AN ANALYSIS OF SOME COMPUTER

ASSISTED VALUATION PROCEDURES

A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Agricultural Business and
Administration in Valuation
at Massey University

Robert Vernon Hargreaves

1982

ABSTRACT

The objective of the thesis is to examine computer applications to the sales, income, and cost approaches to valuation. The author describes and evaluates computer programs suitable for the storage and retrieval of sales data, the analysis of 'net rate' information for houses, and the adjustment of land sales for size variations.

The use of multiple regression analysis in the sales approach to valuation is reviewed, and this methodology is then applied to the valuation of a group of home units and single family homes. Variables were selected from the Valuation Department sales data base and multiple listing information. The inclusion of the existing rating valuation significantly improved the predictive ability of the regression equations.

Several microcomputer applications to the income approach to valuation are discussed in the context of discounted cash flow. These include programs that compute residual land value for hypothetical developments and the optimum building for a site. A case study approach is used to demonstrate the application of net present value, internal rate of return, and financial management rate of return approaches to valuation.

Two computer programs designed to estimate the replacement cost of buildings utilise costing information based on the New Zealand Institute of Valuers modal house. One of these programs calculates the replacement cost of a variety of farm sheds, and the other program calculates the replacement cost of houses.

The author concludes that computer assistance offers considerable potential benefits to valuers for the storage and retrieval of sales information and for automating many aspects of the valuation process.

ACKNOWLEDGEMENTS

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CHAPTER 1

1.1   INTRODUCTION

Computer technology is likely to have a considerable impact on many traditional occupations during the 1980's.   Diebold (1973) sees the computer as the most significant invention of the 20th century. Computers have now evolved into what is commonly known as the fourth generation.   The current fourth generation computers began to emerge in the late 1970's and are characterised by the use of large scale integrated circuits (LSI).   McGlyn (1979) points out that a 50 mm silicon sliver costing $10 has the computational capacity of a desk sized computer that would have cost several hundred thousand dollars in the early 1960's.   Evans (1979) illustrates the dramatic technological change that has occurred in the computer industry by drawing an analogy with the automobile industry.   He says that if the automobile industry had shown the same rate of advance over the last 30 years as the computer industry has then the current cost of a Rolls-Royce would be under $5 and it would do 3 million miles to the gallon.

The miniaturisation of computer circuitry is currently being taken a step further with the development of very large scale integrated circuits (VLSI) where all the computer components can be placed on one tiny silicon chip which is small enough to pass through the eye of a needle.   Economies of scale in the production of these 'computers on a chip' has been brought about by the large consumer market and the increasingly wide range of products which make use of this technology.

Computers are available in a wide variety of sizes and types ranging from large main frame computers that may fill up a large room to microcomputers which are typically about the size of an electric typewriter.

The impact of computer controlled machinery in the traditional blue collar fields of employment such as automobile assembly plants is already well known.   Computers are very good at rapidly performing the repetitive tasks involved in assembly work and can operate continuously at low cost.

Computers are also having major influences on many traditional white collar fields of employment. For example, computers have taken over many of the clerical and bookkeeping functions in the Banking and Insurance industries. It is a mistake to think of computers as simply machines that are very good at rapidly performing repetitive tasks. Computers can be programmed to learn from experience. Simon (1973) warns against making the assumption that higher status occupations and those requiring the most education are going to be the least automated and says on p. 146 that:

> *"There are perhaps as good prospects technically and economically for automating the job of a physician, or a corporate vice-president, or a college teacher, as for automating the job of a man who operates a piece of earth moving equipment."*

1.2   COMPUTER PROGRAMS

Although the cost of the actual computers (hardware) has been reduced significantly in recent years, computer programs (software) have not shown similar reductions. Computer programming is a very labour intensive business as computers currently have to be given very specific instructions to perform every step in a program. Under present technology it is likely that the owners of microcomputers may end up spending much more on software for a given machine than on the initial price of the hardware. Recently, progress has been made on developing interactive computer languages such as Basic and Pascal that are more powerful and easier to understand than earlier languages. Basic (beginners all purpose symbolic instruction code) is the most widely used language for microcomputers. The commands used in the language are relatively easy for a beginner to understand as they are a mixture of written English and simple algebra.

At the present time, programs designed to run on one type of microcomputer cannot be run on another type of machine without first being modified. This can turn out to be expensive since professional programmers charge their time out at around $50 an hour. An operating system known as CP/M (control programs for microcomputers) has been devised to help overcome this problem and most microcomputers are now being designed to use the CP/M system.

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There are significant advantages to companies selling computer
programs to use a system that is compatible with a wide range of
computer hardware.   Similarly, computer users are likely to have a
wide range of software available if they purchase equipment that can
use the CP/M system.

At the time of writing, one thing that is clear in the computer
area is that technology is advancing very rapidly and it is possible
that the current costs of programming will be significantly reduced in
the future as more powerful computer languages are developed and voice
communication with computers over a full vocabulary becomes possible.

1.3   COMPUTERS IN VALUATION

Up until now, computers have had a relatively small impact on the
Valuation profession in New Zealand.   Valuation is said to be a field
that embodies elements of both an art and a science.   It has been
thought that the scientific part of valuation process may be able to be
quantified in terms suitable for computer processing but the human
judgement factors, the so called art, would be much more difficult to
quantify.

The objective of this dissertation is to examine some of the ways
that computers can be used by valuers in New Zealand to assist in the
valuation process.

As valuation practices are typically one or two-man businesses,
the main emphasis will be on microcomputer applications since these are
the type of machines that valuers are most likely to be able to afford.
Microcomputers are characterised by their small size, relatively low
cost, simple and easy to use operation, limited but expandable
capabilities, and ability to interface with television and audio cassettes.

The computer applications to be examined will be mainly relevant
for valuers outside the Valuation Department as it is felt that this is
currently the area of greatest need in the valuation profession.   This
is because staff at the Valuation Department are already involved in
developing computer applications for mass appraisal purposes.

Computer applications to the sales, cost and income approaches to valuation are examined. Wherever possible, existing computer programs have been utilised but in some cases where these were not available new programs have been developed. The three approaches to valuation are briefly described in section 1.4 of this chapter.

The computer applications have been developed very much from the standpoint of computer assisted valuations so that the valuer is always in a position to use his professional expertise in formulating the final estimate of value. The computer is used to speed up many of the calculations that the valuer would normally perform by hand, and perhaps encourage the valuer to explore new methods and test the sensitivity of the value estimate to changes in the basic assumptions.

It is anticipated that the rate of adoption of microcomputers by the New Zealand valuer will be somewhat slower than by counterparts in Australia and the U.S.A. because the equipment is almost twice as expensive in New Zealand than in Australia and the U.S.A. A major reason for this is the 40 per cent sales tax imposed by the New Zealand government on computing equipment.

1.4   THE THREE APPROACHES TO VALUATION

Conventional real estate valuation theory has relied on three main approaches to valuation. These are the comparable sales approach, the capitalisation of income approach, and the replacement cost less depreciation approach. The New Zealand Institute of Valuers (NZIV) have a declared policy that:

> *"No particular method of valuation be approved and that the choice of method of valuation to be used in an individual case must essentially be left to the discretion of the individual valuer concerned."*

In this dissertation a chapter is devoted to the computer applications that have been developed for each of the above three main approaches to value. The word 'value' is used in the context of the most probable selling price of a property. The three approaches are briefly introduced at this point.

1.4.1   The Comparable Sales Approach

The following steps are involved in the comparable sales approach
to valuation:

1.   Sales information and physical data are collected and verified.

2.   A sufficient quantity of comparable sales are collected so
      that the market pattern can be distinguished.

3.   Sales data is analysed using units of comparison.

4.   Sales evidence is compared with the subject property by the
      appropriate unit of comparison.

5.   The value of the subject property is estimated.

The sales approach essentially involves comparing like with like.
In the simple situation, a residential section may sell during a land
auction for $15,000.   If later in the auction another section with
exactly the same features is put on the market then it should also
sell for $15,000.

The situation becomes more complicated when a comparison
between properties with different characteristics is undertaken.
For example, in undertaking a typical residential house valuation the
valuer is likely to have to compare house sales of different sizes,
quality, condition, age and layout with the subject property that he
has been asked to value.   The sales may also be from one month to one
year prior to the date of valuation.   The comparison process becomes
further complicated as the class of property being valued becomes more
heterogeneous such as is the case when valuing a large hill country
sheep farm or a specialised industrial building.   The units of
comparison that are selected for use in the comparable sales approach
should be based on features that are important to people participating
in the real estate market place.   For example, when valuing single
family homes the valuer would normally expect that the size of house
would be an important dimension of value and one of the units of
comparison would be the price per m^2 of living space.   The units of
comparison that are selected can be just based on the valuer's
interpretation of the market based on his experience, or in addition,

the information can be statistically analysed to see which features explain the largest amount of the variation in selling prices between properties.

Having selected the units of comparison for use, the valuer then assembles a chart showing the sales information in comparison with the subject property. Adjustments are normally made to the charted sales information by either dollar amounts or percentage amounts to bring the sales into line with the subject property. The sales analysis will produce a range of values for the units of comparison. From this information the valuer has to make the final estimation of the value for the subject property.

Chapters 2 and 3 examine a number of ways that computers can be used to assist valuers in the application of the comparable sales method and in the storage and retrieval of sales information.

1.4.2   The Income Approach

The following steps are involved with the conventional income (productive) method of valuation:

1.   Calculate the gross income for the property being valued.

2.   Estimate the vacancy and collection losses to give the effective gross income.

3.   Estimate and subtract all operating expenses to give the net income.

4.   Select the appropriate capitalisation rate.

5.   Divide the capitalisation rate into the net income to get the value of the property.

The income approach is based on the premise that the value of a property is equal to the present worth of the rights to the future income from the property. The net income figure used should be for a 'typical year'. The capitalisation rate used should be verified from the market place. The theoretical basis for the income approach used by valuers represents one application of discounted cash flows. This, together with a number of discounted cash flow models suitable for various valuation situations, is described in Chapter 4.

1.4.3   The Cost Approach

The cost approach to valuation involves the following steps:

1. Estimate land value.

2. Estimate the current replacement cost of the improvement to be valued.

3. Estimate and subtract depreciation from the replacement cost.

4. Add back the depreciated value of the improvements to the land value to get the total value of the property.

The cost approach is basically used for the valuation of structural improvements such as buildings with the land component still being estimated by the sales comparison method.

The estimation of current replacement cost is usually straight-forward with new or near new buildings where the cost is already known or can be worked out per m^2 based on the cost of similar type buildings. With older buildings the concept of replacement envisages a functional modern building with the same floor area rather than reinstating say a 70 year old residential house with 5 m ceilings, and double cavity brick construction.

Valuers define depreciation as the loss in value through any cause at all.   This means that depreciation includes physical deterioration (wear and tear), functional obsolescence (out of date, poor design) and economic obsolescence.   Thus it is possible for a new building to be worth considerably less than cost for economic reasons.   Similarly short term demand can result in value exceeding cost.   The fundamental question with the cost approach is the relationship between cost and value at the date of valuation.

Several computer applications to the cost approach are described in Chapter 5.   These deal with the estimation of replacement cost for farm sheds and residential houses.

CHAPTER 2

THE SALES APPROACH

2.1   COMPARABLE SALES INFORMATION

Valuation methods based on comparable sales require that valuers have access to an up to date and reliable source of sales information. In New Zealand the formal system that is used by most valuers in both the private and government sectors is based on the Valuation Department sales system.   Under Section 49 of the Rating Act 1967 it is a requirement that the Valuer General be notified of all property sales within one month of the date of sale.   Administratively this notification procedure is handled by the solicitors acting for the parties to the property transaction.

Prior to 1981 the procedure was that the sales information was processed by the Valuation Department and since 1964 the sale notifications have been passed on to the Statistical Bureau of the NZIV.   The NZIV Statistical Bureau collated the information and then produced sales sheets which were distributed to members on a fee paying basis.   While this system worked reasonably well for the Valuation Department there were often considerable time delays, in some cases several months, before valuers outside the Valuation Department received the sales information.   The inadequacy of the system was highlighted in the 1973-74 property boom experienced in New Zealand. In a rapidly rising market, sales that are many months out of date were of little use to valuers, particularly when more recent sales information existed but was not available on the sales sheets.   Faced with this situation most valuers had to spend a considerable amount of time liaising with other valuers and real estate sales people to obtain the most recent sales information.   A diagram showing the old NZIV sales distribution system is shown in Figure 2.1.   The time dimension is an estimate only and was quite variable.   In some rural areas the NZIV Statistical Bureau waited until there were enough sales to justify sending a list out and this was sometimes several months.

9.

Time Dimension

| STEP 1 | Variable -several weeks to several months |

Lawyers
- send written notification to Valuation Department

Sale transacted

M

| STEP 2 | Two-three weeks |

District Office Valuation Department
- process sales data for 'in house' use and after, then sends to NZIV

M

| STEP 3 | Two weeks |

NZIV Local Collator
- arranges sales slips in order by local authority district and location

M

| STEP 4 | One-two months |

NZIV Statistical Bureau
- produces sheets of sales data
- mails to subscribers

M

Valuers
- Valuers receive sales sheets

M Denotes sales data transmission by mail.

Figure 2.1: Flow of Sales Information - Old NZIV Model

Jefferies (1974b) saw computer applications as one way of improving the distribution of sales information. The feasibility of establishing a sales data base for private valuers in New Zealand was examined by Lawton (1974) who concluded such a data base would be feasible. McGlone (1975) reported on the progress that the Valuation Department were making in converting to a computer based information system that would include sales information.

The need for upgrading the existing sales system for valuers was commented on in a discussion paper by McGough (1981) who said that better dissemination of sales information was a high priority for many valuers. Rapid progress was made in this area and Cooper (1981) reported on a proposed new sales information system for valuers. The proposed system was to be based on the Valuation Department computerised sales information system that became operational early in 1981. The Valuer General had agreed to release the computer tapes containing the sales information to the NZIV, with fortnightly updates. The information on the computer tapes was to be converted to microfilm and then distributed to valuers.

The NZIV adopted this proposal and the system became operational in July 1981. Valuers needed to obtain access to a microfiche viewer in order to utilise the sales information.

An example of the format showing the sales information as it appears on the microfiche is shown in Table 2.1. An abbreviated explanation of the Valuation Department categories used in the table is contained in section 3.3.1. A diagram showing the new NZIV sales distribution system is shown in Figure 2.2. The dotted lines on the diagram indicate a potential path for the flow of sales information that is not yet in place. These potential paths would involve electronic transmission of sales data from the Valuation Department computer tapes to computers used by private valuers and valuers in other government departments. Alternatively, data could be taken from the Valuation Department computer tapes and put onto floppy discs by a computer bureau and then mailed out to subscribers.

Table 2.1:   Sample Microfiche Frame

WELLINGTON CITY   (REVALUED 1-7-79)   601   SALES LIST FOR PERIOD OF 1 JAN 1980 TO 31 DEC 1980

VAL/REF	ADDRESS	CATGY .DATE TITLE/REF	NET SALE PRICE	CAP VAL	LAND VAL	AGE	FLOOR	LAND AREA ZONE USE UNIT COND / LEGAL DESCRIPTION	CONST.	CHATTELS OTHER
17180 299	9 BURNHAM ST	R1 08/80 11A/366	45500	39500	18000	1	14	0 9A 91 1 AA / LOT 2 D P 11602	WI	2500 0
17180 296	22 BURNHAM ST	R2 04/80 16B/41	45000	42000	28000	P	14	0 9A 91 1 GA / LOT 1 DEEDS PLAN 550	FT	2000 0
17180 438	66 BURNHAM ST	R48 03/75 17E/2	31800	32000	15300	4	11	0731 9A 91 1 AA / LOT 2 D P 11703	WI	1200 0
17180 36	16 FERRY ST	R1B 11/80 6D/21	36000	26000	12300	P	8	0341 9A 91 1 AA / LOT 14 DP 1445	WI	2000 0
17180 38	21 FERRY ST	R28 07/80 7B/216	35000	29000	14900	1	8	0412 9A 91 1 GG / LOT 18 DP 1445	WX	0 0
17180 43	31 FERRY ST	R2A 04/80 8A/718	50000	46000	17000	2	13	0405 9A 91 1 AA / LOT 28 DP 1445	WT	3000 0
17180 120	14 INGLIS ST	R1A 09/80 2C/2	55000	53000	20400	X	18	0595 9A 91 1 GG / LOT 2 D P 20196	WI	3000 0
17180 121	18 INGLIS ST	R2A 03/80 1A/42	56000	52000	28800	X	22	1012 9A 91 1` AA / LOT 7 BLK IX DEEDS PLAN 110	WI	3000 0
17180 170 2	93 INGLIS ST	R6A 07/80 6B/216	57000	52000	17600	6	15	0529 9A 91 1 GG / LOT 2 D P 27631	BT	3000 0
17180 173	99 INGLIS ST	R2B 11/79 4E/214	32500	33000	17000	2	10	0663 9A 91 1 GG / LOT 1 DEEDS PLAN 471	WI	1500 0
17180 144	106 INGLIS ST	FC 01/80 5F/161	55000	46000	20500	X	18	0696 9A 92 2 AA / LOT 1 D P 34343	WI	5000 0
17180 144	106 INGLIS ST	FC 02/80 5F/161	65000	46000	20500	X	18	0696 9A 92 2 AA / LOT 1 D P 34343 -	WI	5000 0
17180 149	118 INGLIS ST	R3B 12/79 11E/402	25000	25500	11700	3	8	0689 9A 91 1 GA / LOT 1 D P 8749	WI	0 0
17180 392	53 MANTELL ST	R2B 12/79 5B/28	19000	18000	8800	2	4	0594 9A 91 1 AA / LOT 13 DP 2245	WI	500 0
17180 400	69 MANTELL ST	R2 09/80 12F/2	55000	38000	12600	2	9	0 9A 91 1 AA / LOT 5 D P 2245	WI	4000 0
17180 326	77 MONRO ST	R3B 03/80 2D/42	33000	33000	19500	3	10	0632 9A 91 1 AA / FLAT 1 DP 40627 ON LOT 30 DEED	WI	0 0
17180 305	10 PINNACLE ST	R2B 05/78 LT 8A/23	24000	32000	17500	2	10	0506 9A 91 1 AG / LOT 4 BLK XXIX DP 2258	WI	0 0
17180 50	2 VENTNOR ST	R2B 12/79 16B/47	22000	22000	13200	2	7	0266 9A 91 1 AA / LOT 1 D P 6139	WI	0 C

Source: *The New Zealand Valuer*, March 1981, p. 720.

Time Dimension

STEP 1 | Variable -several weeks to several months

Lawyers
- sent written notification of sale to Valuation Dept.

Sale transacted

By mail

STEP 2 | Approximately one week

District Office Valuation Department
1) Processes sales data
2) Sales data entered onto computer via Visual Display Unit (terminal) based in District Offices.

Data transmission daily - off peak telephone lines

STEP 3 | Two weekly updates

Valuation Department Head Office
1) Data recorded on computer tapes at government computer centre
2) Sales Data checked automatically
3) Sales matched with valuation data and land use data.

Computer Bureau
Computer tapes converted to microfilm for NZIV and Valuation Dept. use.

STEP 4

STEP 5

New Zealand Institute of Valuers Statistical Bureau
Mails microfilm to subscribers every two weeks

By mail

Less than a week

STEP 6

Subscribers to Sales Lists
1) Access data with microfiche viewer
2) May input data into own computer.

Figure 2.2:   Flow of Sales Information - Current NZIV Model

Computer applications for processing sales information will probably not become feasible for most private valuers until the sales information can be taken directly from a computer data base. At the present time the Valuation Department computer tapes are not available to private valuers and all the data has to be retyped into a computer to allow further processing. This policy has been adopted by the NZIV until such time as policy has been formulated for electronic dissemination of sales data.

The present sales information system adopted by the NZIV represents a major step forward. The transmission of sales data has been considerably speeded up although delays still occur when solicitors do not notify the Valuer General within the time specified in the Rating Act. There also appears to be some confusion amongst lawyers about the date of sale. In some cases this is taken as being the date the sale became unconditional and in other cases the date the transfer was registered.

The present NZIV property sales information system is only one of the number of alternatives that could be used by valuers. To evaluate the strengths and weaknesses of the present NZIV system several other alternatives will be discussed.

