed without a permanent foundation. It can consist of one or more units that can be folded, collapsed or telescoped when towed, and expanded later for additional cubic capacity. It can also consist of two or more units, separately towable, but designed to be joined into one integral unit, capable of being again separated into the components for repeated towing."[3]

4.2 Derivation of Final Scores

The judgements of the same group of housing experts were employed for the derivation of quantitative measures for alternative types of shelter with respect to the provision of residential services. The housing experts were asked to evaluate only those types of housing with which they are most familiar in order to reduce the possibility of any biased results. They assigned numerical value for a particular type of shelter on each of the fourteen criteria. Each of

[2]Albin B. Rosenbert, Condominium in Canada, Canada Law Book Limited, Toronto, 1969, pp. XIX, XX.

[3]Harold A. Davidson, Housing Demand: Mobile, Modular or Conventional, Van Nostrand Reinhold Company, 1973, p. 4.

these three types of housing was scored on a scale between 0
and 100 for each criterion shown in Exhibit II. A sample
mean for each criterion was taken in order to represent an
average score for each type of shelter. The product of
these scores and criteria weights represents the final score
for each type of shelter.

$$SSHj = \sum_{k=1}^{i} W_k V_{kj} \qquad j = 1, 2, 3$$

where

    SSHj = Final score for shelter j

    W_k = Numerical weight for criterion k as chosen
            by experts

    V_{kj} = Numerical weight of criterion k in
            shelter j.

Table IV gives us the procedure of derivation of final
score for alternative types of shelter.

Among the alternative types of shelter under study,
conventional homes have received the highest score. The
results in Table IV indicate that conventional dwelling
provides a more complete bundle of residential services for
the housing consumer. These figures indicate that the
advantages of this shelter lie in the provision of criteria
such as "size", "privacy" and "distance from school". Condo-
minium apartments have been ranked second among three types
of shelter. In the provision of location factors, the condo-
minium apartment is a close substitute for conventional dwellings.

Table IV

Derivation of Final Score - Experts' Evaluation

	Criterion Weight (W)	Conventional Home		Condominium Apartment		Mobile Home	
		Shelter Evaluation (V₁)	(W)x(V₁)	Shelter Evaluation (V₂)	(W)x(V₂)	Shelter Evaluation (V₃)	(W)x(V₃)
C1	.080	89.84	7.18	55.40	4.42	62.83	5.02
C2	.089	92.31	8.23	67.12	5.98	56.74	5.06
C3	.065	84.63	5.49	74.46	4.83	70.40	4.57
C4	.065	88.62	5.79	68.85	4.50	50.43	3.30
C5	.045	78.48	3.49	82.20	3.66	61.95	2.76
C6	.090	79.12	7.12	81.60	7.34	60.75	5.47
C7	.106	86.20	9.12	81.28	8.60	63.70	6.74
C8	.094	73.88	6.97	79.72	7.52	59.52	5.62
C9	.080	59.38	4.75	84.71	6.78	80.42	6.44
C10	.047	66.72	3.10	81.80	3.81	55.50	2.58
C11	.081	86.12	7.00	67.80	5.51	57.65	4.68
C12	.051	86.12	4.42	83.44	4.28	57.00	2.92
C13	.065	88.72	5.73	72.96	4.71	54.15	3.50
C14	.042	73.21	3.10	82.04	3.47	55.53	2.35
Final Score			81.50		75.43		61.00

The lower final score that condominium apartments have received is due to the provision of relatively fewer services such as "privacy", "size" and "attractiveness". Although the condominium apartments have received a relatively high score with respect to the provision of criteria such as "recreational facilities" or "transport facilities", the low weights of these criteria have resulted in their contributions to the final score being nominal. The mobile home has received the lowest score. According to the housing experts evaluation, the advantages of this type of shelter lie in the provision of services such as "ease of maintenance" and "quality of construction" which are not the most important services that are required from shelter. Location factors have received a relatively lower score. This is due to the fact that mobile home parks are generally located in the suburbs.

EXHIBIT II

"AN EVALUATION OF DIFFERENT TYPES OF SHELTER"

Please evaluate the different types of shelters that you are most familiar with. Score on a scale of 0 to 100 every criterion under each type of shelter you have selected.

Criteria	two bedroom conventional home	two bedroom condominium apartment	two bedroom mobile home	
Privacy				
Size				
Quality of Construction				
Attractiveness				
Distance from Recreational Facilities				
Distance from Shopping Centre				
Distance from School				
Distance from Places of Employment and Business Sectors				
Ease of Maintenance				
Recreational Facilities				
Neighbourhood				
Municipal Services				
Ease of Resale				
Transport Facilities				

V

VALIDITY OF THE RESULTS

The validity of the results can be tested in alternative ways. Since a rating system based solely on experts' opinions permits little confidence, perhaps a superior way to test the above results is to consider, in addition, the attitudes and views of the actual shelter buyers. The harmony between the experts and actual shelter buyers' views not only reinforces our belief in the use of expert evaluations, it also opens the door to future studies based on experts' views. With this in mind, a shelter buyer's evaluation survey was completed by interviewing 100 shelter buyers.

5.1 Selection of the Shelter Buyers

The shelter buyers were selected randomly from those who have purchased different types of shelter. The sample consisted of 46 conventional home buyers, 31 condominium apartment buyers and 23 mobile home buyers in the Greater Vancouver area within the six months prior to the time of the interviewing. This time constraint was introduced in the hope that those shelter buyers falling into this category would have relatively clear recall of the criteria they employed in the purchase decision. These people were interviewed following the same procedure as was employed in the

interviewing of the experts (Appendix A). The original
questionnaire was extended by a section inquiring about
personal information (Exhibit III). Variables such as
age, income, type of shelter, and number of children are
believed to influence the evaluation of the criteria for
choosing a shelter.

5.2 Crosstabulation Tables

For more information about the characteristics of the
shelter buyers, crosstabulation tables among variables in
our samples are introduced. The tables show the relationships
between variables age and income, income and types of shelter,
income and number of children, age and number of children,
age and types of shelter. Each table is followed by the
relevant chi-square test. "It helps us to determine whether
a systematic relationship exists between two variables.
Since we do not know what the actual relationship is in the
universe, we interpret small values of chi-square to indicate
the absence of a relationship, often referred to as statis-
tical independence. Conversely, a large chi-square implies
that a systematic relationship of some sort exists between
the variables."[1] It has been recommended by some authors

[1]N. Nie, W. Klecka, C. G. Hull, J. G. Jenkinus, K. Steinberg
and D. H. Bent, Statistical Package for the Social Sciences,
Second Edition, McGraw-Hill Book Company, New York, 1975,
pp. 223-224.

that chi-square tests with degrees of freedom greater than

1, less than 20 percent of the cells should have an expected

frequency of less than 5, and no cell should have an expected

frequency of smaller than 1.[2] Adjacent groups, in our sample,

on age, income and number of children have been combined in

order to increase the expected frequencies in different cells.[3]

However, in number of tables the expected frequency of less

than 5 has occured in slightly more than 20 percent of the

cells.

[2] See Sidney Seigel, NonParametric Statistic for the Behavioral Sciences, McGraw-Hill Book Company, Inc., New York, 1956, p. 178.

[3] For the reason mentioned above, the following changes were made for the purpose of crosstabulation:

Age	Representative Value	Annual Family Income	Representative Value
Under 25 years)		Less than $5,000)	
25 - 35) ------------28		$5,000-$8,000)--$ 8,000	
36 - 45)		$8,000-$11,000)	
46 - 55) -----------------45		$11,000-$14,000)	
56 - 65 years)		$14,000-$17,000)---$14,500	
More than 65 years) -------63		$17,000-$20,000)	
		$20,000-$28,000)-$23,500	
		More than $28,000)	

Number of Children	Representative Value
0	0
1)	
2)	
3) -----------------1	
More than 3)	

Note: Conventional homes, condominium apartments and mobile homes are coded by 1, 2 and 3 respectively.