2.1.1   Multiple Listing Systems

Multiple listing is a cooperative form of selling that is used by real estate agents. Properties for sale are submitted to the listing agency by members and then the listings are given out to all the members. When a property sells the listing agent and the selling agent each receive an agreed share of the commission. The multiple listing system generates revenue by charging a membership fee. Multiple listing has been widely used in Christchurch for a number of years and in the last five years has become relatively common in most of the larger New Zealand cities. Multiple listing is the most common method of selling property that is used in the United States. Yarwood (1980) describes a number of computer applications for real estate listing information that are used by real estate agents in the United Kingdom.

Valuers, both in New Zealand and overseas, have realised that access to multiple listing information would provide them with a very good source of up to date information about properties for sale and properties that have been sold. A multiple listing agency has to have a system that quickly alerts members when properties have been sold to avoid wasting agent's time and annoying customers by showing them properties that have already been sold. A number of valuers are directly associated with real estate firms that receive multiple listing information, others have a special membership status with multiple listing agencies which enables them to receive the listing and sales information at a reduced fee.

Multiple listing agencies use various methods to distribute information to their members. United States systems are becoming highly computer orientated. To date very few of the New Zealand multiple listing agencies have access to a computer. This is likely to change quite rapidly as an efficient computer system can offer significant cost savings to a multiple listing agency.

One of the difficulties that valuers have found with using real estate multiple listing data is that the information is not always as accurate as desired. For example, the description of the property shown by the listing service may be partly based on information supplied by the vendor and not verified by the agent. Also, there can be difficulties if valuers rely on conditional sales information and it later turns out that the sale was not transacted. Another difficulty in relying on multiple listing information is that in many areas, less than half the sales are handled by real estate agents associated with multiple listing agencies.

2.1.2   Local Authorities Sales Data Base

Another possible source of sales information is the local authority. Under the Rating Act both the local authority and the Valuation Department are required to be notified about property transactions. A number of the larger local authorities have their own computer programmed to interface with the Valuation Department valuation and land use information tapes. Changes in property ownership means that the rate demands have to be directed to the new

purchaser and the local authorities rating roll altered in the computer.
For example, the Palmerston North City Corporation has developed a
computer program which prints out property sales at regular intervals
for internal use in the Property Department.   In its present format
this type of sales information has no real advantages over the existing
NZIV system but if it could be extended to include additional information
contained in the local authority records (such as plans and building
permits) then it could be useful.

2.1.3   The 'Ideal System' for New Zealand

The ideal sales information system is likely to be one that
combines the best attributes of the New Zealand systems that have
previously been described.   The main advantages of the NZIV system is
that the information is generally reliable and produced in a form
which valuers are familiar with and understand.   The disadvantage
is that any delay by the lawyers in notifying the sale can cause the
system to break down.   (There is no penalty for lawyers who do not
notify within the statutory one month period).

The advantages of a sales system that is based on the flow of
information from real estate agents is that the information is up to
date, potentially on a daily basis.   The disadvantages are that not
all the information that the valuer wants may be available from the
agent and some of the details may not be accurate.

By matching sales information on a particular property that has
been supplied by real estate agents with the valuation and land use
information from the Valuation Department computer tapes it would be
possible to eliminate lawyers from the sales notification process.
Sales data could be verified by obtaining a computerised title search
of the Land Transfer Office records when such a system becomes
available.   A tentative sale could be put into the system and marked
as such.   The final outcome of the tentative sale could be recorded
later.   With rapid inflation in property values, such as was
experienced in 1981, it is very important for valuers to stay completely
up to date with movements in the market, particularly when advising
clients about setting sale prices.

2.1.4   The SREA System

The most advanced overseas sales information system for valuers is found in the United States.   In an effort to overcome some of the disadvantages of using multiple listing agencies as a source of verified and accurate sales information, the Society of Real Estate Appraisers (SREA) in the U.S.A. established a market data centre. This system has been described by O'Neil (1968).   The SREA system was started in 1967 by a group of valuers in Los Angeles, California with the cooperation of a lending institution that provided initial access to a computer facility.   The sales information was taken from valuation reports that had been submitted to lending institutions. This information was then put on a special coded form and then submitted to a key punch operator who typed the information into a computer. Books containing listings of recent sales information, together with the features of interest to valuers, were then published at frequent intervals and sent out to members.   The type of information contained in the SREA books for residential properties is shown in Appendix I.

Lending institutions were encouraged to participate in the system by receiving a credit for each piece of sales information supplied and this was offset against the cost of their membership to the system. The SREA system has proved very successful and is now widespread across the U.S.A. and Canada.   In 1978, the typical costs of membership in the northern California area was a one time only initiation fee of $25 and a monthly cost of approximately $15.   The books of residential sales information are normally published monthly in the larger regional areas and quarterly in the smaller areas.   The books contain over 60 separate pieces of information on each property.   Sales data on income property is also available in the SREA system.

Since the late 1970's a number of valuers in the U.S.A. have had access to a computer.   This is particularly evident where the valuer is employed by a lending institution such as a bank.   In such cases the valuer does not need to wait for the publication of the sales book as it is possible to access the SREA sales data directly via a computer.

Computer programs   which allow the valuer to manipulate the sales data in terms of extracting the required group of sales and performing analyses on these sales are also available.

2.2   LAND INFORMATION SYSTEMS

In addition to collecting comparable sales data for a specific valuation problem the valuer also needs to collect a variety of other data.   The data collection and analysis part of the valuation process as shown in Figure 2.3 indicates the general location and economic data and the specific data that would normally be required for a valuation.

The collection of this data may involve considerable time, effort and expense for the valuer and ultimately for the client.   The title information for the subject property and some of the comparables often has to be searched.   If there is not a land transfer office in the local area then delays are inevitable.   The valuer will probably need to visit the local authority office to verify the zoning, and may need to consult building inspectors regarding plans.   He may also need to visit the rating section of the local authority office and the local Lands and Survey office to view plans and aerial photographs.

It has been apparent to users of land information for some time, and advocated by a number of valuers including McGlone (1975), that there could be real advantages in setting up some type of land information system that would help to avoid much of the duplication of effort in the collection of information that is now evident between local authorities, regional authorities and various government departments. For example, much of the information that local authority valuers collect and store is replicated by the Valuation Department.   Similarly, the Housing Corporation to some extent duplicates information recorded by the Valuation Department.

Efforts to improve the present system of land information have been coordinated by the Land Use Advisory Council which has its secretariat based in the Lands and Survey Department.   Planning in this direction has been proceeding for a number of years and it seems likely that a pilot project involving a computerised system of land information will be tested in the next year or two.

THE VALUATION PROCESS

DEFINITION OF THE PROBLEM

| Identify Real Estate | Identify Rights | Date of Value | Objective of Valuation | Definition of Value |

PRELIMINARY SURVEY AND VALUATION PLAN

| Data Needed | Data Sources | Personnel Needed | Time Schedule | Completion Flow Chart |

DATA COLLECTION AND ANALYSIS

General Data — Specific Data

LOCATIONAL	ECONOMIC	SUBJECT PROPERTY	COMPARATIVE
Region	Market Analysis	Title	Costs
City	Financial	Site	Sales
Neighbourhood	Economic Base	Physical	Rentals
etc.	Trends	Highest and Best Use	Expenses

APPLICATION OF THE THREE APPROACHES
To obtain separate value indications

| COST (Summation) | MARKET DATA (Direct Comparison) | INCOME (Capitalisation) |

RECONCILIATION OF VALUE INDICATIONS
(Correlation)

FINAL ESTIMATE OF DEFINED VALUE

Source: Adapted from 'The Appraisal of Real Estate', 7th edition, American Institute of Real Estate Appraisers, p. 52.

Figure 2.3: The Valuation Process

One possible future structure of information contributors to a computerised land information data bank is shown in Figure 2.4. It is apparent from this structure that there are a wide variety of government departments and local authorities that would be able to contribute information to such a data bank.   These organisations can be aggregated into three broad areas, namely, land administration, physical resources and statistical information.
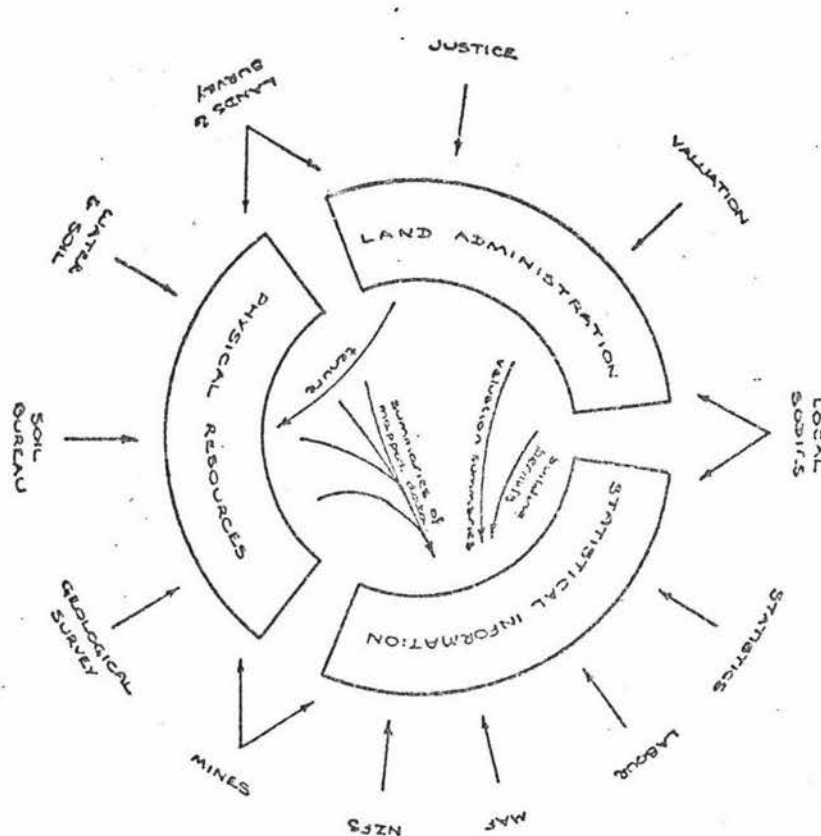
Source: Land Use Advisory Council,
          unpublished 1978 working paper.

Figure 2.4:   Proposed Land Information Systems - Data Contributors

The potential data users are shown in Figure 2.5.   It is apparent that there is a wide variety of potential users including the data contributing organisations.
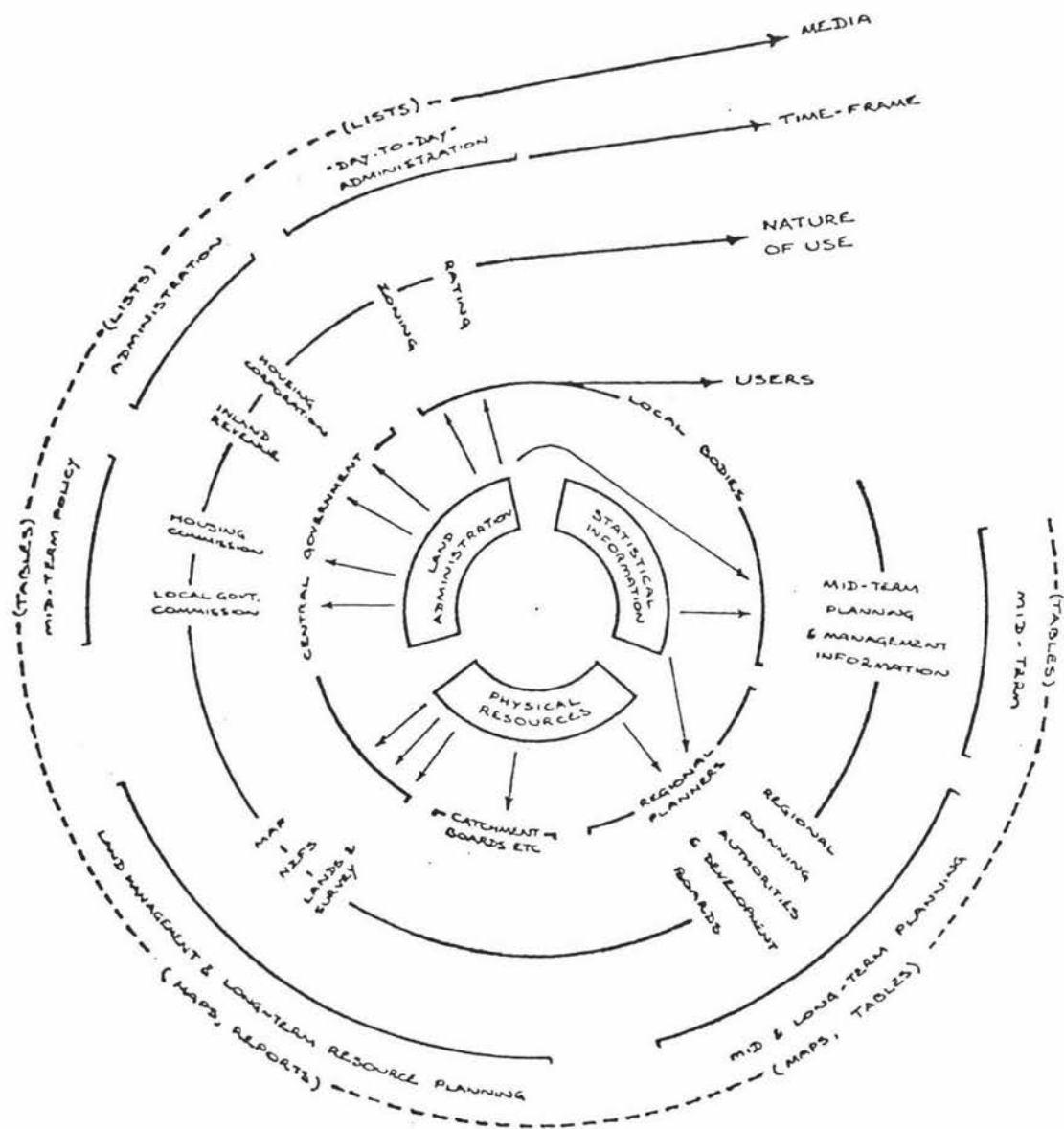
Source: Land Use Advisory Council,
unpublished 1978 working paper.

Figure 2.5: Proposed Land Information Systems - Data Users

A proposal has been made to set up one large centralised computer containing the data with a processing unit that would act as a data enquiry and interrogation facility.   The data enquiry facility would be linked to a number of computer terminals to enable data to be transferred in and out of the central data bank.   A diagram illustrating this type of structure is shown in Figure 2.6.   The computer facility could be organised in such a way that various classes of user had access to different levels of data so that confidentiality could be maintained if required.   Instead of having one centralised data base it would also be possible to organise the facility on a regional or district basis.

NATIONAL DATA-BASE

DATA ENQUIRY & INTERROGATION FACILITY
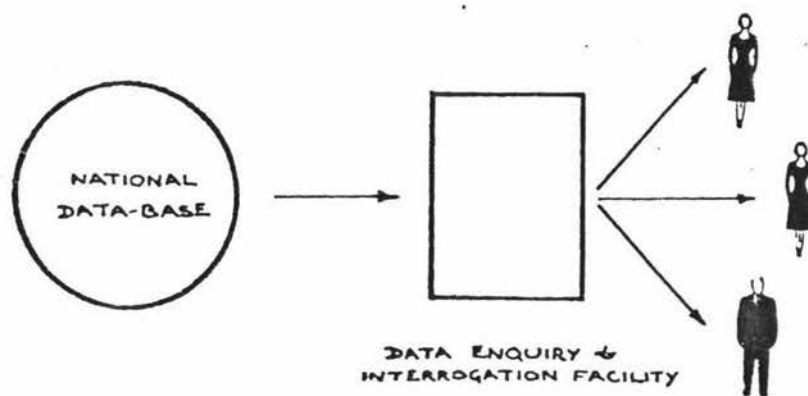
Source: Land Use Advisory Council,
*   unpublished 1978 working paper.*

Figure 2.6:   Proposed Land Information Systems - National Data Base

From a valuation data gathering point of view, establishment of such a system would make it possible to access a great deal of information that is presently difficult to obtain.   For example, a valuer with a microcomputer would be able to use a modem (accoustic coupler) using telephone lines to connect the microcomputer with the computerised data bank.   After specifying what information is required the valuer could receive back sales information, title data, plans, valuation data, planning data, building plans, land capability

information, soil type information, demographic data and a variety of other statistical information relevant to the valuation.

Having the data on a computer would also enable valuers to process the information using a variety of programs   relevant to the particular type of valuation problem.

It is understood that a pilot project for the LIS system could be in place in the Horowhenua area as early as 1983 (K.Allan pers.comm.)

2.3   DATA STORAGE AND RETRIEVAL

This section examines some of the ways that valuers can now utilise computers to store, retrieve and manipulate sales information.

Traditionally, sales information has been stored in printed form as supplied by the New Zealand Institute of Valuers sales lists, and more recently the information has become available on microfilm. When undertaking a valuation, the valuer will need to search through the sales records to pick out the most comparable sales. A manual search of sales data can be rather time consuming since the valuer may need to scan many pages of printed information or microfilm frames to obtain the required sales.   The key details of the comparable sales need to be transcribed by hand from the microfilm to a sales analysis sheet.   The Valuation Department (1981) statistics show that for the year ended 31/12/80 an urban valuer practising in the Auckland region received information on 15,317 house sales and his counterpart in Wellington information on 5,890 house sales.   Although many valuers specialise within certain parts of Auckland and Wellington, they would still need to consider a large volume of sales data.

As it is often claimed that computers are very good at storing information such as property sales it was decided to evaluate several existing computer programs to see if they would be useful to valuers for data storage and retrieval.   The first program was one suitable for use on a microcomputer and the second one suitable for use on a main frame computer.

2.3.1   Microcomputer Applications

The program that was used is called 'Visi Dex' and was selected because it was suitable for use on an Apple II microcomputer and because it was advertised as having real estate applications.

The user's manual claims that 'Visi Dex' can "replace file folders, boxes of index cards, and note books crammed with random information".   In the list of potential uses for the program Kling (1981) describes how 'Visi Dex' can be used by real estate brokers to keep a listing file of properties for sale and how these listings can be matched up with client requirements.

This process has similarities to the valuer's needs to match up the characteristics of a subject property with those of the most comparable sales available from the full set of sales data.   For example, a valuer may have several thousand house sales on file that occurred over the last year.   The property to be valued is likely to have a number of special characteristics that will mean that most of the sales data on file is not comparable.   If the valuer can specify the characteristics of the subject property that he also wants to be reflected in the sales data then a computer can be programmed to search the sales data and pick out those properties that meet the search criteria.

In the 'Visi Dex' program a data set (such as the house sales for a town, city, or suburb) is entered into the computer, with the individual details on each property being entered under a set of headings called 'keywords'.   The complete data on an individual property is recorded by keyword headings on a 'screen'.   Figure 2.7 shows how a set of sales data can be organised under the program.

To test the program, a series of house sales data from Palmerston North City were entered onto the computer.   The keyword headings selected for the data fields are from the NZIV sales information. This means the data can be recorded in the computer in the same format as it appears on microfilm.   This may mean that potentially, this program could be organised to inferface with the Valuation Department data base.
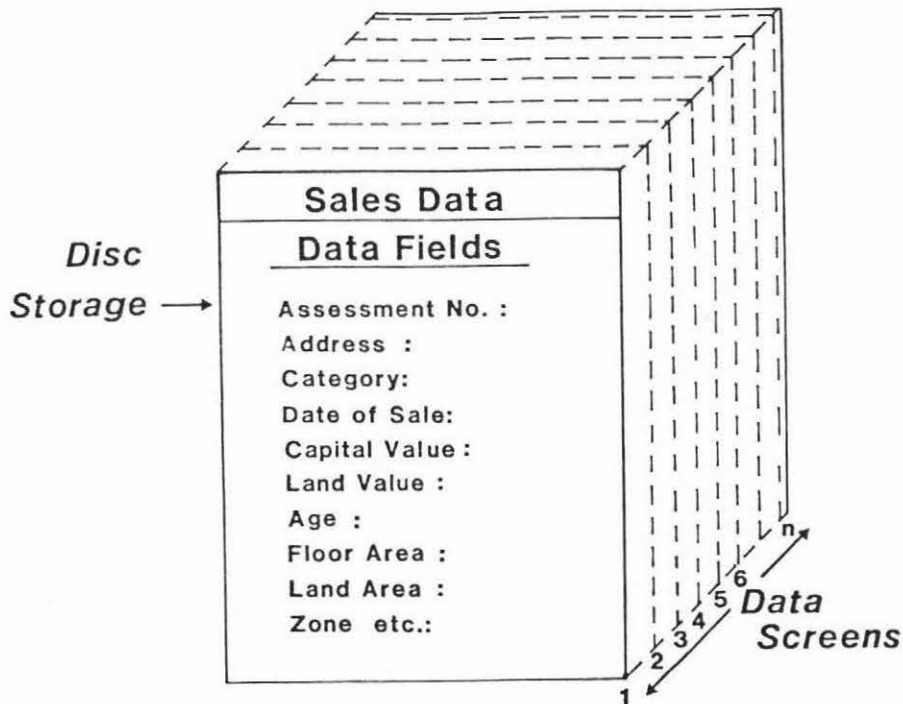
Figure 2.7:   Simplified Diagram Showing 'Visi Dex' Template Screens

Having stored the sales data on disc on a 'Visi Dex' template, the valuer is then in a position to extract information from the data base.

Data retrieval with the 'Visi Dex' program is based on the system of keywords.   For example, a valuer may need to extract say all the sales of houses greater than 150 m^2 in a certain locality of a certain age and within a defined price bracket.   To perform a computer search of the data the valuer would specify the keyword for house size.   The program uses standard mathematical notation >, <, =, ><, <= >=; thus for houses greater than 150 m^2 the valuer would indicate >150.   The locality variable can be entered two ways.   The valuer could use the assessment numbers, or street names, or a combination of each.   The ages of the houses, and sale prices, would be specified by using the appropriate keywords and then specifying a range within this.

The computer is then instructed to carry out a search and the valuer has the option of obtaining a printed copy of the sales that meet the criteria in the search specification or the sales can be displayed on the screen. The subset of sales that has been extracted can also be stored under a new heading so that it forms a set of its own.

The 'Visi Dex' program is fully interactive, and reasonably 'user-friendly'. The program has a prompt mode that helps the user become familiar with all the various keyboard operations. The program is quite versatile and could have a number of uses in a real estate office. For example, the 'Visi Dex' screens can be organised to appear on a T.V. monitor in a real estate office showing recent listing information. It is understood that some real estate agents in Australia are using their microcomputers for this type of function during non-office hours. In such cases the computer requires a 'clock card'. The clock card enables the user to specify when the data is to appear on the screen and thus the computer will automatically go through a procedure at a specified time according to pre-programmed instructions.

Valuers could also consider using this program for scheduling and keeping track of the work flow through an office, filing key information from previously completed valuation reports in a readily accessible form and filing mailing lists of clients.

The main disadvantage with the 'Visi Dex' program is that it does not appear to have been designed to interface with other programs and other computers, although it is theoretically possible to do this from the 'Visi Dex' templates. Difficulties with interfacing data mean that sales information has to be retyped into the computer from the original data source.

Also there are likely to be data storage problems for valuers trying to store a lot of sales data on 125 mm (5") floppy discs. In practice, a valuer searching all the sales data for say residential houses in Wellington over the last six months would need to use several discs to record this amount of data. A standard 125 mm (5") floppy disc will store approximately 180 sales, formatted in the same way as the NZIV microfiche data.

2.3.2   Main Frame Computers

Since 1980, work has been in progress at Massey University aimed at establishing a computerised listing of sales information.   The initial work utilised the University's large main frame computer (Burroughs B6700) and a program called 'Famulus'.   At first, rural sales information was recorded from the NZIV sales sheets and latterly urban sales data has been recorded from microfiche records.   The University is now operating two Prime computers as a replacement for the Burroughs machine and the 'Famulus' program has been converted to run on the new system.

According to Turner (1977), the word 'Famulus' is taken from the Latin and means the 'Alchemist's assistant'.   Kirkland (1977) describes the program as originally designed to handle information such as bibliographies but with the capacity to be used as a file manipulation package for any data sets with a similar structure.   The strength of the program appears to be more in the area of sorting and manipulating words than numbers.   One of the limitations of the program for valuation purposes is that it does not recognise the greater than or less than command.

The data (record) for each real estate sale can be organised under exactly the same headings (fields) as in the NZIV microfiche information.   The program can handle up to 25 fields for each record, subject to the limitation that individual records do not exceed 4000 characters.   The amount of data that can be stored is limited only by the disc storage capacity of the computer that is being used to run the program.

The 'Famulus' program enables the user to manipulate the data in a number of ways.   The 'Edit' program converts the data into 'Famulus' internal files and can be used to add, delete, or amend internal files. The 'Merge' program enables compatible files to be sorted in a single file in alphabetical order.   The 'Search' program is the one most often used for real estate sales purposes and operates by scanning fields to see if records satisfy the search criteria.   The user can search using the commands 'and', 'or', or 'not'.   An example of a search for a particular house sale in Victoria Avenue, Palmerston North, is shown in Table 2.2.

27.

Table 2.2:   Demonstration Famulus Search

```
ASSN    14670 189
TENU    FH
ADDR    64 VICTORIA AVE
CTGY    FC
DATE    10/81
NSP     26000
CV      17000
LV      13800
AGE     1
SIZE    16
AREA    .0689
ZONE    9A
USE     92
UNIT    2
COND    FF
CNST    WI
CHTL    0
```

In this case the field identifier is the street name and number.
If the search had requested all the houses on Victoria Avenue then
9 house sales would have been printed out.   Multiple searches can also
be conducted where the records are searched to satisfy a number of
search criteria such as all the houses in a certain age category in
a specified location.

The 'Ossify' program can be used to make copies of files for
backup purposes and to make files available to other computers or other
programs on the same computer.   This program has been used extensively
to interface the data base, which is in Famulus form, with the SPSS
package on the same Prime 750 computer.

The 'Sort' program arranges files into alphabetical order.
While not particularly relevant for real estate sales purposes, this
facility is very important for word processing type organisation.

The 'Merge' program enables files to be updated by merging the
main data base with additional information.   This program is regularly
used when the fortnightly updated microfiche sales data is put onto
the computer and then merged with the sales data already on the computer.

The 'Multiply' program is used when there are multiple entries in a field and the user wishes to produce a new file selecting one of the items in the field.   A valuer can use this facility to create a separate file for commercial property from the main data base.

There are several other programs available within 'Famulus' but not described here, as they have limited application to a real estate sales data base.

The main advantages of the 'Famulus' program over the 'Visi Dex' program is that the 'Famulus' program has the ability to interface with other programs and other data bases.   Also, the larger Prime computer has much greater storage capacity than most of todays microcomputers.   In addition, users can obtain access to the data base at any one of the numerous remote terminals on Campus that are connected to the Prime 750 computer.

The 'Famulus' program is not as interactive and 'user-friendly' as the 'Visi Dex' program.   This means that it generally takes longer for the user to become familiar with the program.

2.4   NET RATE ANALYSIS

One of the essential elements of the sales approach to valuation is the analysis of a sufficient number of comparable sales using appropriate units of comparison so that a market pattern can be distinguished.   The subject property is then compared with the sales using the appropriate units of comparison.

Sections 2.3.1 and 2.3.2 of this chapter have dealt with two of the ways that the valuer can use the computer to maintain an up to date file of sales information and how the file can be manipulated to sort and print out the most comparable sales for a given valuation situation.

Having selected a group of comparable sales, the valuer then has to decide on the appropriate unit(s) of comparison and then perform the necessary arithmetical calculations on the data.

In urban valuation work one of the most useful units of comparison is known as the net rate. The net rate is a widely used method on all types of residential properties having particular application to the valuation of owner occupied home units and older single family homes. The following example illustrates the use of the net rate method.

Case Example

The sale price of a 50 year old bungalow is $45,000. The house is 150 m^2 with an estimated land value component of $16,000. Other improvements to the site including fences, drive, layout and garage are estimated to be worth $4,000.

Sale price		$45,000
Less other improvements	$4,000	
" land value	$16,000	20,000
Leaves price for house:		$25,000

The net rate per m^2 for the house will be:

$$\frac{\$25,000}{150m^2} = \$166.66 \text{ per } m^2$$

In an actual valuation the valuer will analyse a number of comparable sales and extract a range of net rates that can be used for the valuation of the subject property.

This method has considerable attraction to valuers when compared with the cost approach to valuation since it overcomes the problem of having to estimate depreciation. With the net rate approach the market rate of depreciation is included in the net rate per m^2.

As the net rate method is a residual technique, the validity of the method in a particular situation will depend on the accuracy with which the valuer is able to estimate the land value and the value of other improvements (i.e. excluding the house) at sale. In areas where there is a paucity of land sales information this can create difficulties. However, if the valuer adopts a uniform approach to estimating the land values of the subject property and the comparable sales, then even if the land values are not absolutely right, the fact that they are uniform

should mean that the net rate would still have some validity for the subject property provided that the approach to land value is consistent.

With older properties the valuer also needs to be careful to compare 'like with like' as a property that has been modernised is likely to have a higher net rate per m² than a property in original condition. Similarly, the net rate per m² for a larger than average house, particularly when it includes a verandah, is likely to be lower than that for a smaller house.

Despite the drawbacks that have been discussed above, the net rate approach has a high degree of market orientation, and in many cases it is likely to be more accurate than the conventional replacement cost less depreciation method of estimating the value of houses. This is because of difficulties in accurately estimating depreciation when using the replacement cost method.

2.4.1 Computer Application

Since the net rate approach is such a useful tool for valuers, particularly urban valuers, it was decided to develop a computer program designed to assist the valuer with net rate analysis.

To illustrate the design and capabilities of the program, a case example has been constructed using a group of 1981 residential sales from the New Zealand Institute of Valuers sales list for the Central Districts area. Additional data on the properties was supplied by the Valuation Department. (See Table 2.3).

The steps that the program goes through when analysing the data are shown in Figure 2.8.

STEP 1:   Simple analysis
          (net rate unadjusted for time)

STEP 2:   Analysis based on time adjusted
          sales from regression equation

STEP 3:   Analysis using manual
          time adjustment factor

STEP 4:   Analysis using different
          assumption about LV/CV ratio

STEP 5:   Analysis ignoring roll value and
          using valuer's estimates of land
          value and other improvements

STEP 6:   Analysis based on Step 5
          using time adjustment factor
          from regression equation

STEP 7:   Analysis based on Step 5 using
          manual time adjustment factor

Figure 2.8:   Steps in the Net Rate Program

Table 2.3:   Residential Sales From the Central Districts Area

No.I.D.Code	Date	Area	Capital value	Land value	House size	Sale price	O.I. from Valn.Dept.	O.I. at sale	Land at sale
1 1	3.81	.08	53,000	14,500	145	64,500	7,500	8,600	15,500
2 2	11.80	.09	55,000	14,700	134	63,000	7,000	7,700	15,600
3 3	2.81	.42	70,000	18,500	127	77,000	21,000	23,000	21,000
4 4	2.81	.1	46,000	14,300	145	55,000	6,000	6,800	15,500
5 5	4.81	.07	49,000	13,500	128	60,500	5,000	5,500	14,500
6 6	1.81	.08	33,000	9,600	89	39,000	3,400	4,000	10,500
7 7	12.80	.09	63,000	10,000	194	76,000	13,000	14,500	11,400
8 8	1.81	.08	60,000	10,000	165	66,000	11,300	12,500	11,400
9 9	3.81	.1	59,000	14,700	151	66,000	6,600	7,200	16,000
10 10	11.80	.08	51,000	14,000	131	64,000	8,500	9,300	15,200
11 11	9.81	.09	47,000	11,400	132	64,000	6,500	7,000	12,000
12 12	9.81	.08	47,000	9,600	141	66,000	6,500	7,000	10,000
13 13	9.81	.08	56,000	15,200	137	77,000	6,300	7,000	15,500
14 14	8.81	.08	56,000	14,000	140	70,000	8,500	10,000	15,000
15 15	10.81	.08	44,000	10,600	161	59,500	4,200	15,500	11,000

The net rate program is written in BASIC language for use on Apple II microcomputers. The program is based on a similar program for the analysis of rural sales information as described by Hargreaves (1981). The operating procedures for the program are shown in Appendix 2.

STEP 1

The equation that has been used in the program to calculate the net rate for the first step is as follows:

$$NR = (SP - \frac{(LV + OI) \times SP}{CV})/SM$$

where NR = net rate

SP = sale price

LV = land value from roll value

OI = other improvements value at date of roll

CV = capital value from roll value

SM = size of house in m².

This equation is based on the assumption that the ratio of land value to capital value is constant over time since the last government valuation. The land value to capital value ratio is simply land value from the roll value divided by capital value from the roll value. The land value in dollars per hectare has been calculated using the following equation:

$$\text{Land } \$ \text{ ha} = (SP \times \frac{LV}{CV})/A$$

where SP = sale price

LV = land value from roll value

CV = capital value from roll value

A = area of land in hectares.

The unit of hectares was selected so that the program could also be used for small rural holdings such as 4 ha blocks.

The program analyses the sales data using the equation that has been described and then prints out the information as shown in Table 2.4.

Table 2.4:   Sales Analysis: Step 1

SALES ANALYSIS
===== ========

IDENT	DATE	SALE PRICE	NET RATE	LV/CV RATIO	LAND $/HA	% CHANGE CAP.VALUE
1	3 81	64500	260.2	.27	234035	21.7
2	1180	63000	284.7	.27	185443	14.5
3	2 81	77000	264.2	.26	48441	10
4	2 81	55000	211.9	.31	165677	19.6
5	4 81	60500	294.2	.28	234766	23.5
6	1 81	39000	265.6	.29	140240	18.2
7	1280	76000	248.7	.16	129995	20.6
8	1 81	66000	258	.17	130952	10
9	3 81	66000	279.3	.25	167797	11.9
10	1180	64000	273	.27	215038	25.5
11	9 81	64000	300.2	.24	179461	36.2
12	9 81	66000	307.7	.2	164601	40.4
13	9 81	77000	346.3	.27	257389	37.5
14	8 81	70000	299.1	.25	216316	25
15	1081	59500	245.3	.24	176964	35.2
AVERAGE		64500	275.9		176474	23.3

NOTE - ASSUMPTIONS LV/CV RATIO FROM ROLL VALUE CONSTANT OVER TIME

STEP 2

This step computes a trend analysis on the data over time.
The roll value, which has a common base date for all the properties,
is regressed against sale price over time using the method of least
squares.   The trend line is computed from the date of the oldest sale
to the date of valuation.   From this the average monthly percentage
changes in values are computed and all sales information is then
adjusted by the appropriate percentages to the date of valuation.
The computer output from this step is shown in Table 2.5.

Table 2.5:   Time Adjustment Regression Equations: Step 2


```
THE EQUATION IS -
 INCREASE = .02 X TIME(MONTHS) + -.07

              NOTE - MONTHS FROM JAN 80
R SQUARED   .631

STD.ERROR   .06

SO % INCREASE FROM GOVT.VALUATION TO NOWIS 35.54 %

% INCREASE PER MONTH IS 2.02 %
```

The above table refers to the example information in Table 2.3 and the date of valuation is taken to be October 1981.   The reliability of the regression equation in measuring the changes in value over time can be partially explained by the R^2 statistic and the standard error of estimate as shown in Table 2.5.   The R^2 or correlation coefficient measures how well the trend line fits the data.   In general the closer R^2 is to 1.0 the better the fit.   It must be remembered, however, that the R^2 statistic is also influenced by the number of observations and unless there are a reasonable number of observations (sales) this statistic should be viewed cautiously.   For example, if there were only two observations the trend line would simply link these up and the R^2 would be 1.00.   The standard error of estimate is another measure of the accuracy of the equation.   In general the smaller the statistic the more precise are the estimates in the equation.

It is acknowledged that the growth in the value of properties over time may not always be best explained by a simple linear equation as has been described.   Where property values are growing at an exponential rate a logrithmic function may be more suitable.

A possible refinement of this program would be to use the computer to fit the data to a series of equations and determine which equation provided the best fit.   This type of procedure is explored in more detail in the next section of this chapter which discusses adjusting sales data for variations in the size of properties.

The adjusted sales prices are then analysed using the same
procedures as has been explained for Step 1. The computer print out
showing the analysis of the time adjusted sales prices is shown in
Table 2.6.

Table 2.6:   Time Adjusted Sales Data

IDENT	SALE PRICE	ADJ. SALE PRICE	GOVT.VALUATION
1	64500	73598.21	53000
2	63000	76964.69	55000
3	77000	89413.06	70000
4	55000	63866.47	46000
5	60500	67814.84	49000
6	39000	46073.02	33000
7	76000	91314.81	63000
8	66000	77969.73	60000
9	66000	75309.79	59000
10	64000	78186.35	51000
11	64000	65289.67	47000
12	66000	67329.97	47000
13	77000	78551.63	56000
14	70000	72821.15	56000
15	59500	59500	44000

CALCULATIONS WITH ADJUSTED SALES

SALES ANALYSIS

IDENT	DATE	SALE PRICE	NET RATE	LV/CV RATIO	LAND $/HA	% CHANGE CAP.VALUE
1	3 81	73598	296.9	.27	267047	38.9
2	1180	76965	347.8	.27	226548	39.9
3	2 81	89413	306.8	.26	56250	27.7
4	2 81	63866	246.1	.31	192385	38.8
5	4 81	67815	329.8	.28	263150	38.4
6	1 81	46073	313.7	.29	165674	39.6
7	1280	91315	298.9	.16	156190	44.9
8	1 81	77970	304.8	.17	154702	29.9
9	3 81	75310	318.7	.25	191466	27.6
10	1180	78186	333.5	.27	262704	53.3
11	9 81	65290	306.2	.24	183078	38.9
12	9 81	67330	313.9	.2	167918	43.3
13	9 81	78552	353.2	.27	262576	40.3
14	8 81	72821	311.2	.25	225034	30
15	1081	59500	245.3	.24	176964	35.2
AVERAGE		72267	308.4		196779	37.8

NOTE - ASSUMPTIONS LV/CV RATIO FROM ROLL VALUE CONSTANT OVER TIME

STEP 3

In some cases the valuer will not be able to place very much confidence in the answers from Step 2. This could occur where insufficient sales meant that the trend line developed in Step 2 was unreliable or where there is not a consistent relationship between the roll value and sale price for the type of property being valued. This step allows the user to specify the monthly rate of change to use when the data is time adjusted. The sales information is then updated to the date of valuation by the new adjustment factor and the data re-analysed based on the updated values.

STEP 4

The initial assumption in Step 1 that the improvements and land would change in value at the same rate may not be realistic. Valuers normally expect building costs to go up at about the rate of inflation. In times of increased demand for property it is possible that the land component may increase at a much faster rate than the general rate of increases in building costs. If this is the case then the user can use this option which requires the percentage increase in land value and the percentage increase in the value of other improvements since the roll value to be specified. The program then re-analyses the data based on this change in the assumptions.

STEP 5

This step allows the valuer to use estimates of land value and the value of other improvements that have been made at the time of sale and then to extract the net rate using the following formula:

$$NR = (SP - (ELV + EOI))/SM$$

where NR = net rate
       SP = sale price
       ELV = estimated land value (at sale)
       EOI = estimated other improvements at sale (i.e. excluding house)
       SM = size of house in m^2

This method is the preferred method of extracting the net rate compared with the equation developed in Step 1. Table 2.7 shows the case example analysed on the basis of the above equation.

Table 2.7: Output Showing Analysis Using Valuer's Estimates for Land and Other Improvements

SALES ANALYSIS
===== ========

IDENT	DATE	SALE PRICE	NET RATE	LV/CV RATIO	LAND $/HA	% CHANGE CAP.VALUE
1	3 81	64500	278.6	.27	205570	21.7
2	1180	63000	296.3	.27	171806	14.5
3	2 81	77000	259.8	.26	49988	10
4	2 81	55000	225.5	.31	150194	19.6
5	4 81	60500	316.4	.28	204225	23.5
6	1 81	39000	275.3	.29	129790	18.2
7	1280	76000	258.2	.16	122845	20.6
8	1 81	66000	255.2	.17	135714	10
9	3 81	66000	283.4	.25	163265	11.9
10	1180	64000	301.5	.27	186047	25.5
11	9 81	64000	340.9	.24	138728	36.2
12	9 81	66000	347.5	.2	122100	40.4
13	9 81	77000	397.8	.27	190887	37.5
14	8 81	70000	321.4	.25	185414	25
15	1081	59500	267.1	.24	135802	35.2
AVERAGE		64500	295		152825	23.3

NOTE - USING ESTIMATED LAND + IMPROVEMENTS VALUE AT SALE

STEP 6

This step time adjusts the data using the regression equation that had been developed in Step 2. The program has been written so that the user can branch directly to Step 5 from Step 1.

STEP 7

If the user is not satisfied with the regression equation developed in Step 6 then the percentage adjustment for time can be specified by the user.