EXHIBIT III

SHELTER BUYERS PERSONAL INFORMATION

1. In which of the following age groups do you belong?
    a) Under 25 years
    b) 25 - 35
    c) 36 - 45
    d) 46 - 55
    e) 56 - 65
    f) Over 65 years

2. What is your annual family income?
    a) Less than $5,000
    b) $5,000 - $8,000
    c) $8,000 - $11,000
    d) $11,000 - $14,000
    e) $14,000 - $17,000
    f) $17,000 - $20,000
    g) $20,000 - $28,000
    h) More than $28,000

3. Do both of you work?
    a) Yes
    b) No

4. How many children live at home?
    a) None
    b) 1
    c) 2
    d) 3
    e) More than 3

5. Do you consider your property an investment?
    a) Yes
    b) No

    If so, do you expect returns upon it?
    a) Yes
    b) No

5.3   Income

Income is believed to be a key variable in determining the choice of the shelter buyer. Shelter buyers in our sample are divided into three groups according to their annual family income.

1.   Low income group (less than $11,000 annual family income).

2.   Middle income group (between $11,000 and $17,000 annual family income).

3.   High income group (more than $17,000 annual family income).

We can perhaps reinforce the choice of our income divisions by introducing Table V.

Table V

All Family Income Groups, Canada by Region, 1974

Family Income Group	Limits of All Family Income Groups					
	Atlantic	Quebec	Ontario	Prairies	British Columbia	Canada
Lower Third	0-7,918	0-9,200	0-11,583	0-9,468	0-11,070	0-10,154
Middle Third	7,919-13,174	9,201-15,020	11,584-17,795	9,469-16,263	11,071-17,281	10,155-16,372
Upper Third	13,175+	15,021+	17,796+	16,264+	17,282+	16,373+
Median Income	10,488	12,291	14,792	12,756	14,196	13,249
Average Income	11,454	13,406	15,814	14,401	15,166	14,485

Source: Central Mortgage and Housing Corporation, Canadian Housing Statistics, Ottawa, 1976.

Low Income Group

The rank and average weights of criteria for choosing a shelter as evaluated by low income shelter buyers are shown

in Table VI.

Table VI

Rank and Average Weights of Criteria for Choosing
A Shelter - Shelter Buyer's Evaluation

Low Income Group (Less Than $11,000)

Criterion	Weight	Rank
C1	.172	1
C2	.081	4
C3	.072	5
C4	.055	8
C5	.067	6
C6	.065	7
C7	.023	14
C8	.048	10
C9	.148	2
C10	.053	9
C11	.108	3
C12	.033	13
C13	.041	11
C14	.034	12

Coefficient of concordance	0.3961
Chi-Squared statistic	66.9417
Probability of exceeding chi-squared	0.0000
Number of cases	13

At first glance the results might be surprising, since
criteria such as "ease of maintenance" (C9), "neighborhood"
(C11), and "privacy" (C1) are the top choices of the low
income group. However, in our sample, the majority of the
shelter buyers in this income group are purchasers of the
mobile homes. That this is in fact the case is evident from
the data in Table VII which presents the crosstabulation
between income and types of shelter. Other surveys have
indicated that mobile home households are mostly young

Table VII

Crosstabulation of Income by Types of Shelter

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FILE   CRITERIA (CREATION DATE = 05/12/77)   FOR CHOOSING SHELTER

* * * * * * * * * * C R O S S T A B U L A T I O N   O F * * * * *
INCO   BY HOME

		HOME			
COUNT		1.I	2.I	3.I	ROW TOTAL
INCO	8000.	0	2	12	14 / 14.0
	14500.	14	26	10	50 / 50.0
	23500.	33	2	1	36 / 36.0
	COLUMN TOTAL	47 / 47.0	30 / 30.0	23 / 23.0	100 / 100.0

CHI SQUARE =   72.62842 WITH   4 DEGREES OF FREEDOM   SIGNIFICANCE =   0.0000

families and retired people with low incomes.[4] (See Table XIII
for crosstabulation between age and types of shelter in our
sample.) Location factors have not been considered as
important criteria for choosing a shelter by this income
group. Although to the young purchaser of mobile homes "dist-
ance from places of employment" is an important factor, other
advantages of mobile homes outweigh distance. "Distance from
school" receives a very low ranking, due to the fact that only
a minority of the mobile home owners have children and when
children reach school age, there is a tendency to move to a
conventional dwelling.[5]

Middle Income Group

The rank and average weights of criteria for choosing a
shelter as evaluated by middle income shelter buyers are
shown in Table VIII.

Table VIII
Rank and Average Weights of Criteria for Choosing
A Shelter - Shelter Buyer's Evaluation
Middle Income Group ($11,000-$17,000)

Criterion	Weight	Rank
C1	.099	4
C2	.107	2
C3	.056	8

[4]See M. J. Audain, Mobile Homes Problems and Prospects,
Queens Printer, Victoria, 1975, p. 11.

[5]For a similar argument see Frederick H. Bair, Jr., Mobile
Homes and the General Housing Supply, Mobile Homes Manu-
facturers Association, Chicago, July, 1969, p. 6.

Table VIII (Cont'd)

Criterion	Weight	Rank
C4	.052	10
C5	.051	11
C6	.076	7
C7	.100	3
C8	.132	1
C9	.094	5
C10	.028	14
C11	.081	6
C12	.034	13
C13	.054	9
C14	.036	12

Coefficient of concordance	0.4376
Chi-squared statistic	284.4428
Probability of exceeding chi-squared	0.0000
Number of cases	50

The results displayed in Table VIII indicate the importance of location factors to middle income shelter buyers. As was explained before, transportation cost accounts for an important fraction of middle income family budgets.[6] Middle income shelter buyers, in order to maximize their utilities, subject to a budget constraint, prefer residential locations close to places of employment and schools.

Among location factors, "distance from shopping centres" (C6) and "distance from recreational facilities" (C5) have received a lower rank. This can be explained by the fact that trips to places of employment and schools are daily activities for most people and as a result, an important and

[6]See Table III.

necessary fraction of their budget. As it has already been explained, trips to shopping centres and recreational facilities are weekly or bi-monthly. It is also interesting that criteria such as "ease of maintenance" (C9), which has a direct effect on family income, loses its importance as income increases.

High Income Group

The rank and average weights of criteria for choosing a shelter as evaluated by high income shelter buyers are shown in Table IX.

Table IX

Rank and Average Weights of Criteria for Choosing
A Shelter - Shelter Buyer's Evaluation

High Income Group (More Than $17,000)

Criterion	Weight	Rank
C1	.105	2
C2	.090	5
C3	.075	6
C4	.096	3
C5	.058	10
C6	.057	11
C7	.061	9
C8	.092	4
C9	.075	6
C10	.039	13
C11	.107	1
C12	.044	12
C13	.072	8
C14	.028	14

Coefficient of concordance	0.2880
Chi-squared statistics	134.8099
Probability of exceeding chi-squared	0.0000
Number of cases	36

Location factors - distance to places of employment, schools and shopping centres - receive a low ranking by the high income

group. The main reason is that neither is transportation cost an important fraction of the family budget, nor is time-saving an important motive. However, one can also argue that time-saving is no longer an important motive due to provision of better transit systems.

Other housing criteria such as suitable neighborhood (C11) provide more satisfaction for the home buyers than does accessibility. The appearance of the criterion "attractiveness" (C4) among the top three criteria for choosing a shelter is an indication that demands for luxury attributes are increased with increase in income.