Once the data set has been established, this program enables the valuer to rapidly perform the basic series of calculations necessary for a sales analysis. It is anticipated that the basic programming framework could be further adapted to suit other more specialised sales analysis applications.

This program has been developed primarily as an aid to assist valuers to complete a conventional valuation using the sales approach. It could also be used in conjunction with some of the other programs described in this chapter. For example, the trend analysis section would be useful in adjusting raw sales data before applying the area adjustment method described in the next section.

2.5   AREA ADJUSTMENTS

One of the difficulties that valuers face when using comparable sales information is in adjusting for differences in size between properties. In general, larger properties tend to sell for less per unit area than smaller properties. Part of this difference can often be explained when the improvements are analysed and deducted from the selling price. For example, a small rural farmlet of 2 ha in size will require much the same buildings as a 4 ha farmlet. The loading of buildings will mean that the 2 ha farmlet is likely to sell for more per hectare than the 4 ha farmlet.

Even when the sales of land are analysed on land without buildings or land value basis there will often be some difference in the price paid per hectare. This factor can also be verified from the analysis of vacant land sales. These price differentials between blocks of varying size are related to the demand function. Smaller blocks often tend to attract more buyer interest because of the smaller capital requirements.

In addition, research by Chiu (1976) and others has shown that many purchasers of small farmlets in the 4 ha category simply want a place in the country and would be happier if they had less land than the 4 ha which was the minimum subdivision size allowed in many counties.

The standard valuation approaches used by valuers in New Zealand for the analysis of the land sales of small blocks is described by Halstead (1978) in 'Urban Valuation in New Zealand'. Adjustments to land sales are made by deducting a notional 'site value' for a house and then reanalysing the sales data based on the residual price per ha for the land. Even when the site value has been deducted from the selling price of the bare land the per hectare price for the smaller blocks tend to be more than the larger blocks. A generalised diagram showing this effect is represented in Figure 2.9. Since 4 ha sales tend to be the norm, this area has been adopted as 100 per cent on the vertical axis. This information is often converted to charts and used by valuers for mass appraisal purposes. It is particularly useful when assessing land value. The practical difficulty with the conventional approach is that it is time consuming. Currently it is only used by the Valuation Department. Also, fitting the correct curve to the data points on the graph can be rather time consuming when using manual methods.
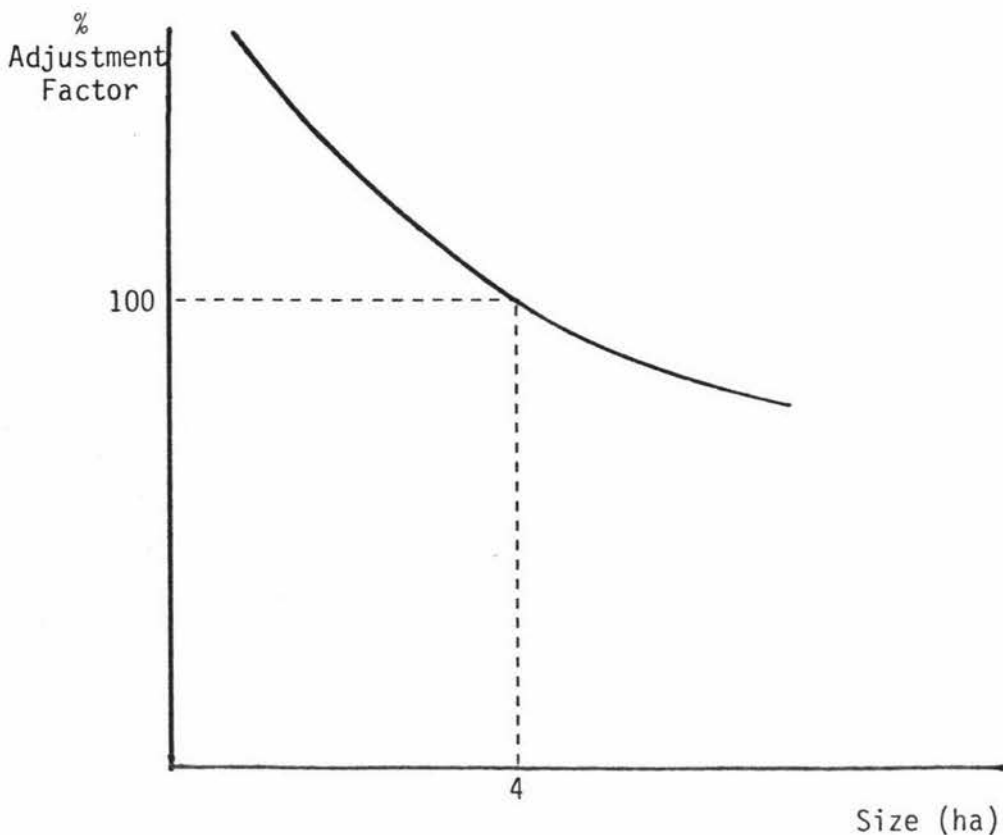
Figure 2.9:   Generalised Size Adjustment Curve

2.5.1   Computer Application

A computer program has been developed by Dilmore (1981) to
assist valuers fitting the appropriate percentage adjustments to a
set of sales information.   Dilmore (1976) suggests unit price
adjustments based on the learning curve formula:

$$P_S = \left(\frac{A_C}{A_S}\right)^\alpha P_C$$

where, P_S is the unit price of the subject property,
   P_C is the unit price of a comparable property,
   A_S is the area of the subject property,
   A_C is the area of a comparable property,
   α is an exponential value which varies according to
      the curve used.

An 80 per cent curve indicates that doubling the area will reduce the
unit price to 80 per cent.

Thus, for example, if $A_S = 2A_C$ then, $P_S = 0.8P_C$ for an 80 per
cent learning curve.   In this case we have:

$$\frac{P_S}{P_C} = 0.8 = \left(\frac{A_C}{A_S}\right)^\alpha = \left(\frac{1}{2}\right)^\alpha$$

and,

$$\alpha = \frac{\log 0.8}{\log 0.5} = 0.322$$

Where the learning curve relationship holds, the product:
$P_j A_j{}^\alpha = \beta$ is constant for all properties.

For a set of sales data where the learning curve relationship
holds, we wish to estimate the coefficient α and the constant β.   We
can then estimate the unit sales price for the subject property:

$$P_S = \beta A_S^{-\alpha}$$

The estimating procedure suggested by Dilmore (1981) is to find iteratively, from a sample of comparative sales data, the value for α such that the coefficient of variation for the average: $\frac{1}{n} \sum_j P_j A_j^\alpha$ of the sample, is a minimum. The estimated unit price for a subject property is then:

$$P_s = \left(\frac{1}{n} \sum P_j A_j^\alpha\right) A_s^{-\alpha}$$

The Dilmore computer program has been adapated for the Apple II microcomputer. Program output, for a sample of four bare-land sales in the Manawatu area, is presented in Table 2.8. In practice the unit sales prices would be adjusted for all factors except size prior to the Dilmore analysis.

According to Dilmore, the learning curve adjustment equation was generally better able to explain variations in unit prices for properties of different sizes, than other methods commonly employed by valuers. These other methods included: linear regression of unit price on size, linear regression of unit price on log (size), and regression of log (unit price) on log (size).

However, Townsley (pers. com.), and Cantwell (1981) have questioned the criterion used by Dilmore to measure how well an adjustment model explained variation in unit prices. Since the learning curve is an exponential equation:

$$P_j = \beta A_j^{-\alpha}$$

least squares regression can be applied to the logarithmic transformation:

$$\ln P_j = \ln\beta - \alpha \ln P_j$$

to obtain estimates of $\ln\beta$ and α. Under certain assumptions about the error term, the least squares estimates have the properties of minimum variance and unbiassedness. Properties of the estimates obtained by the Dilmore method are unknown. Application of least squares regression to the log transformation of the learning curve model has the advantage of simplicity: an iterative procedure is not required and least squares regression computer programs are widely available.

Table 2.8:   Sales Data Vacant Rural Lots

```
          ADJ FACTORS FOR 7 CURVES
      75%  77.5%  80%  82.5%  85%   87.5%  90%
      ==========================================

  1  .9    .91   .92  .93    .94    .95   .96

  2  .75   .78   .8   .82    .85    .88   .9

  3  1.85  1.73  1.61 1.51   1.42   1.33  1.25

  4  1.03  1.03  1.02 1.02   1.02   1.01  1.01
```

INPUTS ARE —

```
      SIZE    PRICE
  1   3.1     7096
  2   2       12500
  3   17.7    4237
  4   4.3     7209
```

```
        MEAN OF PRICES                   = 7760.5
         STANDARD DEVIATION OF PRICES = 3445.95
         COEFFICIENT OF VARIATION        = .444037


        MEAN OF PRICES ADJ'D W/75  % CURVE = 7760.5
      STD DEV=1241.22
      COEFF OF VAR =.15994


        MEAN OF PRICES ADJ'D W/77.5% CURVE = 7718.27
      STD DEV=1380.25
      COEFF OF VAR =.178829


        MEAN OF PRICES ADJ'D W/80  % CURVE = 7688.75
      STD DEV=1579.37
      COEFF OF VAR =.205413


        MEAN OF PRICES ADJ'D W/82.5% CURVE = 7670.28
      STD DEV=1808.34
      COEFF OF VAR =.235759


        MEAN OF PRICES ADJ'D W/85  % CURVE = 7661.67
      STD DEV=2045.52
      COEFF OF VAR =.266981


        MEAN OF PRICES ADJ'D W/87.5% CURVE = 7661.59
      STD DEV=2291.36
      COEFF OF VAR =.299071


        MEAN OF PRICES ADJ'D W/90  % CURVE = 7669.2
      STD DEV=2532.13
      COEFF OF VAR =.330169
```

For the example data analysed in Table 2.8, the least squares estimates are:

$$\ln\hat{P}_j = 9.55764 - 0.43775 \ln A_j$$

The estimate of β is: $e^{9.55764} = 14152.4$, and the predicting equation for unit price becomes:

$$\hat{P}_j = 14152.4 \; A_j^{-0.43775}$$

When $A_j = 4$, $\quad \hat{P}_j = \$7714$.

———

CHAPTER 3

MULTIPLE REGRESSION ANALYSIS

3.1   REVIEW OF LITERATURE

Regression analysis is one statistical technique that can be applied to the comparable sales approach to valuation.   This method enables the valuer to analyse large numbers of comparable sales in order to estimate the relationship between the variable factors that contribute to sale price.   If the selling price of a property could be explained by a single variable, such as the net income, then a simple regression equation using the method of least squares could be developed that would show the changes in property values caused by changes in net income.   Since property values are normally influenced by a number of factors and not just a single variable, valuers need to use multiple regression analysis (MRA) in order to estimate the statistical relationship among the independent variables.

The method of developing a regression equation for valuation purposes is to gather property sales information, and quantify the variable factors that are thought to contribute to the selling price. The regression procedure is then undertaken and results in an estimated equation.   This equation estimates the weighting that should be applied to each variable factor and the contribution that the variables make to predicting the selling price.   Once the regression equation has been developed then the most probable selling price of a property that has not sold can be estimated by inserting the value of the variables into the equation and solving the equation.   A number of statistical tests are used to estimate the reliability and likely predictive ability of the regression equation.

MRA was first used in the valuation process more than 50 years ago.   Work carried out by Haas (1922) attempted to correlate farm sale prices in Minnesota with four independent variables thought to influence farm values.   Reinmuth (1973) reported that similar work in the 1920's was carried out in the United Kingdom where researchers looked at the factors influencing dairy farm prices.

These early valuation researchers faced considerable computational difficulty in obtaining the estimated regression equations. The equations that were developed only 'explained' about 75 per cent of the variation in selling price between properties. In practical terms, MRA was just too time consuming to be seriously considered by valuers until almost 30 years later.

With the availability of high speed computers and MRA programs in the 1950's, it became feasible to make progress in this area. Renshaw (1958) reviewed progress in the area and his own work on developing models for valuing irrigated land. Renshaw also wrote about the potential for the use of MRA in urban valuations, particularly for mass appraisal purposes.

Much of the initial exploratory work on urban applications of MRA was carried out by academics in United States universities. Leading advocates for MRA included Case (1967), Shenkel (1968), and Smith (1971). Doubts about the statistical validity of the MRA models that were being developed were expressed by Lessinger (1968), but these did not seem to deter county assessors. Hinshaw (1969) reported on the actual application of MRA to his assessment work in Orange County, California. The results of the Orange County Study encouraged a number of other California assessors to investigate MRA applications. This work was co-ordinated by the California State Board of Equalization whose statistical consultant Gustafson (1968), was optimistic about the benefits of MRA for assessment procedures in California.

During the 1970's steady progress was made on refining MRA applications for mass appraisal. Numerous journal articles were written on the subject. A major technical report was completed by Jancsek (1972), and a book written by Dasso (1973). In addition to using MRA for the valuation of single family homes, United States valuers had continued to develop assessment models for rural property, Davis (1965), and began to investigate application for vacant urban land and income properties, Shenkel (1974). Applications of MRA for private sector valuers doing one off valuations on single family homes was described by Dilmore (1971).

During the 1960's, valuers in New Zealand began to consider the application of MRA to valuation practice in New Zealand. Hildebrandt (1968) reported working with another valuer, Laing, in developing a regression model for the valuation of rural land in Otago and Southland. The statistical and computing backup for this work was provided by staff at Otago University.

Some of the ideas expressed by Hildebrand were expanded on in subsequent articles in the 'New Zealand Valuer' by Hyndman (1969) and Hargreaves (1971).

A comprehensive report summarising the research work carried out by the Valuation Department (1972) was titled 'Valuing by Computer'. The principal researcher, Hyndman, described pilot studies that were carried out in Levin and Riccarton. These studies investigated the application of MRA to the valuation of single family homes for mass appraisal purposes. Hyndman concluded that although the estimating equations had not been able to 'explain' more than 95 per cent of the price variance, such a degree of estimating precision was also probably not attainable by standard manual valuations. He suggested that the estimating equations could have been improved by the more appropriate stratification of the sales data and better methods of measuring the explanatory variables in the equations.

The research work that was being done by the Valuation Department was continued by Stevenson (1975). Further pilot studies on the valuation of single family homes were undertaken in Wellington and Auckland. Stevenson sounded a note of caution to valuers and warned them not to be taken in by the oversell of computer applications. He concluded that while MRA had benefits for mass appraisal purposes, the benefits to the private valuer were less apparent. The main problems that he thought private valuers were likely to face were: high fixed costs to develop the initial equations, difficulty in keeping the equations updated, the training required to handle the subjective variables, and the question of confidentiality of the information in a shared data base.

A more optimistic view of the benefits of multiple regression analysis to New Zealand valuation practice was expressed by Reinmuth (1973). Reinmuth stressed the cost effectiveness that multiple regression analysis offered and pointed out the apparent public acceptance of mass appraisal systems already in place in the U.S.A.

Mander (1975) reviewed the progress that the Valuation Department had made in the area of mass appraisal. He concluded that the use of statistical methods would do much to improve the professional standing of valuers in that decisions could be made on the basis of sound quantitative analysis. Mander stressed that the final judgement was always left to the individual valuer. He said the benefits of computer valuations were increased staff productivity and the fact that valuers could be freed up from some of the more mundane work associated with mass appraisals.

Mander recognised the psychological barriers that could arise with older valuers, in particular, who may view the computer with considerable misgivings. This relates to the 'demoralisation aura' reported by Jefferies (1974b). Some valuers saw the computer taking over some judgement facets of valuations and had difficulty coping with the new systems of recording information for computer processing. Mander reported that some government valuers complained about having to gather large amounts of information needed for the MRA. At the same time the valuers were required to do a standard manual valuation on the properties.

Further developments in the Valuation Department's MRA mass appraisal system were reported on by Stevenson (1979). Stevenson concluded that it was not feasible to collect large amounts of data for all properties. (In the earlier studies 120-150 fields of data were collected.) He said in future, 29 fields of data, including ten existing fields of land use data would be collected. Stevenson suggested that this restricted level of data would minimise the cost of the MRA system and the number of errors. He stated that the major advantages of the new system were increased productivity and valuation accuracy.

Since 1970 most of the work on computer valuations in New Zealand has been carried out by research staff at the Valuation Department who have been developing systems for mass appraisal purposes.

Some exploratory work was also done on the application of MRA to rural valuation during the 1970's in New Zealand universities. Hargreaves (1974) described a study that was carried out using dairy farm sales from 1969-72 in the Manawatu.   In the regression equations that were developed, the variables relating to location, productivity, and the value of buildings were consistently shown to be important. The equations that were developed generally 'explained' between eighty and ninety per cent of the variation in selling price of the properties.

A study by Lee (1975) examined factors influencing rural land prices in the Canterbury area for farms on the Lismore soil type. Lee concluded that productivity was only one of the important variables and that a number of non-monetary considerations influenced prices.

Currently, MRA is a method that is used by the Valuation Department for the valuation of single family homes in their five yearly revaluations.   The government valuers are given the MRA estimates before they inspect the properties but the valuer still makes the final decision and does a conventional valuation.

There is now a large amount of information available regarding the application of MRA for mass appraisal purposes.   In general MRA has been found to be a very useful tool for mass appraisal and has helped to increase the productivity of valuers and the accuracy of their valuation estimates.   The relatively high cost of developing a useful MRA model can usually be justified when the equations can be used for the valuation of literally thousands of properties. In New Zealand, MRA models for mass appraisal only have to be developed once every five years for each local authority area. Further, the time adjustment problem that valuers face in a changing market can be overcome to some extent in New Zealand mass appraisal, since the effective date of the valuation is usually backdated so that the valuers have sales information both before and after the date

of valuation.   This means the time adjustment factor applied to
sales prior to the date of valuation can be verified by looking at the
level of sales at and after the date of valuation.

Valuers in practice outside the Valuation Department do not
appear to be using MRA techiques.   The main reasons for this would
appear to be that most valuers don't have access to computing
facilities, that the sales data bases necessary to generate the
equations are not yet in place in the private sector, the time necessary
to learn about the system, and the problems in continually updating
the models.

3.2   REGRESSION INDEXING

Regression indexing is a system that has been developed by the
Valuation Department to incorporate the existing government rating
valuation into the MRA model as one of the so-called 'independent'
variables.   Stevenson (1979) stated that in a study conducted in
Howick, Auckland, the inclusion of the government valuation in the
model improved the predictive ability of the equations.   He concluded
that regression indexing appeared to be a viable and potentially
powerful estimating tool.   Work carried out at Massey University in
1980 confirmed Stevenson's hypothesis (Ming Hu pers.comm.).

Regression indexing is a much more sophisticated valuation tool
than the simple rule of thumb'plussing up' of government valuation
method that is often quoted by real estate agents and used by buyers
and sellers in the market.   Regression indexing can be used to
develop a unique index for a particular type of property.   For example,
market conditions could mean that only the wealthy can obtain mortgage
finance.   As a result, the market prices for expensive housing could
be rising with medium housing static, and inexpensive housing falling.
In this case it would be possible to develop separate MRA models for
each subgroup.

Using the government valuation to predict market value can give rise to some statistical difficulties. If the equation included floor area, number of bedrooms, and government valuation, then it is likely that both floor area and number of bedrooms would themselves be correlated with government valuation. This could mean that the coefficients in the final equation were suspect since one variable could be acting as a proxy for other variables. Technically, this is the problem of multicollinearity.

An additional problem described by Murray (1969) is the tendency for rating valuations to show an excessive concentration around the mean selling price in an area. The human factor can also result in an unevenness of the distribution of rating values. For example, the individual government valuers are often given a set geographical area to work through; or one valuer may specialize in a certain type of property in a local authority area. In some cases individual valuers may be more conservative than others.

Statistical problems apart, the practising valuer is likely to want to make use of regression indexing because it is clearly very useful in predicting market prices.

3.3   PALMERSTON NORTH MRA MODELS

To test the feasibility of using MRA in the typical situation that a New Zealand private valuer in an urban practice would face, an experiment was designed using sales information from Palmerston North city. The emphasis in the experiment was on developing equations that could 'predict' sales prices rather than a model which 'explained' sale prices. The reason for this was that a valuer is most likely to use MRA as a tool to assist in predicting values.

Sales data supplied from the NZIV microfiche service was loaded into the 'Famulus' data base program on the Massey University Prime 750 mainframe computer and interfaced with the SPSS suite of programs.

The SPSS package contains regression programs including the stepwise
multiple regression program used in this study.