5.4 Age

Shelter buyers have been classified into three age groups:

1. Young age group (less than 35 years of age);

2. Middle age group (between 36 and 55 years of age);

3. Old age group (more than 56 years of age).

Table X shows the effect of shelter buyer's age on the rank and average weights of criteria for choosing a shelter.

At first glance, the age variable does not seem to have a great influence on the ranking of criteria for choosing a shelter. However, a closer look shows that this variable is a good predictor of shelter buyers' preferences among the criteria. In our sample, the age variable either directly or through other variables has affected the ranking of

Table X

Effect of the Shelter Buyer's Age on the Rank and
Average Weights of Criteria for Choosing a Shelter

Criterion	Less Than 35 Weight	Rank	36 - 55 Weight	Rank	More than 56 Weight	Rank
C1	.109	1	.099	4	.177	1
C2	.100	4	.100	3	.070	5
C3	.075	6	.057	10	.066	7
C4	.070	8	.072	6	.044	11
C5	.062	10	.048	11	.069	6
C6	.071	7	.063	8	.081	4
C7	.053	11	.102	2	.011	14
C8	.106	3	.116	1	.052	9
C9	.109	1	.072	6	.157	2
C10	.029	14	.032	14	.066	7
C11	.085	5	.098	5	.102	3
C12	.032	12	.044	12	.024	13
C13	.067	9	.062	9	.034	12
C14	.031	13	.033	13	.047	10

Coefficient of concordance	0.3221	0.3777	0.4850
Chi-squared statistic	142.3983	270.1123	69.3578
Probability of exceeding chi-squared	0.0000	0.0000	0.0000
Number of cases	34	55	11

criteria for choosing a shelter. This indirect influence

arises because each age group appears to be associated with

particular categories of the other variables. Tables XI,

XII and XIII provide us with crosstabulation between

variables: age and income, age and number of children and

age and types of shelter respectively. Using the information

that these tables provide, the following relationships

between age and the categories of the other variables are

suggested:

Table XI   Crosstabulation of Age by Income

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FILE   CRITERIA (CREATION DATE = 05/12/77)   FOR CHOOSING SHELTER

* * * * * *   C R O S S T A B U L A T I O N   O F   * * * * *
AGE   BY   INCO

AGE	COUNT	INCO 8000.	14500.	23500.	ROW TOTAL
28.		6	17	10	33 / 33.0
45.		1	29	26	56 / 56.0
63.		7	4	0	11 / 11.0
COLUMN TOTAL		14 / 14.0	50 / 50.0	36 / 36.0	100 / 100.0

CHI SQUARE = 32.14713 WITH   4 DEGREES OF FREEDOM   SIGNIFICANCE = 0.0000

Table XII   Crosstabulation of Age by Number of Children

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.02

FILE   CRITERIA (CREATION DATE = 05/12/77)   FOR CHOOSING SHELTER

* * * * * * * * * * * * * * C R O S S T A B U L A T I O N   O F * * * * * * *
         AGE   BY CHIL
* *

	CHIL			ROW TOTAL
COUNT		0. I	1. I	
AGE				
28.		21	12	33 / 33.0
45.		1	55	56 / 56.0
63.		11	0	11 / 11.0
COLUMN TOTAL		33 / 33.0	67 / 67.0	100 / 100.0

CHI SQUARE =   61.01984 WITH   2 DEGREES OF FREEDOM   SIGNIFICANCE =   0.0000

Table XIII   Crosstabulation of Age by Types of Shelter

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.02

FILE   CRITERIA (CREATION DATE = 05/12/77)   FOR CHOOSING SHELTER

* * * * * * * * * * C R O S S T A B U L A T I O N   O F * * * * * * * * * *
AGE   BY   HOME

AGE COUNT	HOME 1.I	2.I	3.I	ROW TOTAL
28.	13	10	10	33 / 33.0
45.	33	19	4	56 / 56.0
63.	1	1	9	11 / 11.0
COLUMN TOTAL	47 / 47.0	30 / 30.0	23 / 23.0	100 / 100.0

CHI SQUARE =   30.79041 WITH   4 DEGREES OF FREEDOM   SIGNIFICANCE =   0.0000

Age	Variables	Income	Number of Children Residing at Home	Types of Shelter
Young age group		Low or middle income	0 or 1	Mobile home or condominium apartment
Middle age group		Middle or high income	1 or more	Conventional home or condominium apartment
High age group		Low or middle income	0	Mobile home

5.5 Number of Children

Shelter buyers have been classified according to the "children" variable, into two groups:

1. Shelter buyers with children who reside at home;

2. Shelter buyers without children.[7]

Table XIV shows the effect of the children of the shelter buyers on the rank and average weights of criteria for choosing a shelter.

Table XIV

Effect of the Children of the Shelter Buyers on the Rank and Average Weights of Criteria for Choosing a Shelter

Criterion	Children Weight	Rank	No Children Weight	Rank
C1	.095	4	.143	1
C2	.103	3	.084	4
C3	.061	10	.071	6
C4	.069	7	.066	9
C5	.047	11	.070	7

[7]The term "shelter buyers without children" refers to the shelter buyers with no children in residence.

Table XIV (Cont'd)

Criterion	Children		No Children	
	Weight	Rank	Weight	Rank
C6	.067	8	.069	8
C7	.105	2	.018	14
C8	.118	1	.083	5
C9	.073	6	.135	2
C10	.029	14	.047	11
C11	.094	5	.093	3
C12	.043	12	.029	13
C13	.064	9	.055	10
C14	.032	13	.036	12

	Children	No Children
Coefficient of concordance	0.3924	0.4048
Chi-squared statistic	336.7055	178.9421
Probability of exceeding chi-squared	0.0000	0.0000
Number of cases	66	34

As was expected, distance from school (C7) has received a high ranking by the shelter buyers with children and a very low ranking by shelter buyers without children. Surprisingly, both the criterion "recreational facilities" (C10) and the criterion "distance from recreational facilities" (C5) received a lower ranking by the shelter buyers with children than by those without children. It is also very interesting that both groups gave a similar rank to the criterion "size" (C2). The ranking of criteria such as "municipal services" (C12) and "transport facilities" (C14), as was expected, is not influenced by the number of children. Table XV shows the crosstabulation between variables income and number of children in our sample.

Table XV   Crosstabulation of Income by Number of Children

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES SPSSH - RELEASE 6.02

FILE   CRITERIA (CREATION DATE = 05/12/77)   FOR CHOOSING SHELTER

* * * * * * *   C R O S S T A B U L A T I O N   O F   * * *
INCO   * * * * * * * * * * * * * *   BY   CHIL   * * * * * * * *

CHIL

COUNT	0.1	1.1	ROW TOTAL
INCO			
8000.	11	3	14 / 14.0
14500.	13	37	50 / 50.0
23500.	9	27	36 / 36.0
COLUMN TOTAL	33 / 33.0	67 / 67.0	100 / 100.0

CHI SQUARE =   15.30012 WITH   2 DEGREES OF FREEDOM   SIGNIFICANCE =   0.0005

5.6 Comparison of the Two Evaluations

Now it is time to compare the experts' evaluation of average weights and ranks of criteria for choosing a shelter, with the actual shelter buyers' evaluation. For this purpose a group of shelter buyers among those with annual family income between $11,000 and $17,000 and at least one child at home was selected as representative of the average shelter buyer's group. Table XVI shows both the results of the average shelter buyer's evaluation and the experts evaluation.

Although some dissimilarities are apparent, the results are generally congruent. Both groups have chosen the same two criteria as their top choices, with an inversion in their ranking. The dissimilarities exist mostly in the ranking of criteria such as "privacy" (C1) and "distance to shopping centre" (C6). However, there is close agreement between ranking of several other criteria such as "neighborhood" (C11), and "quality of construction" (C3).

Table XVI

Rank and Average Weights of Criteria
For Choosing a Shelter
Average Shelter Buyers and Experts Evaluation

| Criterion | Experts | | Average Shelter Buyers | |
	Weight	Rank	Weight	Rank
C1	.080	6.5	.090	4
C2	.089	4	.113	3
C3	.065	8	.056	8
C4	.065	8	.052	10
C5	.045	13	.047	11
C6	.090	3	.072	7
C7	.106	1	.125	2

Table XVI (Cont'd)

Criterion	Experts Weight	Rank	Average Shelter Buyers Weight	Rank
C8	.094	2	.135	1
C9	.080	6.5	.079	6
C10	.047	12	.021	14
C11	.081	5	.085	5
C12	.051	11	.037	12
C13	.065	8	.055	9
C14	.042	14	.033	13

Coefficient of concordance	0.3993	0.5380
Chi-squared statistic	129.7879	272.7893
Probability of exceeding chi-squared	0.0000	0.0000
Number of cases	25	39

5.7 Spearman's Rank Correlation Coefficient

Our confidence in this method will be strengthened if the conclusions made thus far on the basis of what might be termed casual empiricism are supported by statistical examination.

To this end, Spearman's rank correlation coefficient was used. This coefficient is quite similar to the simple Pearson correlation coefficient. "A perfect correlation ($r_s = +1$) means that the two samples rank each object identically, while a perfect negative correlation ($r_s = -1$) means that the ranks of the two samples have an exactly inverse relationship."[8]

[8] Donald L. Harnett and James L. Murphy, Introductory Statistical Analysis, Addison-Wesley Publishing Co. Inc., 1975, p. 469.

$$r_s = 1 - \frac{6 \sum_{i=1}^{n} d_i^2}{n^3 - n}$$

where

> r_s = Spearman's rank coefficient
>
> d_i = The difference between the rank of an object in two samples
>
> n = Number of observations

For the data used in our sample

$$r_s = 1 - \frac{6(36.50)}{2744 - 14}$$

$$r_s = 0.91$$

Significant at .005

This figure indicates a close agreement between both groups on the ranking of criteria for choosing a shelter.

VI

RANKING HOUSING ALTERNATIVES

The method that was used by the experts to derive the final score for each type of shelter is to evaluate these scores by the purchasers of the three different types of shelter. The purchasers were interviewed following the procedure outlined for Exhibit II. Before any attempt to derive the total score, it is advisable to show the rank and average weight of criteria by type of shelter.

Table XVII

Rank and Average Weight of Criteria for Choosing
A Shelter - Shelter Buyers Evaluation
By Type of Shelter Purchased

Criterion	Conventional Home		Condominium Apartment		Mobile Home	
	Weight	Rank	Weight	Rank	Weight	Rank
C1	.100	2	.087	4	.166	1
C2	.093	4	.108	3	.089	4
C3	.072	8	.057	10	.059	7
C4	.085	5	.052	11	.056	8
C5	.053	11	.058	9	.055	9
C6	.065	10	.068	7	.071	5
C7	.074	7	.115	2	.023	14
C8	.103	1	.142	1	.064	6
C9	.076	6	.079	5	.149	2
C10	.034	13	.029	14	.049	10
C11	.098	3	.077	6	.109	3
C12	.044	12	.034	12.5	.031	13
C13	.072	8	.062	8	.038	12
C14	.029	14	.034	12.5	.042	11

Coefficient of concordance	0.2943	0.4956	0.4462
Chi-squared statistic	175.9886	199.7614	133.4318
Probability of exceeding chi-squared	0.0000	0.0000	0.0000
Number of cases	46	31	23

The main reason, apart from that of deriving the final scores, for dividing the shelter buyers according to their types of shelters is to find out their attitudes toward the other two types of shelter. Table XVIII presents the final scores of different types of shelter as evaluated by shelter buyers. These figures are derived following the procedure shown in Table IV.

Table XVIII

Final Scores of Different Types of Shelter
Shelter Buyers Evaluation, By Types of Shelter Purchased

Type of Shelter	Conventional Home	Condominium Apartment	Mobile Home
Conventional Home	83..89	70.86	50.45
Condominium Apartment	82.16	74..29	48.01
Mobile Home	73..77	57..01	54.06

Conventional dwellings have received the highest score by the purchasers of all three different types of shelter. It is interesting that the purchasers of each type of shelter have given a high score to their own type of shelter in comparison to the scores that are given to that dwelling by the purchasers of the other two types of shelter.[1]

6.1 Unit of Services Per Dollar Spending

Many people, particularly those in the mobile home industry have argued that the advantage of the mobile home

[1]The final scores for each criterion in different types of shelter are shown in Appendix B.

lies in its lower price, particularly its lower cost per
square foot. Studies conducted on mobile homes indicate that
the comparative cost advantage of mobile homes over other
types of housing is the main reason for choosing a mobile
home. "For example, 77 percent of the respondents to the 1971
Department of Industrial Development, Trade and Commerce
Survey indicated that they bought a mobile home as it was a
'relatively inexpensive form of housing' and 49 percent of
the respondents to the United Community Services Survey gave
'economy, low cost of acquisition' as their major reason and
62 percent as their second major reason."[2]

The initial survey for this study with the aim of finding
socio-economic characteristics of mobile home owners was based
on two mobile home parks: "Kostur's" and "Wildwood" in
Coquitlam, B. C. A total of 53 mobile home owners were inter-
viewed during the fall of 1975.[3] According to this survey,
83 percent of the people under 30 years of age indicated that
expensiveness of the other types of housing is their reason
for choosing a mobile home. Twenty-seven percent of the people
over sixty years of age gave the same reason for choosing a
mobile home. The relatively cheap selling price of mobile

[2]M. J. Audain, op. cit., p. 12.

[3]In view of our specific orientation, only relevant aspects
pertaining to our study have been utilized.

homes is due to low per square foot cost. This relatively low per square foot cost of mobile homes has been shown empirically in several studies. For example, a recent study conducted on mobile homes in British Columbia indicated that mobile homes have a minimum $8.00 per square foot cost advantage for the purchaser over conventional homes.[4] This study indicates that "new single-wide mobile homes set up in a park are presently retailing at between $17.00 and $25.00 per square foot, depending on their grade and style. By way of comparison, the per square foot costs of detached houses (exclusive of land) are in order of $27.00 to $30.00 in the Lower Mainland.[5] Based on the survey for our study, condominium apartments appear to have per square foot costs of between $24.00 and $29.00. Having established the final scores for different types of shelter, and having estimates of their per square foot cost, it is possible to establish a ratio of final shelter score to per square foot cost. This represents the unit of services provided by shelter per square foot dollar spending. It can be represented by:

$$U_j = \frac{SSH_j}{CC_j}$$

Where U_j = Unit of services per dollar, provided by shelter j;
SSH_j = Final score for shelter j;
CC_j = Per square foot construction cost of shelter j.

[4] M. J. Audain, op. cit., p. 64.

[5] Ibid., p. 64.

In the case of the experts' evaluation, the following

results are obtained:

$$U_{C.H.} = \frac{81.50}{28.5} = 2.859$$

$$U_{C.A.} = \frac{74.43}{26.5} = 2.846$$

$$U_{M.H.} = \frac{61.00}{21.5} = 2.837$$

where

$U_{C.H.}$ = Unit of services per dollar, provided by conventional home;

$U_{C.A.}$ = Unit of services per dollar, provided by condominium apartment;

$U_{M.H.}$ = Unit of services per dollar, provided by mobile home.

Unit of services per dollar provided by alternative types

of shelter as evaluated by shelter buyers is shown in Table XIX.