The SPSS stepwise regression procedure used, selects from the
matrix of correlation coefficients, those variables that come within
a predetermined tolerance level for entry into the regression and then
fits these variables to the equation.   Variables are selected starting
with the variable that explains the largest variation in the selling
prices between properties until all the variables that satisfy the
entry criteria have been entered into the equation.   (In this study
the tolerance level selected was $F = 2.0$).

It was felt that practising valuers would be unlikely to have the
resources to gather additional information beyond that included on the
microfiche.   For this reason the analysis was limited to using the
variables shown in Table 3.1.

Table 3.1:   Variables Included on NZIV Microfiche

1. Assessment number: (Valuation Department reference number);
2. Street address;
3. Category: (type of property, e.g. FO = ownership unit);
4. Date of sale;
5. Net sale price;
6. Government valuation: (capital value, land value);
7. Age: (age of main building on site);
8. Floor area: (size of main building on site);
9. Area: (area of land);
10. Zone: (land use zone);
11. Use: (the use that the site is being put to);
12. Unit: (number of units on the site);
13. Condition: (outside condition of exterior walls and roof);
14. Construction: (type of construction for exterior walls and roof);
15. Chattels: (amount paid for chattels).

The land use variables relating to the size, condition, type of
exterior materials and use, were originally collected for town planning
purposes by the Valuation Department.   Although the Valuation Department

now collect an additional 20 variables for mass appraisal purposes, this information has not yet been collected for most urban areas in New Zealand, including Palmerston North city.   A list of the mass appraisal variables collected by the Valuation Department was discussed by Stevenson (1979) and is shown in Table 3.2.

Table 3.2:   Valuation Department Mass Appraisal Data   (29 variables)

Underground servicing - Yes/No;

Class of surrounding improvements, 1 = poorest; ... 3 = best;

Lot position - inside, corner or rear;

Contour - steep fall - to steep rise;

Landscaping - poor, fair, average or good;

View type - sea or other;

View scope - none, slight, moderate, wide;

House type - quality classing;

Internal modernisation - Yes/No;

Poor foundation - Yes/No;

Effective age;

Sundeck - Yes/No;

Large other improvements - Yes/No;

Basement laundry/workshop/storage space - Yes/No;

Car access - Yes/No;

Number of parking spaces - under main roof
                         - detached/carport;

Outlier - usual property - Yes/No.

EXISTING LAND USE DATA:

Zone;

Actual use;

Parking;

Actual age;

Condition, walls and roof;

Material, walls and roof;

Site coverage;

Total floor area;

Land area;

Location - (rolls).
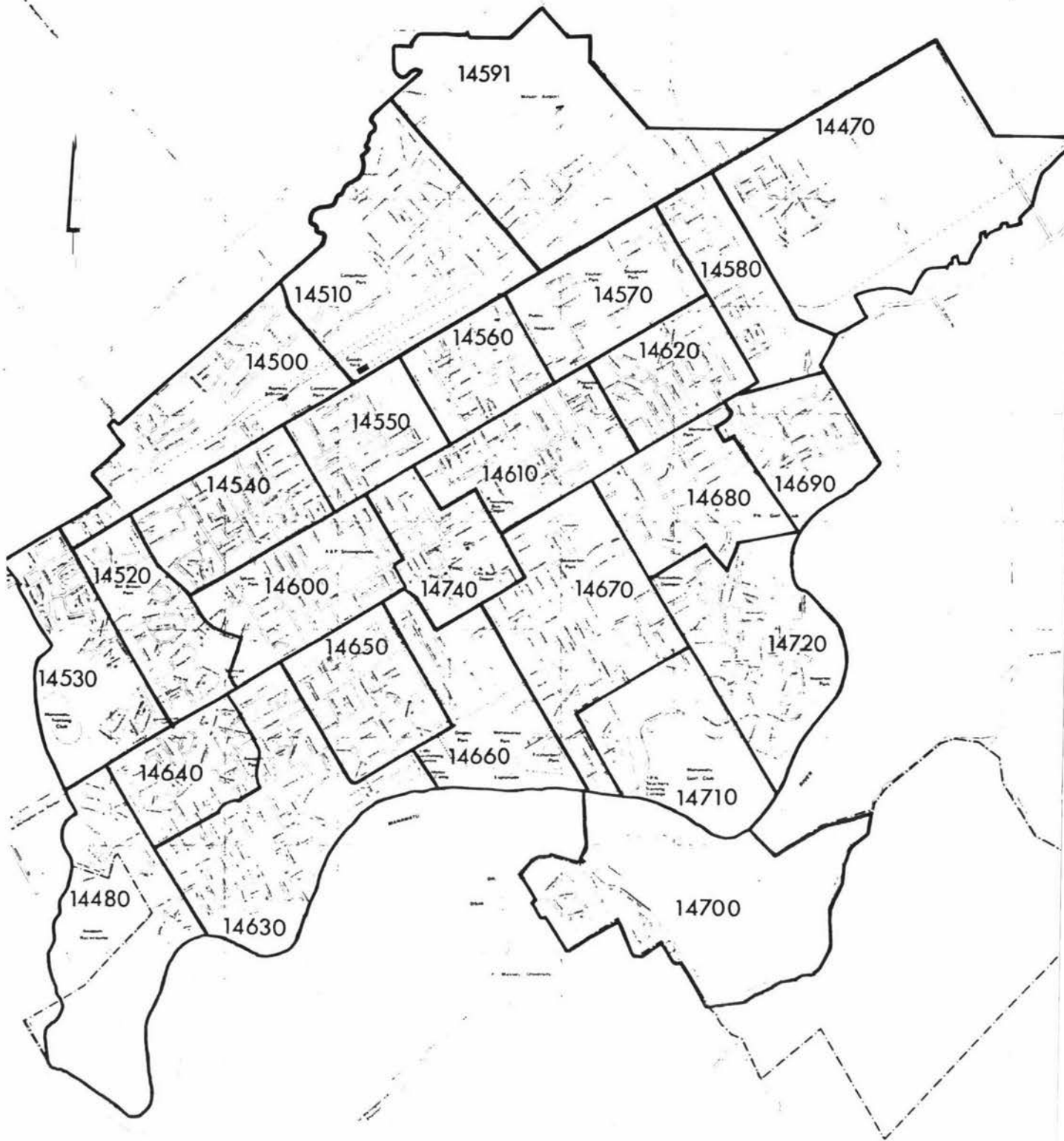
CITY OF PALMERSTON NORTH

Figure 3.1: Location of Roll Plan Boundaries

3.3.1   Explanation of Variables Used in the Study

1.   Assessment Number: Every property has a unique Valuation
Department assessment number and an attempt was made to use the
assessment numbers to explain the variation in selling prices due to
locality influences.   Palmerston North is divided up by the Valuation
Department into a number of what are called 'roll plans'.   The
geographical location of the boundaries for each roll plan are shown
in Figure 3.1.

Within the area of one roll plan there are usually several
hundred individual properties.

Mahoney (1974) suggests that the growth pattern of Palmerston
North is characterised by the sector theory first reported on in the
U.S.A. by Hoyt (1939).   Under this theory we would expect that
Palmerston North could be divided up into four sectors with the high
income sector in the southeast, the middle income sectors in the north-
east and southwest and the low income sector in the northwest.   The
boundaries of the sectors being established by Main Street to the
east-west and Rangitikei Street and Fitzherbert Avenue to the north-
south.   A MRA housing model using sector theory was explored at an
early stage in this study but the results were disappointing.

While the sector theory may be a useful overall approximation of
how housing values are distributed in Palmerston North, there are many
exceptions to this generalisation.   In Palmerston North, there are
pockets of very expensive housing in the so called middle income areas
such as Riverdale, and pockets of low cost State Housing in the
so called high income area of Hokowhitu.   This problem can be partly
overcome by excluding certain assessment numbers on a roll plan from
the model.   For example, if the assessment numbers for the State
Housing area in Hokowhitu are excluded then this particular problem
will be overcome, provided that the model is not used to estimate
selling prices for the class of property excluded from the analysis.

A more difficult problem to overcome with using the sector theory
to explain differences in selling price by locational factors is the
more subtle changes that occur between houses in a given street.

In many cities there is an obvious geographical feature which marks
the change from an expensive locality to a less expensive locality.
In Palmerston North this factor is much more blurred.   It is
relatively common to find a very expensive house selling for over
$100,000 only a few doors away from another house selling for only
half this amount.

This problem is recognised in the mass appraisal information
collected by the Valuation Department and a variable for the 'class
of surrounding improvements' is used.

Selecting sales by assessment numbers can also be used to
stratify the sales data into the newer and older parts of the city.

2.   Category: In developing MRA models the valuer would expect
that the equation developed for one class of property would not
necessarily be very useful for other classes of property.   A MRA
model used to predict the value of home units is unlikely to be very
useful in predicting the value of vacant industrial land.

3.   Date of Sale: Whenever the real estate market is not in a
static situation (and this seems to be most of the time) then date of
sale will be an important dimension in explaining price variations
between properties.   Several approaches can be taken to the problem
of adjusting sale price data for date of sale.

Where sale prices are increasing at some constant (say monthly)
rate, then an estimated sale price can be adjusted for date of sale
relative to some base value:

$$Y_t = Y_0(1 + r)^t$$

The rate of adjustment (r) can be estimated from sales information.
According to Stevenson (1978) the percentage adjustment method
described, is preferable to using a fixed dollar adjustment per month:

$$Y_t = Y_0 + At.$$

The base period price (Y_0) for a property would usually be the most
recent government valuation.

The percentage adjustment method based on government valuations was tried in this study, but produced disappointing results. Over the period studied, property sale prices had not been changing at some constant (monthly) rate. Also, using government valuations as a base can suffer from the human problems associated with lack of a uniform approach by different government valuers. An alternative base could have been developed using changes over time in the average selling price of representative properties, but this approach was not explored in this study.

Where the rate of change in property prices has been varying unevenly over time, dummy variables in MRA offer an alternative approach to analysing the effect of date of sale on selling price. For example, if sales data is being analysed for a three month period, then a dummy variable can be created in MRA to adjust for average sale price in each month. Figure 3.2 illustrates the dummy variables for such a situation.

	Var.1 (Jan.)	Var.2 (Feb.)	Var.3 (March)
Sale 1	1	0	0
2	0	1	0
3	0	0	1

Figure 3.2:   Time Adustment Dummy Variables

The dummy variable regression coefficients estimate the way in which average sale prices have varied over time. The remaining MRA variables attempt to explain variation about these period-average sale prices. One practical problem in using dummy variables is that this approach can use up a large number of degrees of freedom in the equation. In an effort to minimize this problem, sales data were grouped into two monthly periods in this study.

A further problem associated with use of dummy variables to 'explain' historical price variation concerns our desire to use the estimated MRA equation to 'predict' sale prices.   Since the dummy variables do not necessarily represent a price trend, but rather they adjust sale prices for variation in factors such as availability of mortgage finance, the adjustment to use at any particular point in time may not be clear.   One suggestion would be to use the adjustment indicated by the 'most recent' dummy variable.

Also, it is unlikely that the effect of other MRA variables will remain independent of the general price level over a long time period.   The most feasible solution to this difficulty would be to continually update the sales information file while eliminating the most out-of-date information.   Such an approach would need to give due consideration to the need to retain sufficient sales information to generate statistically meaningful equations.

4.   Age: This variable represents the decade built, (e.g. a 7 would mean the house was built between 1970 and 1979).   As with date of sale, dummy variables were used to analyse the variation in selling prices caused by age differences.   An alternative system used by the Valuation Department and not explored in this study is to weight the ages according to an agreed scale.

5.   Floor Area: This is the floor area of the main building on the site.   Floor area has generally shown up as an important variable in most of the reported MRA studies.   The problem with floor area as shown on the microfiche is that it does not separate the living area out in cases where a house may have an integral garage.   Thus there could be two houses with identical living areas and garage space but the floor area of the house with the integral garage will show up as considerably greater than the house with a free standing garage.

6.   Area: The size of the section is generally straight forward except when dealing with home units where the ownership arrangement is by either cross leases, companies or unit titles.   In these cases,

the section size for the individual unit is not legally defined and this does not appear in the microfiche information.

7. Zone: Palmerston North currently has only one residential zone and the great majority of residential houses are in this zone. In this study only properties that were in the residential zone were included.

8. Use: This category indicates the type of use, ranging from recreational to residential. Within each type of use there are a number of sub-groupings. For example, in the residential category there are nine residential sub-groupings, ranging from vacant residential land to multiple uses within one residential building. Thus the analyst can select the sales data for a regression experiment by choosing only say single unit homes from the residential category.

9. Unit: The number given under this category indicates the number of separate units occupying the property. For example, a block of three rental flats may be all on one title but would be listed as 3.

10. Condition: This category refers to the condition of firstly the exterior walls of the main building on the site and secondly the exterior condition of the roof of the main building on the site. Both of these features are scored by the government valuers when doing the inspections for the five yearly rating valuation. The scoring system is: G (good); A (average); F (fair); P (poor); and X when none of the preceding fit the situation.

11. Construction: This category lists the type of building material used for firstly the exterior walls; and secondly the roof of the main building on the site. The codes used are as follows: W (wood); B (brick); C (concrete); S (stone); R (roughcast); F (fibrolite); M (malthoid); P (plastic); I (iron); A (aluminium); G (glass); T (tiles); X (mixture).

12.   Chattels/Other: The figures here are firstly the price paid
for the chattels, and secondly that part of the gross sale price
attributed to other items of plant, stock, goodwill etc.

3.3.2   Results of the Study

The MRA method was applied to two groups of properties in
Palmerston North City and separate regression equations were developed
for home units and modern single family homes in the medium price range.

(i)   Home Units: Although there is no published information in New
Zealand about using MRA for predicting the selling price of home units,
it was thought that further investigation was warranted because home
units are a relatively homogeneous housing type, and there is now a
reasonable volume of sales data in most cities.

Home unit sales were selected for the area of Palmerston North
that is south of Main Street as the majority of home unit sales occur
in this section of the city which has a broad cross-section of
neighbourhoods.   The 47 home unit sales were confined to those that
had occurred in the period from May 1981 to December 1981.   No attempt
was made to stratify the data by selling price categories.   The list
of variables that were tried in the initial run are shown in Table 3.3.

Table 3.3:   List of Home Unit Variables

Independent variables

Date of sale (two monthly intervals)
Wooden walls
Tile roof
Age (decade built)
Wall condition good
Roof condition good
Locality (roll plan number)
Size of unit (m^2)
Separate surveyed section
Size of unit (greater than 100 m^2)

The results of the regression are shown in Table 3.4.

Table 3.4: Regression Equation for Predicting Home Unit Sale
            Prices South of Main Street

Independent variable	Units of measurement	Regression coefficient	Beta coefficient	Order of importance
Age (built in 1960s)	(Yes/No)	-16,494	-.677	1
Locality Riverdale	(Yes/No)	14,061	.369	2
Age (built in 1970s)	(Yes/No)	- 3,853	-.181	3
Size (greater than 100m^2)	(Yes/No)	3,113	.146	4

Constant $50,831   Degrees of freedom = 42
          R^2 = .581

$$\frac{\text{Standard error of estimate}}{\text{Average selling price}} \frac{(\$6935)}{(\$47521)} = 14.6\%$$

Thus, for example, the predicted sale price of a home unit built
in the 1970's, located in Riverdale and of a size less than 100 m^2,
is given by:

50,831 - 16,494(0) + 14,061(1) - 3853(1) + 3113(0) = $61,039.

In an effort to improve the predictive ability of the equation,
the capital value from the 1978 Government Valuation was included in the
list of variables and a further equation was developed.   The rationale
for including this variable, which is not strictly independent, was
discussed in the section on regression indexing.

The results of this regression run are shown in Table 3.5.

Table 3.5:   Regression Equation for Predicting Home Unit Sale
              Prices South of Main Street (Includes Capital Value)

Independent variable	Units of measurement	Regression coefficient	Beta coefficient	Order of importance
Capital value	$	.79885	.676	1
Locality Hokowhitu	(Yes/No)	11,299	.260	2
Tile roof	(Yes/No)	4,914	.207	3
Sale date (May/June)	(Yes/No)	-7,120	.164	4
Wall condition (good)	(Yes/No)	3,549	.149	5
Sale date (Nov/Dec)	(Yes/No)	-2,557	.117	6

Constant = $22,137   Degrees of freedom = 40

$R^2 = .739$

$\frac{\text{Standard error of estimate}}{\text{Average selling price}} \frac{(\$5472)}{(\$47,521)} = 11.5\%$

Discussion

The variables tested in this study were selected on the basis of a discussion with local valuers, experimentation with different variables, and earlier survey work on buyer preferences reported by Hargreaves (1976).

The initial regression showed that unit age was the most important factor causing a variation in prices.   Home unit purchasers are typically older people who wish to minimise the amount of maintenance work that needs to be done and this may account for the fact that older units tend to be discounted quite heavily.   Newer units are also likely to have superior internal fittings compared with older units.

As it was felt that larger units had a higher standard of internal fittings a variable was incorporated to test the effect on sale price of size of unit greater than 100 m².

The time of sale adjustment variables did not appear in the initial equation even though it is known that the market was moving up rapidly over most of this period.   An examination of the matrix of correlation

coefficients shows that the time variables were significantly correlated to several other variables (including locality and age) which do appear in the final equation and could therefore be acting as proxies for time. Thus, during one period sales were predominantly in one locality, while during another period sales were predominantly in another locality.

When capital value was included as a variable, the structure of the equation changed. As might be expected the age variables were no longer significant as the age factor was already incorporated into capital value. The time of sale became more important and showed that the market appeared to peak over the July-October period and decrease slightly in the November-December period. This is probably partly due to the contraction in the availability of mortgage finance immediately following the 1981 general election and a possible peaking of the market prior to the election.

The regression coefficients and the variables that appear to be important in the equations must be treated cautiously. When testing the model over several time periods using slightly different data the ranking of the variables changed significantly indicating some instability in the structure of the model. As long as this type of model is used to predict rather than explain variations in selling prices then this instability may not be a serious problem.

The results of the equations that have been developed here are encouraging enough to warrant further study of the application of MRA to the valuation of home units. The study was confined to using data that is readily available on the microfiche. There are a number of additional variables that could warrant inclusion in a future study. These include the number of bedrooms, number of other home units in the development, size of living area, number of covered carspaces, class of surrounding improvements, class of internal fittings, and distance to the central city.

(ii)   Single Family Homes: Single family houses form the majority
of the residential properties within Palmerston North City.   It was
thought that the most homogeneous group of single family homes was
likely to be medium priced houses built since 1950. With older housing,
an absence of information on the degree of interior modernisation was
thought likely to present significant difficulties in applying MRA.
The 148 single family homes sold during the period from May 1981 to
December 1981 and used in this study were selected on the basis of
age (built since 1949), house size (90 m^2 - 180 m^2), sale price
($35,000-$80,000), and section area (300 m^2 - 1500 m^2).   This selection
criteria helped to remove any obvious outliers from the data and the
price range is sufficiently wide to be representative of medium cost
housing.

The list of variables that were tried in the initial run is shown
in Table 3.6.

Table 3.6:   List of Medium Cost Housing Variables

List of independent variables

Date of sale (two monthly intervals)
Locality (roll plan number)
House size (m^2)
Section size   (m^2)
Age of house (decade built)
Type of walls (brick, wood, roughcast)
Type of roof (tile, iron)

The results of the regression run are shown in Table 3.7.

A separate regression equation was also developed for the same
sales data including the capital value as an additional variable.   The
results of this equation are shown in Table 3.8.

Table 3.7:   Regression Equation for Single Family Homes

Independent variable	Units of measurement	Regression coefficient	Beta coefficient	Order of importance
House size	m^2	33.13	.656	1
Age (built 1970's)	(Yes/No)	3914	.179	2
Age (built 1950's)	(Yes/No)	-4962	-.175	3
Age (built 1980's)	(Yes/No)	4353	.120	4
Locality (Atawhai)	(Yes/No)	11460	.094	5
Walls (wood)	(Yes/No)	-2159	-.094	6
Locality (Central)	(Yes/No)	5153	.084	7
Locality (Westbrook)	(Yes/No)	-2469	-.075	8

Constant $12,733   Degrees of freedom = 139

R^2 = .58

$$\frac{\text{Standard error of estimate}}{\text{Average selling price}} \quad \frac{(\$7064)}{(\$51243)} = 13.7\%$$

Table 3.8:   Regression Equation for Single Family Homes
             (Includes Capital Value)

Independent variable	Units of measurement	Regression coefficient	Beta coefficient	Order of importance
Capital value	$	.999	.652	1
House size	m^2	11.15	.221	2
Sale date (May/June)	(Yes/No)	-7470	-.095	3
Age (built 1970's)	(Yes/No)	1668	.074	4
Locality (Central)	(Yes/No)	4410	.072	5
Locality (Atawhai)	(Yes/No)	6471	.068	6
Locality (Terrace End)	(Yes/No)	-3379	-.060	7

Constant $8237   Degrees of Freedom = 140

R^2 = .75

$$\frac{\text{Standard error of estimate}}{\text{Average selling price}} \quad \frac{(\$5505)}{(\$51243)} = 10.74\%$$

going to sell and that vendors would set the listing price above the price that they expected to sell for, so as to leave room for negotiation.

The list of data gathered from the Multiple Listing Bureau files is shown in Table 3.9.

Table 3.9:   List of Data Obtained from Multiple Listing Bureau

1) Street address
2) Listing price
3) Date listed
4) Number of bedrooms
5) Separate dining room (Yes/No)
6) Number of car spaces
7) Interior condition (1-3)
8) Class of surrounding improvement (1-3)
9) External modernisation (Yes/No)
10) Study (Yes/No)
11) Family room (Yes/No)
12) Gas installed (Yes/No)
13) Car port (Yes/No)
14) Foundation adequate (Yes/No)
15) Swimming pool (Yes/No)
16) House size (m^2)

A judgement on interior condition, the class of surrounding improvements, and the adequacy of the foundations was made from the description given on the multiple listing form for each property. (The sale price information is not recorded by the multiple listing bureau).

Due to limitations in the number of data fields that can be used with the 'Famulus' computer program a decision had to be made to eliminate some of the multiple listing data from the computer analysis. The complete list of variables used in the computer analysis is shown

in Table 3.10.   Variables 1-8 on the list contain multiple listing
data, and variables 9-26 contain existing data from the NZIV sales
system.

Table 3.10:   List of Variables Analysed in Multiple Listing Study

1)	Listing price	14)	Net selling price
2)	Date listed	15)	Capital value
3)	Number of bedrooms	16)	Land value
4)	Separate dining room (Yes/No)	17)	Age
5)	Interior condition (1-3)	18)	House size
6)	Class of surrounding improvements (1-3)	19)	Land area
7)	External modernisation (Yes/No)	20)	Zone
8)	Number of car spaces	21)	Number of units
9)	Assessment number	22)	Types of walls
10)	Tenure	23)	Condition of walls
11)	Category	24)	Type of roof
12)	Month sold	25)	Condition of roof
13)	Year sold	26)	Value of chattels

Multiple listing variables were eliminated where there was
missing data on a significant number of properties and when very few
properties had a certain feature.   Similarly, information about the
foundations was often incomplete.   The multiple listing data was
then matched up with the existing NZIV sales data base by using the
merge files facility on the 'Famulus' program.   Street addresses were
used as the basis for merging the files.   It was possible to match
98 properties by street addresses.   In a number of cases the matching
was not possible because the sales shown by the multiple listing bureau
had not appeared on the NZIV microfiche.   In other cases, data entry
spacing or spelling errors in the street address shown meant that the
files for particular properties could not be readily merged.

3.4.1   Results of the Study

The first analysis was done using the 'Scattergram' program in
SPSS.   This is a simple linear regression program with graphical
output.   Selling price was regressed against listing price.   The
results of the analysis are shown in Figure 3.3.
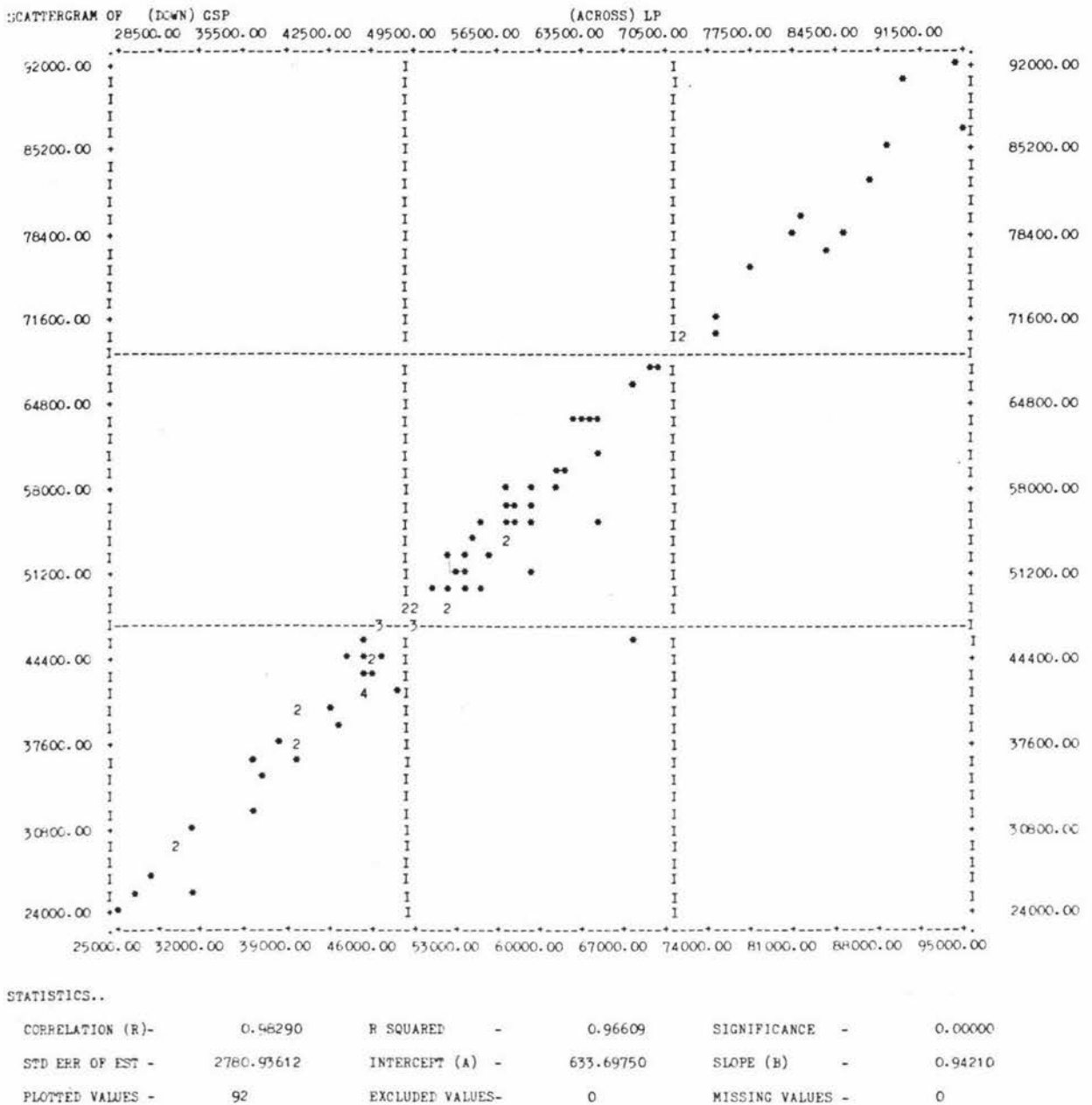
Figure 3.3:   Scattergram of Gross Sale Price (GSP) with Listing Price (LP)

The period under study included sales from July 1981 to March 1982. It is apparent that gross sale price and listing price are highly correlated. The R^2 statistic indicates that the listing price explains 96 per cent of the variation in selling price between the properties. The standard error of estimate is ± $2780 which is 5 per cent of the mean selling price. The sample of properties analysed covers all types of residential properties, in various locations, and over a broad range of prices. The predictive accuracy of the equation is high. This is particularly significant because it is known that the market went through considerable upward changes from July to November 1981, followed by a subsequent levelling off in prices in 1982.

The data was then analysed by using stepwise multiple regression analysis on all the variables shown in Table 3.10. As the inclusion of the additional variables did not improve the predictive ability of the equation the results of this regression have been excluded from the text. Additional regressions excluding the listing price information produced equations that had a low level of predictive ability.

Discussion

There is clearly a strong correlation between listing price and selling price. When valuing properties where the listing price is known, the valuer has a useful piece of additional information that can be used to help predict the selling price of a subject property. There are several limitations in using listing prices for valuations. This method is not directly applicable when the subject property is not for sale. Equally important is the property which is on the market with an unrealistically high asking price. In some cases these properties will stay on the market for extended periods and the length of time an unsold property has been on the market when compared with the average selling time may be an important factor to consider when using listing prices as an indication of the most likely selling price. However, there was an insignificant correlation between the length of time on the market and the amount of the difference between listing price and selling price for the data analysed.

An area of further research that has not been explored in this study is the use of listing prices to predict the most likely selling prices of properties that are not on the market. This could possibly be achieved by the use of average listing prices for particular types of properties. For example, it may be found that 3 bedroomed houses built since 1970 are on average selling for 5 per cent less than listing price in a particular locality. A valuer could then use this information to calculate the predicted average selling price and establish a benchmark price. When valuing a particular property, the valuer could use the benchmark price as the starting point and then make appropriate adjustments for aspects where the subject property did not conform to the average. The variables in the MRA equations could possibly provide valuers with some guidance regarding the adjustment factors to use.

Listing prices are also likely to be an early warning signal to valuers about changes in the property market over time. It is likely that as listing prices rise or fall sales prices will move in the same direction a short time later. This hypothesis has not been explored in any depth in this study. However, the high correlation between listing price and sale prices during the 'property boom' experienced in the second half of 1981 suggests vendors rapidly adjust asking prices to changes in market conditions.

CHAPTER 4

THE INCOME APPROACH

4.1 DISCOUNTED CASH FLOWS

The income approach to valuation is based on the premise that the value of a property is equal to the present worth of the rights to the future income from the property. The theoretical basis for the income approach is founded on the notion of discounted cash flows.

Discounted cash flow is a widely used tool in capital budgeting and investment analysis. The concept behind discounting is that a dollar received in the future is likely to be worth less than a dollar received today because the investor has the opportunity to invest a dollar received now at interest. In an inflationary period the investor is likely to anticipate that a dollar received in the future will have a lower value than a dollar received today because in real terms a future dollar will not buy the same amount of goods and services as a dollar received now.

Discounting is the reciprocal of compounding. A valuer can move from a future value to a present value by discounting and from a present value to a future value by compounding. Fisher (1930) showed the interest rate linkage between present and future values. This effect is illustrated in Figure 4.1.
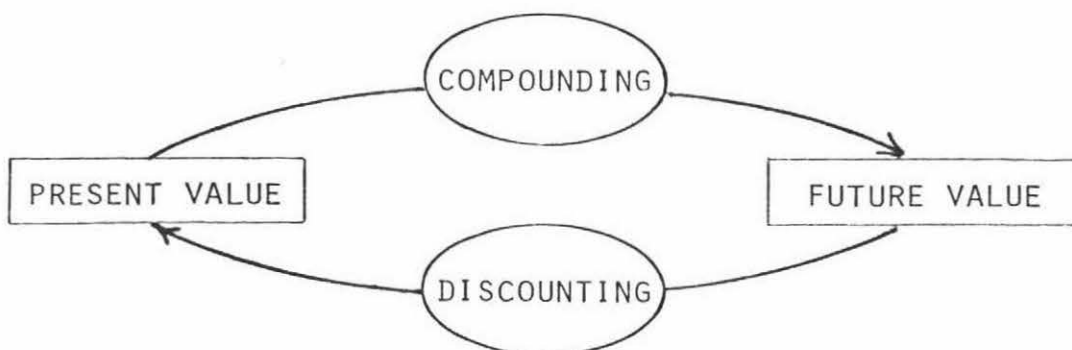
Figure 4.1: Interest Rate Linkage Between Present and Future Values

The formula for discounting is as follows:

$$PV = \frac{R}{(1 + I)^n}$$

where PV = Present value of a future lump sum R, received at the
end of year n,

I = Interest rate.

In the case of a real estate valuation problem the analyst is
likely to be dealing with a series of future incomes and the above
formula would be extended as follows:

$$PV = \frac{R_1}{(1 + I)} + \frac{R_2}{(1 + I)^2} + \frac{R_3}{(1 + I)^3} \cdots + \frac{R_n}{(1 + I)^n}$$

Where PV = Present value of the income stream,

R_i = Income associated with each year,

I = Interest rate,

n = Final year of the investment.

When the valuer assumes that the income from the property will
continue in perpetuity, and that the income stream is constant, then
Heady (1952) shows mathematically that the discounting formula will
reduce to:

$$PV = \frac{R}{I}$$

4.2   CAPITALISATION

The formula $V = \frac{R}{I}$ is the basis for the traditional income approach
to valuation used by valuers.   When using this formula to convert
income to value, valuers say they are capitalising the income.
Capitalisation is the process of converting the income stream to a sum
which indicates the present value of the property.   The capitalisation
rate is that number which divided by the income stream will produce the
value.   Where the income stream is multiplied by a figure to arrive
at the value then this factor is called the years purchase.   The
capitalisation rate is the reciprocal of the years purchase rate.

In discussing the landmarks of valuation in his 'Principles and Practice of Valuation' Murray (1969) attributes the origins of the income approach to the 17th century valuation work in Ireland of Sir William Petty.   Petty had said that land in Ireland was worth seven years purchase, i.e. $V = 7R$ or $I = 14.3$ per cent.

The traditional income approach assumes that the net income to be capitalised represents a stabilised typical income from the property. Where the property has a fluctuating future income, such as in a development situation, then the estimation of present value may be incorrect.   The traditional approach also assumes that the income stream from a property continues in perpetuity but in fact this will be governed by the life of the improvements.   Further, the approach does not take account of anticipated changes in the value of the property over time and the ownership time horizon of the purchaser.

Ratcliff (1968) criticised the simplifying assumptions in the traditional income approach.   Initial refinements to the income approach were aimed at relaxing these assumptions so that buyer behaviour in the market place could be more closely simulated.

4.2.1   Determining the Rate of Capitalisation

In the case of perfect competition Fisher showed that the market rate of interest is equal to the capitalisation rate.   When the assumption of perfect competition is relaxed the rate of capitalisation is usually different from the market rate of interest.

Historically the market interest rate for mortgage finance has often been less than the rate of return that the investor earns on the equity that he has put into the property himself.   Since most investment properties are financed with borrowed funds the rate of capitalisation used may be expected to reflect the overall return on the property taking the effects of the mortgage interest rate and the equity return into account.

Ring (1963) describes four methods that can be used to determine the rate of capitalisation:

(i)   The market method derives the rate of capitalisation by relating the net income from properties that have been sold to the selling price of the properties.   Johnson (1971) used such an approach to derive the capitalisation rate for rural land in New Zealand from 1954-69.

(ii)   The band of investment or weighted average method takes account of the percentage and cost of equity and mortgage debt.   From this a weighted rate of capitalisation is calculated.   For example:

First mortgage - 50% x interest rate 9% = 4.5%
Second mortgage - 20% x interest rate 15% = 3.0%
Equity   - 30% x interest rate 12% = 3.6%

Total weighted rate of interest   11.1%

(iii)   The build up method calculates a composite rate of interest. The rate of interest on government bonds is used as a basis and the additional reward for factors such as management, risk and non-liquidity is calculated and added to the basic interest rate.

(iv)   Ring describes the bankers' rate selection method as a back door approach that makes use of the valuers' knowledge of loan to value ratios and the interest payments to net income ratio allowed by investment loan bankers.   By taking the maximum interest payment that a lender would allow in relation to the net income, income and capitalising this, the maximum loan can be calculated.   By applying the loan to value ratio the value of the property can be calculated and then related back to net income to give the overall capitalisation rate.

Example:
   A lender will advance 60 per cent of value on mortgage at 10 per cent interest.   The interest payments are not to exceed 40 per cent of the net income of $10,000.   The maximum interest payment will be $4000 which will support a loan of $40,000.   This indicates a total property value of $66,666 and an overall capitalisation rate of 15 per cent.

4.3 ANNUITIES

The capitalisation process that has been described is one
specialised application of the discounted cash flow procedures.
Although appealing to valuers because of the computational simplicity
the traditional capitalisation formula assumes that the income stream
will continue in perpetuity.   In many circumstances investors have
a specific time period in mind for the ownership of investment
properties.

Provided that the income stream (R) is constant then, instead
of discounting the income for each year back to present value, the
valuer can use the formula for the present value of a unit annuity
which is as follows:

$$PV = R \times \left(\frac{(1 + I)^n - 1}{I(1 + I)^n} \right)$$

4.3.1   The Valuation of Partial Interests

Example

The annuity formula is commonly used by valuers for the
valuation of partial interests such as the lessee's interest in a
leasehold property.   Consider a simple lease which has no compensation
for improvements, and five years to run at a rental of $800 per year.
The current market rental for the property is $1000 per year.   If the
lessee (tenant) wishes to sell then his interest will be the present
value of an annuity of $200 per year.   Assuming a discount rate (I)
of 10 per cent then the lessee's interest can be ascertained either by
discounting or by using the annuity formula.

(a) Discounting

Year	Item	Amount	Present value factor	Present value
1	Rent	$200	.909	181.8
2	Rent	$200	.826	165.2
3	Rent	$200	.751	150.2
4	Rent	$200	.683	136.6
5	Rent	$200	.620	124.2
			Total present value:	$758.0

(b)   Present value of an annuity:

$$\text{Present value} = \$200\left(\frac{(1 + .1)^5 - 1}{.1(1 + .1)^5}\right)$$

$$\text{Present value} = \$200 \times 3.790$$

$$\text{Present value} = \$758.$$

In many valuations the annuity method can be combined with the discounted cash flow method.   When it is assumed that the net operating income is a constant then this part of the income analysis is easily handled by the annuity formula. The income stream in the final year of ownership should also include the estimated value of the property at the end of the holding period.   In the leasehold example that has been set out, the valuer may also be faced with valuing the lessor's (landlord's) interest.

Example:

The landlord has an income of $800 per year for the next five years.   At the end of five years he gets the property back.   At this stage the property is worth $15,000.   The discount rate is assumed to be 10 per cent.

Step 1:   Present value of rental income = $800 x $\left(\dfrac{(1 + .1)^5 - 1}{.1(1 + .1)^5}\right)$

Present value of rental income = $800 x 3.790

Present value of rental income = $3032.

Step 2:   Residential property value in five years = $15,000

Present value of residual property value = $\dfrac{\$15,000}{(1 + .1)^5}$

Present value of residual property value = $9300.

Step 3:   Present value of rental income   = $3032

Present value of residual property $9300
                                          ─────
Total present value lessor's interest $12332
                                          ─────

4.3.2   Computer Application to Partial Interest Valuations

A simple interactive computer program has been written in Basic language to perform the calculations for the valuation of lessees interest.   The program uses the annuity formula and Table 4.1 shows the print out from the program using the same data as for the above example.

Table 4.1:   Computer Output From Lessee's Interest Program

```
LESSEES INTEREST

WHAT IS THE RENT
?800
WHAT IS THE CMV OF THE RENTALVALUE?10000
WHAT IS THE RENTAL RATE(%)?10
WHAT IS THE UNEXPIRED TERM OF THE LEASE(YEARS);
?5


LESSEES INTEREST=758.157358
PV FACTOR=3.79078679
```

4.4   RESIDUAL METHODS

One of the concepts that early valuation theorists had difficulty with was the notion that the improvements (buildings) fixed to land had a limited life whereas the land itself was permanent.   Babcock (1932) introduced the idea of split capitalisation rates where the income attributable to land was capitalised at a lower rate than the income attributable to the improvements.   Babcock produced a series of charts which attempted to help the valuer determine the appropriate split rates for various types of buildings.

Using the Babcock approach the value of a property was the summation of the capitalised value of the land and the capitalised value of the improvements.

Although the concept of split capitalisation rates was criticised by Ratcliff (1950) on the grounds that it did not simulate investor behaviour, it continued to be used by valuers and is described in a number of contemporary valuation text books including McMichael (1972).

The residual methods that are currently used by valuers are usually described as the property residual, land residual, and building residual approaches.

4.4.1   The Property-Residual Method

Instead of using a split rate capitalisation Wendt (1974) suggests that most academic writers have advocated the property residual method. The net income stream is valued as an annuity using a single overall capitalisation rate, for the duration of life of the buildings, and the residual land value at the end of the holding period is discounted back to present value and then added to the present value of the net income stream to arrive at the value of the property.   This method is similar to that used in the valuation of leases and removes the unrealistic assumption regarding capitalising an income stream in perpetuity.

Thus:
$$PV = \sum_{t=1}^{n} \frac{R}{(1 + I)^t} + \frac{RLV}{(1 + I)^n}$$

where PV = Present value of a future sum, received at the end
         of year n,

    R = Income,

    I = Interest rate,

  RLV = Residual land value.