Table XIX

Units of Services per Dollar, Shelter Buyers Evaluation

	Unit of Services per Dollar		
Type of Shelter Purchased	$U_{C.H.}$	$U_{C.A.}$	$U_{M.H.}$
Conventional Home	2.943	2.673	2.346
Condominium Apartment	2.882	2.727	2.233
Mobile Home	2.588	2.151	2.514

The experts' results and the results displayed in

Table XIX indicate that considering per square foot cost,

these three types of housing are currently close substitutes

for each other. This might be the reason for the sharp

increase in the demand for mobile homes due to increase in

the price of conventional dwellings within the past decade.

6.2 Correlation Analysis

Correlation analysis is generally used in order to evaluate the degree to which a linear relationship exists between the variables under study. "Two variables are said to be correlated when a change in the value of one of the variables tends to be associated with a consistent corresponding change in the value of the other."[6]

Since not all the variables are continuously distributed, the coefficients of correlation are between the ranks of the 14 criteria for choosing a shelter (dependent variables) and the ranks of independent variables (age, income, number of children).[7] These coefficients are shown in Table XX.

[6]Robert Parsons, Statistical Analysis: A Decision Making Approach, Harper and Row, Publishers, New York, 1974, p. 702.

[7]The following values are used to denote ranks delineated for each of the following variables: age, income and number of children in the calculation of correlation coefficients:

Age	Rank	Income	Rank
Under 25 years	1	Less than $5,000	1
25 - 35	2	$5,000-$8,000	2
36 - 45	3	$8,000-$11,000	3
46 - 55	4	$11,000-$14,000	4
56 - 65	5	$14,000-$17,000	5
More than 65 years	6	$17,000-$20,000	6
		$20,000-$28,000	7
		More than $28,000	8

Number of Children	Rank
0	1
1	2
2	3
3	4
More than 3	5

Table XX

Coefficient of Correlation Between Rank of
The Criteria and Independent Variables

Criteria	Age	Income	Number of Children
C1	0.143	-0.124	-0.229
C2	-0.113	0.080	0.289
C3	-0.061	-0.038	-0.122
C4	-0.100	0.412	-0.107
C5	0.088	0.004	-0.249
C6	0.064	-0.253	-0.102
C7	-0.116	0.027	0.659
C8	-0.229	0.074	0.214
C9	-0.002	-0.367	-0.240
C10	0.198	0.013	-0.186
C11	0.183	0.067	-0.122
C12	-0.017	0.096	-0.045
C13	-0.125	0.223	-0.017
C14	0.168	-0.244	-0.074

The results indicate that there is not a single case of high correlation or no correlation between the rank of the criteria and ranks of independent variables. However, a relatively high degree of correlation exists between the rank of criteria such as "attractiveness" (C4), "distance from school" (C7) and "ease of maintenance" (C9), with ranks of variables income, number of children and income respectively.

A low degree of correlation between the rank of the criterion "distance from places of employment" (C8) and the variable income is surprising. It seems particularly inconsistent with our previous explanation about the relationship between family income and rank of location factors. According to our previous explanation, cost is an important consideration

of the middle income families. This would naturally imply
that transportation cost be at least as important to the lower
income families. As a result, one would expect a high ranking
for location factors, particularly "distance from places of
employment". The higher income group, as we have already
explained with the aid of Table IX, has given a relatively
low rank to the criterion "distance from places of employ-
ment".[8] If these were the cases, one would expect a high
degree of negative correlation between the rank of the
criterion "distance from places of employment" and the rank
of variable income.

The crosstabulation between income and types of shelter
would perhaps provide us with more information to explain this
paradox. Table VII presents crosstabulation between types of
shelter and income. It shows that in our sample, a great
majority (12 out of 14) were the purchasers of mobile homes.
As has already been explained in this study, the main pur-
chasers of mobile homes are young families and retired people.
To the senior citizen and to the retired purchaser of a mobile
home, "distance to places of employment" is clearly of no
importance. To the young purchaser of the mobile home, the
relatively cheap buying price of mobile homes has outweighted
possible locational disadvantages as important criteria.

[8]It should be noted that correlation between the income group
4 to 8 (middle and high income groups) and rank of criterion
"distance from places of employment" is -0.348.

Perhaps we can support the selection of mobile home pur-
chasers in our sample by comparing them with mobile home
households in the Lower Mainland. In our sample, 21.4% of
the mobile home purchasers under interview were aged 65 or
over as opposed to 25% aged 60 or over of the mobile home
dwellers in the Lower Mainland.[9] There were 43.4% of our
sample in the 35 or less category; in the Lower Mainland 50%
of mobile home family heads were 34 or younger.[10] It is
hoped that the above explanation is sufficient to defend our
study as well as our sample.

6.3 Conclusions

With Tables II, VI, VIII, IX, XIV, XVI and XVII, we
have displayed the rank and average weights of the criteria
for choosing a shelter in order to show the preferences of
the shelter buyers. Considering these tables and the
correlation coefficients, we can divide the criteria for
choosing a shelter into two categories.

    I. Criteria that are relatively independent of the
        influence of the "variables".

    II. Criteria that are directly or indirectly related to
the "variables".

    Category I can be further divided into two subcategories:

[9]M. J. Audain, op. cit., p. 11.

[10]Ibid., p. 11.

a) Those criteria that are considered as "necessities";

b) Those criteria that are considered as "complemen-
taries".

Good examples in subcategory a are criteria such as
"privacy" and "neighborhood". A closer look at the various
tables shows that these criteria, particularly "privacy", have
always been ranked among the top criteria, and no variable has
had a great influence on their ranking and importance. At the
other end of the ranking scale are criteria that represent
subcategory b - criteria such as "municipal services" and
"recreational facilities". Although the existence of these
attributes is not very important, their availability is
required to make a shelter a better place to live.

Category II consists of criteria for which ranking and
importance depends on the variables. Location factors such
as "distance from school" and other criteria such as "ease
of maintenance" and "attractiveness" are good examples for
this category.

By introducing three different types of shelter, we
showed that although all provide services that are required
of a shelter, these services (with some exceptions) are
provided to a much lower degree by condominium apartments and
by mobile homes than by conventional housing.

A conventional dwelling satisfies more of the household's
needs by providing a relatively better and more complete

bundle of residential services. Of the two other alter-
natives considered, condominium apartments are a closer
substitute for conventional dwelling in providing a fairly
complete bundle of residential services. The deficiencies
of the condominium apartment, e.g. common elements, have been
the main reason for their receiving a lower score and being
less demanded. Due to provision of residential services to
a markedly lower degree, mobile homes received the lowest
scores among the alternative types of housing considered. To
the young purchaser, a mobile home is an inferior good. As
their income is low and the prices of other types of housing
are high, the mobile home is the only solution to their
housing problem, since it provides them with some basic
services that are required of a shelter. To the old age group,
purchasing a mobile home reflects the emphasis that group
places on what are considered the advantages of such a
shelter, i.e., "ease of maintenance".

VII

HOUSING AS AN INVESTMENT

It is interesting that some decisions which at first
glance appear largely divorced from investment in fact may
be considered as investment decisions.[1] Such decisions
naturally lend themselves to analysis in terms of capital
budgeting. In this category the decision to purchase a
shelter may be included. The predominantly positive response
to question five (Do you consider your property an investment?
If so, do you expect return upon it?) of Exhibit III by two
groups of shelter buyers is a sufficient indication of their
belief that the purchase of a shelter constitutes an invest-
ment. Table XXI shows shelter buyers' response to question
five of Exhibit III.

Table XXI

Purchasing a Shelter as Investment Decision
Shelter Buyers Response

	Conventional Home	Condominium Apartment	Mobile Home
Yes	93.4%	90.3%	21.7%
No	6.6%	9.7%	78.3%

The medium ranking received by the criterion "ease of
resale" is a good indication that a shelter is not purchased

---

[1] An "investment" throughout this study refers to an asset
that generates a certain or an uncertain cash flow at
intervals through time and/or yield capital gain when
resold. This is different from term investment in economic
theory which is defined as "real capital formation".

solely for investment purposes through capital gain.[2]

This part of the study is to determine:

1. Whether purchasing a shelter is an investment;

2. A comparison between the value of so-called investment in different types of shelter.

7.1 Basic and Monthly Cost

An attempt to achieve the above objectives requires determination of the basic and monthly costs (tax, electricity, heating, water and rental park space) for three different types of shelter. In order to determine the basic cost, we consider three potential shelter buyers who are planning to purchase three different types of shelter; conventional home, condominium apartment and mobile home.

It is assumed that all three potential purchasers are in a position of paying cash for their transactions. Table XXII shows the basic and monthly costs of alternative types of shelter.

Table XXII

Basic and Monthly Costs, Lower Mainland

Basic Cost	3 bedroom C.H.	2 bedroom C.A.	2 bedroom M.H.
Purchasing Price $	60,000	36,000	18,000
Monthly Costs			
Taxes $	45	25	10

[2]It should be noted that according to Canadian Income Tax Law, an individual is permitted an exemption for gain on the disposition of his shelter. See <u>Canadian Master Tax Guide, A Guide to Canadian Income Tax</u>, CCH Canadian Limited, Don Mills, Ont., 1977, p. 285.

Table XXII (Cont'd)

Monthly Costs	3 bedroom C.H.	2 bedroom C.A.	2 bedroom M.H.
Water and Electricity $	18	15	12
Heating $	25	15	12
Rental Park Space $	-	-	130
Total Monthly Payment $	$87 paid monthly for 50 years	$55 paid monthly for 40 years	$164 paid monthly for 15 years

Source: M. J. Audain, Mobile Homes Problems and Prospects, Personal Inquiry

7.2 Marginal Efficiency of Investment

The aim is to evaluate the investment worth of three

types of shelter under consideration. This could be done by

finding the "marginal efficiency of capital" (investment) for

each of these investments. Before proceeding any further, a

brief explanation of marginal efficiency of investment is

required. This criterion for investment decisions was

suggested by Keynes, and in his words:

"When a man buys an investment or capital
asset, he purchases the right to the series of
prospective returns, which he expects to obtain
from selling its outputs, after deducting the
running expenses of obtaining that output, during
the life of the asset. This series of annuities,
Q, Q_2, . . ., Q_n it is convenient to call the
Prospective yield of the investment. Over against
the prospective yield of the investment we have the
supply price of the capital asset, meaning by this,
not the market-price at which an asset, of the type
in question can actually be purchased in the market,
but the price which would just induce a manufacturer

newly to produce an additional unit of such
assets, i.e. what is sometimes its <u>replace-
ment costs</u>. The relation between the pros-
pective yield of a capital-asset and its
supply price or replacement cost, i.e. the
relation between the prospective yield of one
or more unit of that type of capital and the
cost of producing that unit, furnishes us with
the marginal efficiency of capital of that type."[2]

"The inducement to invest can be stated in terms of the

spread between the marginal efficiency of capital, which we

may call <u>r</u>, and market rate of interest <u>i</u>."[3] Marginal efficiency

of investment (capital) can be calculated from the equation

below:

$$C_R = \frac{Q_1}{1 + r} + \frac{Q_2}{(1 + r)^2} + \ldots + \frac{Qn}{(1 + r)^n}$$

where

C_R = replacement cost

r = marginal efficiency of investment (MEI)

Q = prospective annual return, or prospective yield.

By calculating <u>r</u>, three possibilities exist:

1. $r > i$ investment is profitable

2. $r = i$)
) no inducement to invest
3. $r < i$)

In this study we consider the purchasing price of alter-

native types of shelter as the replacement cost. The monthly

payment for renting (since for a person who is looking for a

shelter, two alternatives exist, buy or rent) that shelter as

[2]John M. Keynes, <u>The General Theory of Employment, Interest and
Money</u>, Harcourt, Brace and World, Inc., New York, 1936, p. 135.

[3]Alvin H. Hansen, <u>A Guide to Keynes</u>, McGraw-Hill Book Company,
Inc., New York, 1953, p. 118.

a series of the prospective annual (or monthly) return. Then
the marginal efficiency of investment or the percent r which
the investor may earn, can be calculated for each different
type of shelter under consideration.

"It has long been recognized that one of the disadvantages
of an unstable price level is that it makes the task of
appropriately analyzing the economic advantages of different
alternatives more difficult and complex."[4] This point is
particularly pertinent for the current study, therefore, in
order to take the possibility of inflation into account, we
introduce the following four assumptions:

First, the amount of monthly payment and monthly costs
would remain constant during the length of the contract
(average life of shelter). Second, the discounted value of
the building (salvage value) after its average life is equal
to zero. Third, the same degree of risk exists in each
investment. Fourth, the increase in the price of land during
the period 1963-1972 (Chart 1) and general inflation (increase
in consumer price index) level for the same period will be
maintained during the lifetime of the shelter. By intro-
ducing assumption one, the prospective annual returns are
valued in real terms. Money value of land is converted into
real value by dividing the money value after its average life

[4]Harold J. Bierman, Jr. and Seymour Smidt, The Capital
  Budgeting Decision, Fourth Edition, Macmillan Publishing
  Co., Inc., New York, 1975, p. 311.

of shelter by the change in consumer price index during
the average life of the shelter.

7.3 Land Value and Inflation Rate (1963-1972)

It is extremely difficult to find the exact appreciation
in residential land values. A study by United Community
Services of the Greater Vancouver area, based on information
published by the Real Estate Board of Greater Vancouver, has
shown that the cost of a typical lot (33-60' frontage) in
Burnaby between 1963-1972 has increased by 362.5%.[5] Accord-
ing to the figure published by Statistics Canada, the Consumer
price index for all items has increased from 101.9 in 1963 to
132.1 in 1972 in Vancouver.[6] Chart 1 shows the comparison of
land cost index and consumer price index between 1963-1972.