4.4.2   The Land-Residual Method

Using this method the valuer deducts a return on the building from the total net income and the balance represents the residual return to the land which is then capitalised to arrive at the land value. Another application of the land residual approach is often used when developers are contemplating building on a vacant site or redeveloping an existing building, and need to estimate the site value.   In this case the projected income stream is capitalised to give the value of the development.   The estimated building costs are deducted from the total value to give the residual land value.

The discounted cash flow procedure can also be applied to the land residual method. Instead of capitalising the income stream from the property to arrive at the value, the valuer can estimate the selling price of a completed project on the basis of direct sales comparison, deducting development cost to arrive at the value of the site in its present condition.

4.4.3   The Building-Residual Method

The building residual method is very similar to the land residual method and involves the same basic steps except that the unknown factor is the value of the building. In this case it would be assumed that the value of the land could be estimated by using sales comparisons based on market information. This method is likely to be most accurate when the net income is already known (as in the case of lease).

4.4.4   Computer Applications for Residual Approaches

Two computer programs have been developed for application to the residual method. The first program that is described is a generalised program that can be used for both the property residual and land residual approaches to development valuations. The second program has been specifically written for the hypothetical subdivisional statement that is commonly used when valuing raw land suitable for subdivision into residential sections.

A.   Development Project

The residual method of valuation as it applies to development projects can be explained by the following generalised formula:

$$NV = GR - (SE + PR + DC + HC)$$

where NV = Net value of the project,

GR = Gross realisation from sale of the completed project,

SE = Expenses associated with selling the project (normally legal fees and real estate commission),

PR = Amount for profit and risk, in dollars;

where

$$PR = (\frac{P}{100 + P}) \times NR$$

where P = Profit and risk as a percentage of outlay,

NR = Net realisation, and

$$NR = GR - SE$$

O = Outlay, and

$$O = NR - PR$$

DC = Direct development costs (includes items such as acquisition and subdivision fees, costs of furnishing and decoration, and building costs in some cases),

HC = Holding costs for the project (includes items such as rates, insurance, front end fees and interest on outlay).

This generalised equation can be used for both the property residual approach and the land residual approaches to development valuations.   In the case where a developer buys an existing property, subdivides, and then sells the individual units, the valuer will be using the property residual approach.   Where the developer is considering building on a vacant site or redeveloping an existing site with a new building then the land residual approach will be used.

A similar approach can be used in the development and rent appraisal and is described by Marshall (1981).   In this case the income stream projected from the property would be capitalised to arrive at the gross realisation.

Thus

$$GR = \frac{R}{I}$$

where GR = Gross realisation,

R = Income stream for a 'typical' year,

I = Overall rate of capitalisation.

A case example has been constructed to illustrate the capability of the program.

Example - buy/sell development

A developer is considering buying a block of 10 flats, obtaining
separate titles to each flat and then selling the units after spending
some money upgrading the flats.   The developer considers that average
selling price of the units would be $30,000.   He expects a profit
factor of 25 per cent on his outlay, and expects to pay 15 per cent
interest on bridging finance.   Selling costs would include real estate
and legal fees.   Fixed costs associated with the project might be as
follows:

		$
Cleaning		500
Redecoration		5000
New stoves		4000
New automatic washing machines		6000
Replacement carpets		10000
Fees for separate titles		10000
Contingencies		2000

The expected holding (variable) costs associated with the project are:

Rates (per annum)	$1000
Insurance (per annum)	$250
Purchase legal costs & fees	$2000
Interest on bridging finance	15%

The computer output using the assumptions in the case example is
shown in Table 4.2.   The program assumes interest is charged on
outlay for half the period of realisation.

The main advantage that this computer program has over the
conventional manual approach is that the valuer can rapidly test the
sensitivity of the value estimate to changes in the critical variables.
The user is able to change one variable and recalculate, holding all
other variables equal to their previous levels.   This process can
be accomplished in a few seconds and encourages the user to explore a
number of possible outcomes before selecting what is considered to be
the most likely outcome.

Table 4.2:   Output for Development Project

DEVELOPMENT-VAL

GROSS REALISATION	300000
SELLING COSTS	12000
PROF & RISK FACTOR	25
CLEANING	500
REDECORATION	5000
NEW STOVES	4000
AUTOWASH MACHINES	6000
CARPETS $ DRAPES	10000
TITLE FEES	10000
CONTINGENCIES	2000
OTH DIRECT EXPS	0
RATES	2000
INSURANCE	500
LEGAL & VAL FEES	2000
INTEREST RATE	.15
PERIOD OF OUTLAY	2

NET VALUE OF PROJECT   = 153840

TOTAL OUTLAY   = 230400

TOTAL EXPENSES   = 76560

In this type of development the key variables are usually gross realisation, the profit and risk factor, the period of outlay and the interest rate.   Table 4.3 shows how the value would be influenced by changes in the holding period and interest costs.

This program can also be used by a developer in a develop and sell project.   In this case the costs of the building will be entered as a direct development cost and the residual value will be the land value.

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Table 4.3: Sensitivity Analysis for Changes in Interest Rate and Holding Period

		Holding Period 12	24	36
Interest rate	10%	178,130	165,360	152,590
	15%	172,370	153,840	135,310
	20%	166,610	142,320	118,030

B.   Hypothetical Subdivisions

The hypothetical subdivision method of valuation is used for working out what a developer can afford to pay for a block of bare land that is ready to be subdivided.   The following generalised formula summarises this residual method.

$$BV = NSP - [C + HC + PR]$$

where   BV = Block value,
        NSP = Net selling prices of the sections,
          C = Costs of development,
         HC = Holding charges,
         PR = Profit and risk factor.

The computer program has been designed to follow the hypothetical subdivision method that New Zealand valuers have traditionally used. This method is set out in the Valuers' Handbook (1974).

The interest rate assumptions used in this part of the computer program are the same as those suggested in the Valuers' Handbook. Interest is charged on outlay for half the realisation period including development.   This is a 'rule of thumb' approach and relies on an assumed rate of cash flow from section sales.   Speedy (1980) describes a more theoretically correct approach which formally incorporates discounted cash flow methodology.   The second part of the computer program allows the user a discounted cash flow option.   The computer program has been designed to ask the valuer a series of questions that will provide the raw inputs for the analysis.   An example is shown in Table 4.4.

Table 4.4:   Computer Output Showing Raw Data Inputs

```
RAW  INPUTS  FOR  SUBDIVISION
===  ======  ===  ===========

AREA OF LAND (HA)              2.11
LENGTH OF ROADING REQ'D (M)    210
NO.OF SECTIONS TO BE REALISED  20
AV.SELLING PRICE/SECTION ($)   19500
PROFIT AND RISK FACTOR (%)     25
NO.OF YEARS FOR DEVELOPMENT    1
REALISATION PERIOD (YEARS)     3
COST/LINEAL METRE FOR ROADING ($) 400
COST PER M^3 FOR EARTHWORKS    3
AMOUNT OF EARTHWORKS (M^3)     2000
SURVEY COST PER LOT ($)        200
FEE FOR ENGINEERING (%)        7
ADVERTISING COST PER LOT ($)   80
POWER COST PER LOT ($)         400
PHONE COST PER LOT ($)         100
RATES(BLOCK) BEFORE SUB ($)    3500
RATES/LOT AFTER SUB.($)        450
RESERVE CONTRIBUTIONS (%)      7.5
BULK SERVICE FEE/HA ($)        2500
GAS COST PER LOT ($)           50
INTEREST RATE/ANNUM (%)        12
REAL ESTATE COM./LOT (%)       3
LEGAL FEE AT SALE/LOT ($)      200
LEGAL FEE AT PURCHASE ($)      1200
PROP.MANAGEMENT FEE ($/YR)     0

NUMBER SECTIONS LEFT TO SELL AFTER YEAR-
1 20
2 10
3 0
```

After initially entering the data, the valuer can either change any of the input items or get the computer to print out the subdivisional statement as shown in Table 4.5.

Table 4.5:   Computer Output Showing Block Subdivision Statement

BLOCK VALUE OF SUBDIVISIONAL LAND
===== ===== == ============= ====

GROSS REALISATION (PERIOD 4 FOR REALISATION AND DEVELOPMENT)

20 SECTIONS @ $ 19500 EACH   390000

LESS SALES/LEGAL EXPENSES $ 785/LOT   15700

                    NET REALISATION   374300

PROFIT AND RISK 25% OF OUTLAY

EQUALS 25/125 OF NET REALISATION   74860

                    OUTLAY   299440

EXPENSES:
========

ROADING   84000
EARTHWORKS   6000
ENGINEERING   6300
SURVEYING   4000
ADVERTISING   1600
POWER   8000
PHONE   2000
GAS   1000
RESERVE CONTRIB.   27787.5
INTEREST @ 12 % FOR
HALF REALISTION PERIOD   53899.2
RATES   17000
BULK SERVICES   5275
PROP.MNGMNT FEES   0
OTHERS   0

                                       216861.7

                                       82578.3

NET VALUE OF LAND:
=== ===== == ====

LESS CONVEYANCING FEE $ 1200   1200

BLOCK VALUE OF 2.11 HA $ 81378.3
                                       ======

              ANALYSIS TABLE
              ======== =====

                PER SECTION   PER HECTARE
                    $ $

EXPENSES   10843.09   102778.06
BLOCK VALUE   4068.91   38567.91
INTEREST   2694.96   25544.64
ROADING   4200   39810.43

The valuer can then go to the next stage in the program which enables him to get the computer to perform a discounted cash flow analysis on the data using the initial inputs and a specified discount rate. The output from the discounted cash flow analysis is shown in Table 4.6.

Table 4.6: Computer Output Showing Discounted Cash Flow Method

```
DISCOUNTED CASH FLOW - INTEREST RATE OF 25 %
========== ==== ====    ======== ==== == ====

                                    DISCOUNT PRESENT VALUE
     YEAR ITEM           CASH OUT CASH IN  FACTOR  OUT      IN
     ==== ====           ======== =======  ======== =============
     1
          EXPENSES       145963            .8
                                                   116770
          RATES          3500              .8
                                                   2800
     2
          SECTION SALES          187150   .64
                                                            119776
          RATES          6750             .64
                                                   4320
     3
          SECTION SALES          187150   .51
                                                            95821
          RATES          2250             .51
                                                   1152
                                                   =============
                                                   125042   215597
```

The difference between the present value of the cash inflows and the present value of the cash outflows represents the net present value of the block before development. If the developer buys the raw land at the net present value then he will achieve a 25 per cent return on the investment given the assumptions used in the analysis are correct. The profit and risk factor and interest on outlay shown in Table 4.5 is the valuer's approximation for the discount rate shown in Table 4.6.

4.5   THE ELLWOOD METHOD

A major step forward in income approach methodology occurred
with the publication of Ellwood's (1958) work on mortgage equity
appraising.   Ellwood recognised that real estate investors were
typically interested in the returns that they could achieve on equity
investment over the period of ownership.   He said returns to equity
were influenced by the annual cash income stream from the property, the
effect of mortgage finance on the annual cash flow to equity and changes
in the value of the property over the period of ownership.

The Ellwood method takes the band of investment method that is
used to determine the rate of capitalisation as a basis and adjusts for
the effect of loan amortisation and changes in the value of the property
over time.

The possible effects of changes in the equity position over time
due to changes in the property value and mortgage reduction are shown
in Figure 4.2.
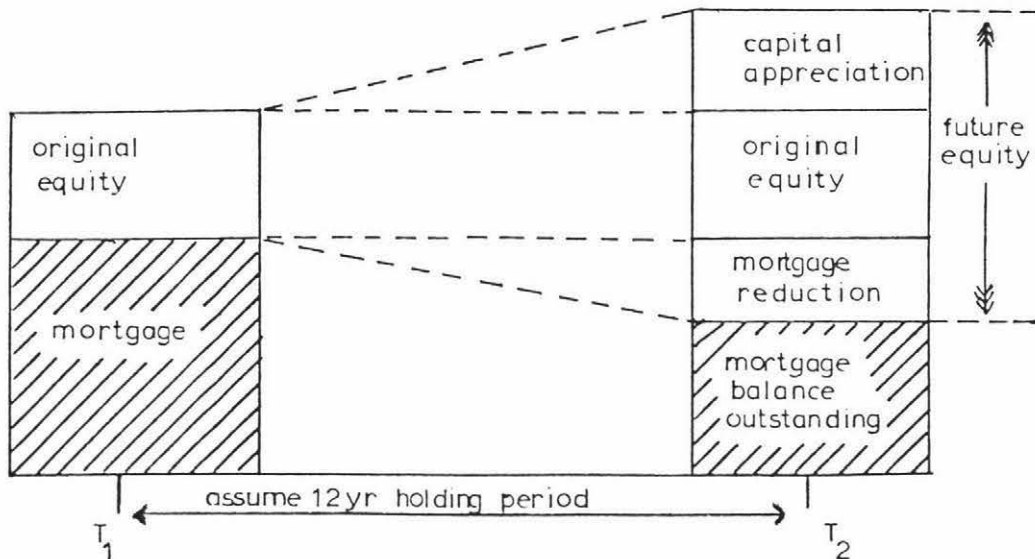
Figure 4.2:   Cross Sectional Changes Over Time due to Capital
Appreciation and Mortgage Reduction

The Ellwood premise was expressed by the following formula:

$$R = Y - MC \pm \% \text{ App/Dep} \times {}^1\!/Sn$$

where   R = Overall capitalisation rate,

              Y = Equity yield rate,

              M = Ratio of mortgage to total investment,

              C = Mortgage coefficient where:

$$C = Y + (P \times {}^1\!/Sn) - F$$

              P = Percentage of loan paid off,

      ${}^1\!/Sn$ = Sinking fund factor at equity yield rates,

              N = Number of years owned,

              F = Annual level of mortgage loan payments per dollar of debt,

App/Dep = Expected appreciation or depreciation in the residual sale price of the investment.

The relative complexity of the Ellwood formula made it difficult for many valuers to understand the method and the assumptions used in it. A book of tables was produced by Ellwood to simplify the calculation of the capitalisation rate. Akerson (1970) showed how the band of investment method used in determining the rate of capitalisation under the traditional income approach method could be further developed in a more understandable way to arrive at the same answer as the Ellwood method.

The Ellwood method represents another specialised application of the discounted cash flow procedure. It has considerable attraction to valuers because it makes use of the traditional income approach formula $V = \dfrac{I}{R}$. Once the capitalisation rate has been found then this is divided into the net income to arrive at the value of the property.

The following example illustrates the use of the Ellwood
method by the standard manual approach and then describes a computer
program that has been developed to speed up the computational
process.

Details of Case Example Property:

Net operating income	=	$10,000
Equity yield demanded by prudent investor	=	15%
Holding period	=	12 years
Interest rate of mortgage	=	14%
Term of mortgage	=	25 years
Number of mortgage payments per year	=	1
Percentage of ingoing costs on mortgage	=	66%
Appreciation in property value over the holding period	=	100%

Problem:

An investor wishes to know how much he can pay for the
property.

Using the Ellwood method to solve this problem manually:

Determine C

$$C = Y + (P \times \frac{1}{S_n}) - f$$

$$C = .15 + (.1499457^{[1]} \times .034481^{[2]}) - .145498^{[3]}$$

$$C = .15 + (.0051702) - .145498$$

$$C = .0096722$$

---

[1] P has been calculated using the formula for the future value of an annuity which is as follows:

$$\frac{(1 + i)^n - 1}{i}$$

Where i = Interest rate,

and n = Number of time periods.

The percentage of the mortgage paid off at the end of the holding period will be the future value of an annuity at the mortgage interest rate for the holding period (a) divided by the future value of an annuity at the mortgage interest rate for the length of mortgage (b).

In the case example: $a = \frac{(1 + .14)^{12} - 1}{.14}$

and $b = \frac{(1 + .14)^{25} - 1}{.14}$

$P = \frac{27.270749}{181.870827}$

$P = .1499457$

[2] The sinking fund factor at equity yield rates has been calculated using the following formula for an annuity whose terminal value is unity:

$$\frac{i}{(1 + i)^n - 1}$$

Where i = Interest rate,

and n = Number of time periods.

In the case example we have:

Sinking Fund Factor $= \frac{.15}{(1 + .15)^{12} - 1}$

Sinking Fund Factor $= .034481$

[3] The annual level of mortgage payments per dollar of debt = F. This has been calculated using the following formula for an annuity whose present value is unity:

$$\frac{i(1 + i)^n}{(1 + i)^n - 1}$$

Where i = Interest rate,

and n = Number of time periods.

In the case example we have:

$F = \frac{.14(1 + .14)^{25}}{(1 + .14)^{25} - 1}$

$F = .145498.$

Thus, $R = .15 - (\tfrac{2}{3} \times .0096722) - (1.0 \times .034481)$

$R = .15 - .00644813 - .034481$

$R = .10907087$

$V = {}^{I}/_{R}$

$V = \dfrac{\$10,000}{.1090707}$

$V = \$91,683$

The calculations can be verified as follows:

Check:

Assume the investor pays $91,683(V) for the property.

Cash Flow (I)	=	$10,000
<u>Less</u> Debt Servicing $61,122 x .145498	=	8,893
(⅔ mortgage = $61,128)		
gives cash flow to equity of		$1,107

The present value of this cash flow is $1107 x 5.4206[4] = $6000.

The reversionary income when the property is sold is the sale price less mortgage outstanding and costs of selling.

Sale price = $91,683 x 2 (100% increase)	=	$183,366
<u>Less</u> Mortgage unpaid (1 - .149945) x 61,122	=	51,957
		$131,409

Since the reversion occurs in year 12 this needs to be discounted to present value thus:

---

[4]   Represents the present value of an annuity for 12 years at 15 per cent, i.e.

$$\frac{(1 + .15)^{12} - 1}{.15(1 + .15)^{12}} = 5.4206$$

| Reversion | = | $131,409 x .186907[5/] | $24,561 |
| " | = | add present value income stream | 6,000 |

This gives ingoing equity $30,561

Add original mortgage   61,122

                                    $91,683

4.5.1   Computer Application for the Ellwood Approach

It is thought that a number of valuers would not feel comfortable using the Ellwood method due to the time involved in doing the necessary calculations and checking the arithmetic. Even with the aid of an electronic calculator and a set of mathematical tables it is relatively easy to make a mistake. Small mistakes in deriving the capitalisation rate can have a major effect on the value of the property.

The Ellwood formula can be readily programmed to run on a computer and this has been one of the first computer applications in the area of income property valuations. In the United States a computerised Ellwood model has been available to valuers for about ten years and is part of the EDUCARE time sharing computer package based at the University of Wisconsin and described by Jefferies (1973). In addition to the speed and accuracy of the computerised Ellwood method the EDUCARE program also can test the value sensitivity to changes in the assumptions.

A simple computer program has been written in Basic language for the Ellwood method.

The user is asked to specify the input information as shown in Table 4.7 which incorporates the data from the previous case example.

[5/]   Represents the discount factor for 12 years at 15 per cent, i.e.

$$\frac{1}{(1 + .15)^{12}}$$

Table 4.7:   Input of Data for Mortgage Equity Calculation

```
          MORTGAGE EQUITY CALCULATIONS

          ENTER -

          YIELD (%) ? 15
          HOLDING TERM ? 12
          MORTGAGE RATE (%) ? 14
          TERM OF MORTGAGE ? 25
          NUMBER OF PAY PERIODS/YR ? 1
          % OF MORTGAGE ? 66
          IS PROPERTY DEPRECIATING ? (Y/N) N
          TOTAL APPRECIATION (%) ? 100
          NET INCOME ? 10000
```

The computer completes the calculation and prints out the
analysis and value estimate as shown in Table 4.8.

Table 4.8:   Output Data From Mortgage Equity Calculation

```
          MORTGAGE EQUITY ANALYSIS
          ======== ====== ========

          YIELD 15 %
          HOLDING TERM 12 YEARS
          MORTGAGE RATE 14 %
          TERM OF MORTGAGE 25 YEARS WITH 1 PAY PERIODS PER YEAR
          APPRECIATION OF 100 %
          NET INCOME $ 10000


          VALUE ESTIMATE $ 91628.95
```

As the computer can calculate the Ellwood formula in a second or
so it is very easy to rerun the program to test the sensitivity of the
value estimate to changing the assumptions.   Walters (1971) showed
that the Ellwood method is normally most sensitive to changes in the
net operating income and that capital appreciation, which is usually
some way off in the future, is less significant.