Table XXIII shows the purchasing price, present value of
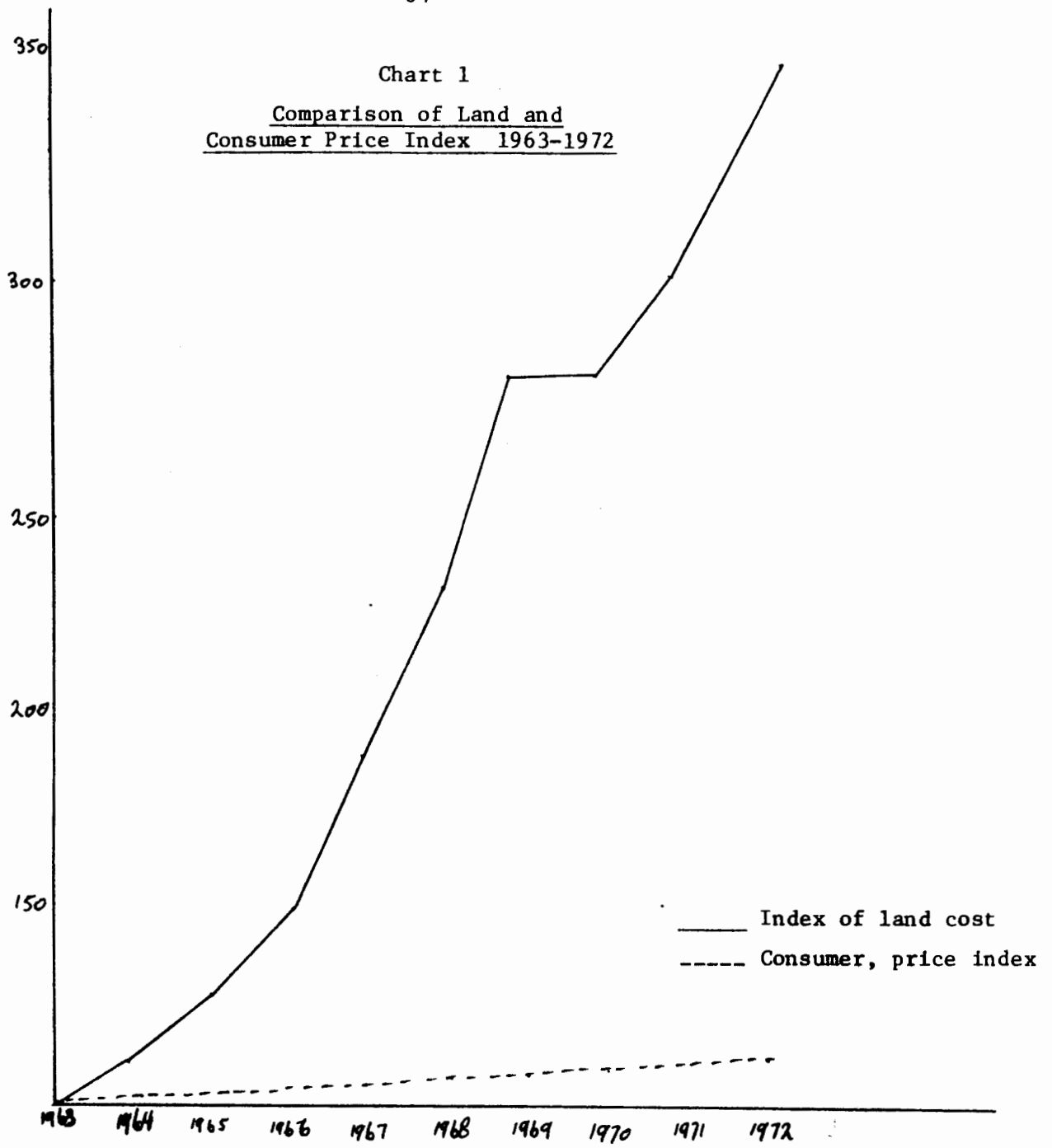land and average life of different types of shelter.

Table XXIII
Purchasing Price and Present Value of Land

	Purchasing Price $	Average Life Years	Present Value of Land $
3 bedroom C.H.	60,000	50	30,175

[5]Trend in Home Ownership Costs and Disposable Income Over the
Past Decade, Social Policy and Research Department, United
Community Services of the Greater Vancouver Area, November
1973, Appendix: Table VII, which made reference to yearly
edition of Real Estate Trends in Metropolitan Vancouver,
Real Estate Board of Greater Vancouver, Statistical and
Survey Committee, 1963-1972.

[6]Statistics Canada, Price and Price Indexes, Catalogue 62-002,
January, 1975.

Chart 1

Comparison of Land and
Consumer Price Index 1963-1972

Source: United Community Services of Greater Vancouver
Statistics Canada

Table XXIII (Cont'd)

	Purchasing Price $	Average Life Years	Present Value of Land $
2 bedroom C.A.	36,000	40	12,833
2 bedroom M.H.	18,000	15	0

Table XXIV shows the monthly payment (including rent, taxes, electricity, heating, water) for renting each of the three different types of shelter.

Table XXIV

Monthly Payment, Greater Vancouver Area

3 bedroom C.H. $	2 bedroom C.A. $	2 bedroom M.H. $[7]
450	280	230

Note: Excluding pad rent for mobile home.

[7]Rental mobile homes are rare in British Columbia. In the Greater Vancouver area only one park, Lazy Boy Court in Coquitlam, used to provide rental mobile homes. (Information from Mr. M. Kostur, Kostur's Auto and Trailer Court, Coquitlam, B.C., interviewed November 1975). At the present time, Brown's Mobile Homes Ltd., in Surrey, B.C., provides rental mobile homes. Their rents vary according to the length of leasing and distance outside Greater Vancouver area that mobile home must be transferred. Figure that is shown in Table XXIV is an average rate that is charged for monthly leasing in the Greater Vancouver area by the same company. It should be noted here that rental mobile homes occasionally exist on a subletting basis. (Information from Mr. F. Izzard, President, Surrey Tenants Association, interviewed February, 1976.)

We calculated r for different types of shelter and various net monthly return from:

$$P.P_j = \frac{N_1}{1 + r} + \frac{N_2}{(1 + r)^2} + \ldots + \frac{N_n}{(1 + r)^n} + PV_L$$

where:

PP_j = Purchasing price of shelter j;

N = Net monthly return (difference between monthly rent and monthly costs);

r = Marginal efficiency of investment;

PV_L = Present value of land.

7.4 Derivation of MEI for Different Types of Shelter

a) For $60,000 Conventional Home:

$$60,000 = \frac{363}{1 + r} + \frac{363}{(1 + r)^2} + \ldots + \frac{363}{(1 + r)^{600}} + 30175$$

$29825r = 363$ $r = 0.0122$

$r = 14.6\%$ $i = 11.5\%$

So $r > i$

b) For $36,000 Condominium Apartment:

$$36,000 = \frac{225}{1 + r} + \frac{225}{(1 + r)^2} + \ldots + \frac{225}{(1 + r)^{480}} + 12833$$

$23167r = 225$ $r = 0.0097$

$r = 11.6\%$ $i = 11.5\%$

So $r > i$

c) For $18,000 Mobile Home:

$$18,000 = \frac{66}{1 + r} + \frac{66}{(1 + r)^2} + \ldots + \frac{66}{(1 + r)^{180}} + 0$$

$-0.005 < r < -0.004$

$- 6.0\% < r < -4.8\%$ $i = 11.5\%$

So $r < i$

7.5 Conclusions

These results suggest that among these three types of
shelter, purchasing a conventional home is the best from an
investment point of view. This is mostly due to the apprec-
iation in the residential land value. Condominium apartments
appear to be a risky investment. Although in the case involv-
ing condominium apartments the marginal efficiency of invest-
ment has exceeded the market interest rate, the fact that the
land upon which several condominiums are sited is not easily
divisable among owners, suggests that condominiums may prove
to be unprofitable investments. Since the land associated with
a single condominium may not be easily redeployed, its apprec-
iation in value is restrained. Purchase of a mobile home
appears to be a less worthwhile investment. Depreciation in
the value of the home is rapid and is not offset by any
compensatory land value appreciation. It should be noted that
this conclusion is not consistent with experience in British
Columbia, although the latter, with some confidence, can be
considered atypical. The appreciation in the value of mobile
homes in British Columbia may be attributed to a shortage of
mobile home parks in the metropolitan areas.[8] As was shown in
Table XXI, the majority (78%) of the mobile home purchasers
did not consider it as an investment. This can be explained

[8]See M. J. Audain, op. cit., p. 67.

by the fact that those who are young usually have low incomes
and therefore a small capacity to invest. Those who are old
have mostly lost the motive for investment.[9]

[9] *Ibid.*, p. 67.

VIII

SUMMARY AND CONCLUSIONS

The procedure outlined in this study provided indexes
of residential services that housing consumers consider when
purchasing their shelters. These indexes were derived in an
attempt to support the view that housing is a combination of
specific and heterogeneous residential services. The experts
evaluation technique was introduced to provide the main index
of residential services. It was shown that the importance of
the residential services to the shelter buyers varies, although
not drastically, with the change in the characteristics of the
housing consumers. It was also shown that although different
types of shelter provide services that are required of shelter,
the degree of provision of these services varies according to
the type of shelter. In the case of this study, considering
the provision of residential services, conventional homes,
condominium apartments and mobile homes have been ranked
first, second and third respectively. This can be a suffici-
ent reason for a high demand for conventional homes in compar-
ison to the two other types of shelter under consideration.

What has been achieved in this study suggests that among
alternative types of shelter, those that are sited on their
own land provide a better bundle of residential services.
Although this topic was not systematically investigated, one

can claim that residential land has influence on the quantitative measurements of different types of shelter through the better provision of certain residential services. This has been particularly reinforced by the evidence that these types of shelter are better from an investment standpoint.

The analysis presented in this study provides a reliable input for planning and decision-making purposes in the housing industry. Demonstrating the preferences of the housing consumers for the residential services, and the perceived deficiencies of different types of shelter in providing some of these services, can well be used in future planning and decision-making. Although weaknesses of some types of shelter in providing some services cannot be solved through planning, in certain cases providing a service, i.e. "distance from school", by a type of shelter, i.e. "mobile home", can be improved through planning.

Finally, it should be noted that the particular bundle of housing services that is used here may or may not be usable for the same kind of study in other regions. Although there are certain residential services that are universally accepted as main criteria for choosing a shelter, the importance of residential services varies with the social, cultural and geographical characteristics of the region and the shelter buyers.

Appendix A

INTERVIEW PROCEDURE[1]

There are different numbers of phases depending on the number of subgroups. In this case there are five phases, each consisting of a number of criteria.

Phase 1: C_1 , C_2 , C_3 , C_4

Phase 2: L_1 , L_2 , L_3 , L_4

Phase 3: F_1 , F_2

Phase 4: S_1 , S_2 , S_3 , S_4

Phase 5: C, L, F, S

The first step is to arrange the criteria in the order of their relative importance, beginning with the most important. (For purposes of discussion, these criteria are designated A_1 , A_2 , . . . A_k , respectively, i.e., A_1 designates the most important, A_2 the next most important, and so on.)

The second step is to make numerical assignments to the criteria as a measure of their relative importance; begin by assigning the number 10 to A_1 and then choose numbers to assign to the other criteria in turn, reflecting individually their importance to A_1 . The numbers so selected should be between 0 and 10; let them be designated V_1 , V_2 , ..., V_k respectively.

[1]The procedure outlined in this appendix is mostly taken from T. Var, R.A.D. Beck and P. Loftus, op.cit.

The third step is to make a comparison between criterion A_1 and the combination of A_2, A_3, . . ., A_k. There are three possible results:

a) Criterion A_1 is more important than the combination of A_2, A_3, . . ., A_k; in this case adjust the value V_2, V_3, . . ., V_k (if necessary) so that $V_1 > V_2 + V_3$ . . . V_k.

b) Criterion A_1 is equally important as the combination of A_2, A_3. In this case adjust the values V_2, V_3, . . . V_k (if necessary) so that $V_1 = V_2 + V_3$ . . . V_k.

c) Criterion A_1 is less important than the combination of A_2, A_3, . . ., A_k. In this case, delete criterion A_k from the group and then make the comparison of A_1 versus the combination of A_2, A_3, . . . A_{k-1}. If C_1 is more important or equally important to the combination, then adjust the values as in a or b above so that $V_1 > V_2 + V_3 + . . . + V_{k-1}$ or $V_1 = V_2 + V_3 + . . . + V_{k-1}$, respectively. If A_1 is less important than the combination, then delete A_{k-1} from the group and make the comparison again. Repeat the process until finally a combination is reached which is less important or equally important to A_1; then the values V_2, V_3, . . . V_k are being adjusted, it is important that the new values preserve the relative positions defined by original assignment. Once this step is completed, a new set of values (generally, but not necessarily) will result. Designate these V_1^1, V_2^1, . . ., V_k^1.

The fourth step is to remove criterion A_1 from consideration and repeat the entire process of the third step employing A_2 in comparison with the combination of A_3, A_4 . . . A_k and starting with the values V_2^1, V_3^1, . . . V_k^1.

Next: similarly, repeat the process until the logical final step in which the comparison is made between A_{k-1} and A_k. The same procedure is followed for each four groups of criteria. The final result of each of these first four phases is a set of values for each of the criteria groups; then phase five provides a set of values reflecting the relative importance of the groups one to another. In each of the 5 cases the values are normalized; i.e., new values U_1, U_2, ..., U_k are defined from the final values V_1, V_2, ..., V_k as follows:

$$U_j = \frac{V_j}{\sum_{j=1}^{k} V_j} \qquad \text{for } j = 1, 2, \ldots, k$$

Thus these new values U_1, U_2, ..., U_k are numbered between 0 and 1.

Finally, if the normalized values from phase 5 are designated as X_1, X_2, X_3, and X_4, then the final overall, normalized weights, W_1, W_2, ..., W_{14} for the 14 criteria are computed as follows:

$$X_1 \begin{pmatrix} U_1 \\ U_2 \\ U_3 \\ U_4 \end{pmatrix} = \begin{pmatrix} W_1 \\ W_2 \\ W_3 \\ W_4 \end{pmatrix} \qquad X_2 \begin{pmatrix} U_1 \\ U_2 \\ U_3 \\ U_4 \end{pmatrix} = \begin{pmatrix} W_5 \\ W_6 \\ W_7 \\ W_8 \end{pmatrix}$$

$$X_3 \begin{pmatrix} U_1 \\ U_2 \end{pmatrix} = \begin{pmatrix} W_9 \\ W_{10} \end{pmatrix} \qquad X_4 \begin{pmatrix} U_1 \\ U_2 \\ U_3 \\ U_4 \end{pmatrix} = \begin{pmatrix} W_{11} \\ W_{12} \\ W_{13} \\ W_{14} \end{pmatrix}$$

Appendix B

<u>FINAL SCORES FOR EACH CRITERION</u>
<u>IN DIFFERENT TYPES OF SHELTER</u>
<u>SHELTER BUYERS EVALUATION</u>

Criteria	Conventional Home			Condominium Apartment			Mobile Home		
	<u>C.H</u>	<u>C.A</u>	<u>M.H</u>	<u>C.H</u>	<u>C.A</u>	<u>M.H</u>	<u>C.H</u>	<u>C.A</u>	<u>M.H</u>
C1	90.27	51.11	55.79	89.32	56.52	69.50	83.57	35.00	64.29
C2	92.08	60.69	48.33	87.61	63.96	63.00	78.67	50.91	52.67
C3	88.57	75.29	61.67	83.70	71.46	74.00	75.33	49.09	66.67
C4	94.14	58.29	34.44	94.35	57.92	35.00	89.00	33.18	36.67
C5	78.82	77.50	55.88	78.70	79.58	66.67	67.33	54.55	46.67
C6	78.82	83.24	50.59	83.18	85.22	31.25	77.33	62.27	34.00
C7	82.50	78.68	44.72	82.27	82.61	23.75	77.33	65.00	29.33
C8	81.18	81.62	45.83	79.55	83.48	50.00	72.33	68.18	30.67
C9	61.25	86.67	75.83	62.17	91.04	62.22	50.67	78.18	81.00
C10	61.29	80.43	54.41	60.43	85.63	47.78	54.67	77.27	42.00
C11	88.19	64.03	43.61	85.22	65.00	50.00	79.29	54.50	67.86
C12	83.38	76.18	51.47	80.87	68.75	34.44	76.00	58.64	36.00
C13	91.25	61.25	43.13	90.00	62.92	17.78	91.33	59.00	29.33
C14	81.86	85.57	47.06	82.61	84.58	28.89	77.33	77.27	33.33

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