4.5.2   Limitations and Modifications to the Ellwood Method

As with the traditional income approach formula the income to
be capitalised under the Ellwood method should represent the net
income from the property for a 'typical year' under average efficient
management.   In some cases this notion may be unrealistic because the
income from the property may vary from year to year.   Ellwood
postulated that his formula could be modified by a so called J factor
which converts a changing income to the equivalent of a level income.
The formula for the J factor is as follows:

$$J = \frac{(n - 1)^{1/S_n}}{1 - V^n Y}$$

where   J   =   Income adjustment factor,
         n   =   Projection period in years,
         V^n =   Reversion factor for projection period at equity
                 yield rate,
         Y   =   Equity yield rate,
       $1/S_n$ =   Sinking fund factor.

Steele (1981) shows that the Ellwood J factor is a valid approach
provided that the net income is changing in the form of a geometric
progression.   Although the Ellwood J factor may be an improvement on
the original Ellwood formula there are still likely to be many
properties where the income fluctuates and where the application of
the Ellwood method would be inappropriate.

A further limitation of the Ellwood method demonstrated by Wendt
(1974) who shows that in certain cases where the purchase price was
already known the Ellwood method overstated the value of the property
and that the net income from the property was not large enough to
service the proposed mortgage.   (The Ellwood method assumes money
could be borrowed from outside the project to cover periods of
negative cash flow).

Jefferies (1973) and (1974a) suggested that valuers in New Zealand
should consider using the Ellwood approach with appropriate modifications
to simulate local investor behaviour.

4.6   INCOME AND EXPENDITURE PROJECTIONS

One of the weaknesses with the Ellwood method is that the
concept of using the budget from a typical year to derive a stable
net operating income may not be realistic.   There are many circumstances
when real estate income fluctuates from year to year.   For example, a
developing horticultural orchard may have a large number of new trees
or vines not at the bearing stage.   Even an established orchard is
likely to have to alter the variety of trees due to changes in market
conditions that may make a particular variety uneconomic to produce.
If there is a negative income stream during the development (early
growing) phase the valuer may have difficulty in deciding what in fact
is a 'typical' year.   Figure 4.3 is a diagram showing a typical
orchard income stream over time.
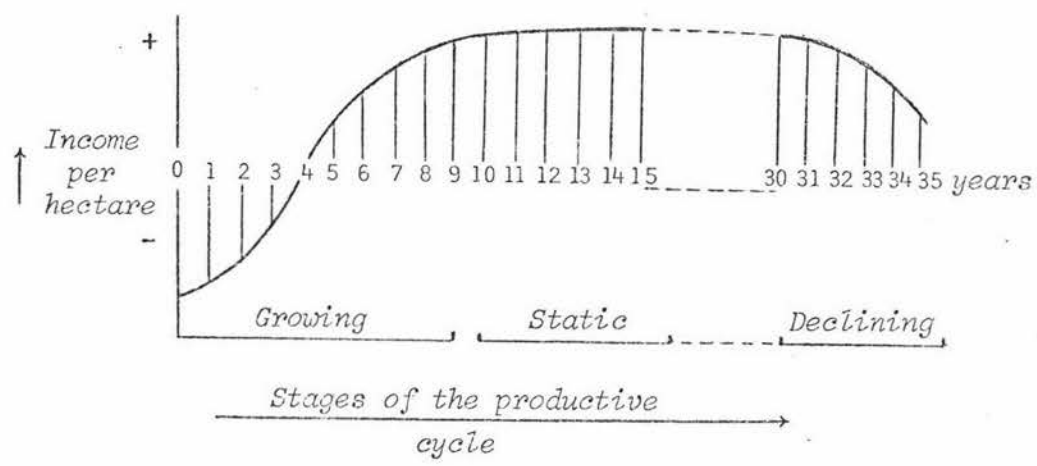
Figure 4.3:   Diagram Showing Orchard Income Stream Over Time

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While the horticultural example given is perhaps an extreme
example of difficulties in stabilising income streams, the valuer
still has difficulty with urban investment properties when the
investor refinances during the holding period to extract some equity
and to 'regear' the property.   Similarly, a motel owner may have very
high expenditure in one year if large scale redecorating and upgrading
is undertaken.

In these cases the correct application of the income approach
would be for the valuer to estimate the net operating income for each
year of the holding period and to discount this back to arrive at the
present value of the income stream.

A hypothetical cross sectional analysis of a real estate
investment with a fluctuating annual income stream is shown in
Figure 4.4.
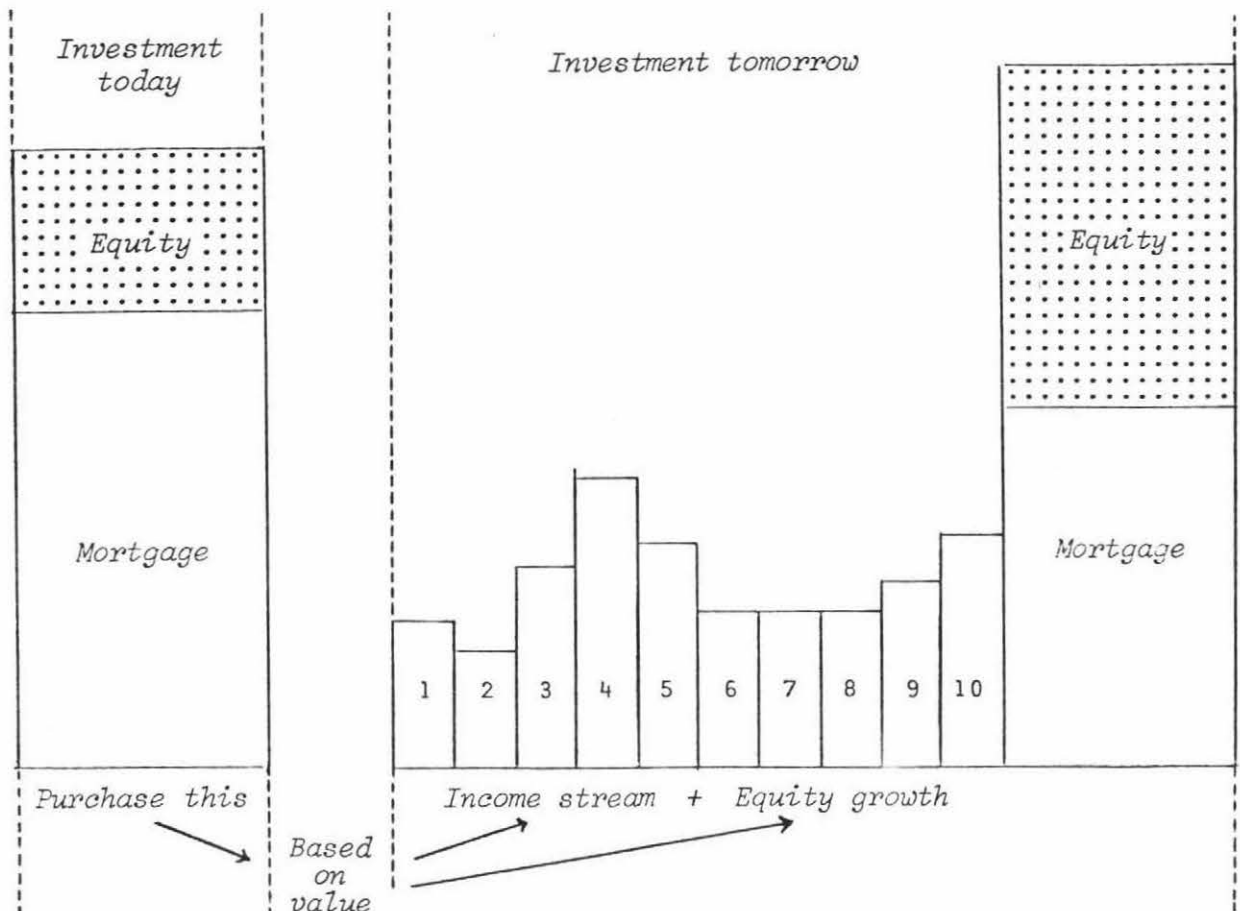
Figure 4.4:   Cross Sectional Analysis of Income Property Over Time

To illustrate the budgeting exercise necessary when the valuer is analysing uneven cash flows, a case example of an investment property in Palmerston North has been selected.

Case Example:

The property comprises of two one-bedroomed flats, and one two-bedroomed flat on a 1080 m^2 site near the Palmerston North showgrounds. The estimated rentals for the property (1982) are $50 per week for the one bedroomed flats and $65 per week for the two bedroomed flat.

The valuer is required to estimate the net operating income for the property before debt servicing and tax over the projected ten year holding period.

The following categories of annual expenses will be considered. The annual level of expenditure is as follows:

1.	Rates	$700
2.	Insurance	$100
3.	Repairs and maintenance	$500
4.	Management	$400

It is estimated that the vacancy factor will be 2 per cent of gross rent.

The valuer estimates that there will be the following changes to the first year levels of expenditure and income:

Rents: will increase 10 per cent per year.

Vacancies: will remain at 2 per cent.

Rates: will increase by 20 per cent per year.

Repairs and maintenance: will be static for the first five years followed by a redecoration costing $2000 in year 6.   From years 7-10 this item will be $600 per year.

Management: will increase at 16 per cent per year.

Insurance: will increase at 10 per cent per year.

4.6.1   Computer Applications to Income and Expenditure
        Projections

There is a considerable amount of repetitious calculation
involved with the analysis of this small investment property.   A
computer program has been developed to assist with the computational
process.   Table 4.9 shows the print out with the above information
being analysed.

This program, which was originally written for a TRS80, has
been adapted to run on an Apple microcomputer.   It asks the user a
series of questions and allows interaction and editing.   The program
will handle up to 20 lines of income and expenditure and will project
over ten periods.

The income and expenditure items can be varied by constant
percentage factors, can remain static, or vary by irregular amounts.

4.7   INTERNAL RATE OF RETURN

The internal rate of return (IRR) method is another variation of
discounted cash flows and an extension of the net present value
procedure described in section 4.4.   The IRR method determines the
actual rate of return on the total investment in a property or the
actual rate of return on the components of equity and borrowed money.
The IRR is the discount rate that sets the net present value equal to
zero.   That is the rate which discounts all returns equal to the
original investment.   The IRR is generally found as the result of a
calculation rather than a specified or desired rate of return.

Solving for the IRR by conventional methods is a time consuming
process.   The analyst chooses a rate that gives a positive net present
value and then another rate that gives a negative net present value
and solves for the IRR using interpolation.

The use of the IRR method can be illustrated by using the case
investment property referred to in section 4.6 and by including the
following additional details of the property.

Table 4.9:   Income and Expenditure Projections for Income Flats

INCOME AND EXPENSE PROJECTIONS

DESCRIPTION	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
***********	********	********	********	********	********
SCHED. INCOME					
RENT	$8580	$9438	$10381	$11419	$12561
LESS V&C LOSSES	$172	$189	$208	$228	$251
GROSS OP.INC	$8408.4	$9249	$10174	$11192	$12311
DEDUCT EXP.					
RATES	$700	$840	$1008	$1210	$1452
INSURANCE	$100	$110	$121	$133	$146
REPAIRS/MAINT	$500	$500	$500	$500	$500
MANAGEMENT	$400	$464	$538	$624	$724
TOTAL EXP.	$1700	$1914	$2167	$2467	$2822
NET OP INCOME	$6708	$7335	$8007	$8725	$9489
% CHANGE NOI	0.0	9.34	9.16	8.96	8.76
EXP/GOI RATIO	20.22	20.69	21.3	22.04	22.92

INCOME AND EXPENSE PROJECTIONS

DESCRIPTION	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
***********	********	********	********	********	********
SCHED. INCOME					
RENT	$13818	$15199	$16719	$18391	$20231
LESS V&C LOSSES	$276	$304	$334	$368	$405
GROSS OP.INC	$13541.81	$14896	$16386	$18024	$19827
DEDUCT EXP.					
RATES	$1741.824	$2090	$2508	$3010	$3612
INSURANCE	$161.051	$177	$195	$214	$236
REPAIRS/MAINT	$2000	$600	$600	$600	$600
MANAGEMENT	$840.13666	$975	$1130	$1311	$1521
TOTAL EXP.	$4743	$3841	$4433	$5135	$5968
NET OP INCOME	$8799	$11054	$11952	$12889	$13858
% CHANGE NOI	-7.27	25.63	8.12	7.84	7.52
EXP/GOI RATIO	35.02	25.79	27.06	28.49	30.11

Additional Details for Case Property:

The investor has specified that he required a minimum pre-tax return of 25 per cent on the investment. He can acquire the property for $42,000 and at the end of the holding period it is estimated that the sale price would be $84,000. Assuming the property was financed on a $20,000 table mortgage over 20 years at 12 per cent interest then the balance outstanding on the mortgage at the end of the holding period would be $15,121 leaving the equity a realisation of $68,879.

The net operating income including the debt servicing influence but excluding the depreciation and taxation considerations is shown in Table 4.10.

4.7.1   Computer Applications for IRR

Solving for the IRR is an ideal application for microcomputers and programmable calculators because it is a job that involves a lot of 'number crunching' and this is something that computers are very good at. Computers can save analysts literally hours of time in both net present value and internal rate of return calculations.

A computer program available for use on a variety of micro-computers and which solves for IRR is described by Poole (1980). Programs that calculate the net present value can also be used to solve for the IRR. This is done by selecting a series of discount rates until the NPV is set equal to zero. The print out from the purpose written program developed by Poole is shown in Table 4.11 which incorporates the data from Table 4.10 relating to the case property.

Table 4.12 shows how the simple net present value program has solved for the IRR by using a trial and error method.

The IRR method does have some drawbacks. Where there are intermediate negative cash flows, it is possible to arrive at more than one mathematically correct rate. There is also some controversy about the reinvestment assumptions used in the IRR method when it is used to measure the rate of return on an investment rather than used just as a device to rank various investment alternatives.

Table 4.10: Income and Expenditure Projections Including Debt Servicing

INCOME AND EXPENSE PROJECTIONS

DESCRIPTION	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
**********	********	********	********	********	********
SCHED. INCOME					
RENT	$8580	$9438	$10381	$11419	$12561
LESS V&C LOSSES	$172	$189	$208	$228	$251
GROSS OP.INC	$8408.4	$9249	$10174	$11192	$12311
DEDUCT EXP.					
RATES	$700	$840	$1008	$1210	$1452
REPAIRS/MAINT	$500	$500	$500	$500	$500
INSURANCE	$100	$110	$121	$133	$146
MANAGEMENT	$400	$464	$538	$624	$724
DEBT/SERV.	$2678	$2678	$2678	$2678	$2678
TOTAL EXP.	$4378	$4592	$4845	$5145	$5500
NET OP INCOME	$4030	$4657	$5329	$6047	$6811
% CHANGE NOI	0.0	15.55	14.42	13.47	12.64
EXP/GOI RATIO	52.07	49.65	47.62	45.97	44.68

INCOME AND EXPENSE PROJECTIONS

DESCRIPTION	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
**********	********	********	********	********	********
SCHED. INCOME					
RENT	$13818	$15199	$16719	$18391	$20231
LESS V&C LOSSES	$276	$304	$334	$368	$405
GROSS OP.INC	$13541.81	$14896	$16386	$18024	$19827
DEDUCT EXP.					
RATES	$1741.824	$2090	$2508	$3010	$3612
REPAIRS/MAINT	$2000	$600	$600	$600	$600
INSURANCE	$161.051	$177	$195	$214	$236
MANAGEMENT	$840.136663	$975	$1130	$1311	$1521
DEBT/SERV.	$2678	$2678	$2678	$2678	$2678
TOTAL EXP.	$7421	$6519	$7111	$7813	$8646
NET OP INCOME	$6121	$8376	$9274	$10211	$11180
% CHANGE NOI	-10.13	36.85	10.72	10.1	9.49
EXP/GOI RATIO	54.8	43.77	43.4	43.35	43.61

Table 4.11:   Internal Rate of Return

INTERNAL RATE OF RETURN

ENTER THE AMOUNT OF THE INITIAL INVESTMENT (0 TO END)?22000

NUMBER OF CASH FLOW PERIODS?10

(ENTER INFLOWS AS POSITIVE, OUTFLOWS AS NEGATIVE AMOUNTS)

1?4030

2?4657

3?5329

4?6047

5?6811

6?6121

7?8376

8?9274

9?10211

10?80059

INTERNAL RATE OF RETURN =30.78448%

Table 4.12:   Solving for Internal Rate of Return From Net Present Value
              Program

```
INTEREST RATE PER PERIOD AS A PERCENTAGE = 35
INTEREST RATE =                 35
NET PRESENT VALUE = -3410.05448
INTEREST RATE PER PERIOD AS A PERCENTAGE = 30
INTEREST RATE =                 30
NET PRESENT VALUE = 742.922323
INTEREST RATE PER PERIOD AS A PERCENTAGE = 32
INTEREST RATE =                 32
NET PRESENT VALUE = -1078.66835
INTEREST RATE PER PERIOD AS A PERCENTAGE = 31
INTEREST RATE =                 31
NET PRESENT VALUE = -197.498466
INTEREST RATE PER PERIOD AS A PERCENTAGE = 30.5
INTEREST RATE =                 30.5
NET PRESENT VALUE = 265.005976
INTEREST RATE PER PERIOD AS A PERCENTAGE = 30.7
INTEREST RATE =                 30.7
NET PRESENT VALUE = 78.1893864
```

Messner and Findlay (1975) suggest that the problems of negative cash flows can be overcome by discounting future negative income back to the first year of the holding period.

The reinvestment assumption in the IRR method is that the cash generated from the property can be reinvested at the IRR rate. Strung (1976) points out that in some cases, large amounts of equity are required for the investor to be able to buy a high yielding investment property. While the investor is accumulating equity capital to buy another property he may have to accept a relatively lower return on this capital while it is held in short and medium deposits at a 'safe' rate perhaps within the banking system.

While accepting that there is some logic to this argument Doenges (1972) suggests that the reinvestment problem, while significant in theory, may be much less apparent in actuality. Wendt appears to support this view when he points out that the difficulties in accurately estimating future cash flows and residual sale prices are likely to be of greater significance to the IRR than the reinvestment assumptions used.

4.8   FINANCIAL MANAGEMENT RATE OF RETURN

In order to overcome some of the theoretical problems that have been discussed with respect to the IRR method, Messner and Finlay (1975) devised a method known as the Financial Management Rate of Return (FMRR). The FMRR method modifies the IRR method as follows:

1.   Negative future cash outflows are first offset against future cash inflows.   Where this is not feasible the cash outflows are discounted back to year 1 at a 'safe' rate.

2.   Small cash inflows compound at a rate for liquid investments (such as a savings account) until enough capital has been accumulated to reinvest at a safe rate in a run of the mill fixed term investment such as debentures or real estate.

3. A composite rate of return on the investment is then calculated
    which takes account of the safe rate on liquid investments, the
    rate for run of the mill projects and the internal return on
    the equity invested in the case property.

    The FMRR method is a refinement of earlier work by Soloman (1959).

4.8.1 Computer Application

A computer program to calculate the FMRR has been written in a
general Basic language suitable for use on most microcomputers.
Table 4.13 shows the computer output from the case property when
analysed using the FMRR method.   It can be seen that if it is assumed
that the safe rate for liquid investments is 7 per cent and the run of
the mill rate for longer term investments is 12 per cent, then the
FMRR for the case property is 21.96 per cent.   It is also assumed
that the liquid investment has to accumulate to a minimum of $5000
before it can be reinvested at 12 per cent.

As expected, the FMRR return to equity is considerably lower than
the 30.78 per cent calculated return for the same project using the IRR
method.

Table 4.13:   Computer Print Out Showing FMRR Method

```
/FINANCIAL MANAGEMENT/RATE OF RETURN

NUMBER OF YEARS?10
LIQUID INVESTMENT INTEREST RATE?7
'SAFE' FIXED INVESTMENT INTEREST RATE?12
MINIMUM AMOUNT OF FIXED INVESTMENT
?5000

(ENTER INFLOWS AS POSITIVE, OUTFLOWS AS NEGATIVE.)

ENTER CASH FLOW AMOUNT FOR YEAR 0?-22000
              1?4030
              2?4657
              3?5329
              4?6047
              5?6811
              6?6121
              7?8376
              8?9274
              9?10211
             10?80059


FIXED INVESTMENT OF $5329TO BE MADE AT END OF YEAR3
FIXED INVESTMENT OF $6047TO BE MADE AT END OF YEAR4
FIXED INVESTMENT OF $6811TO BE MADE AT END OF YEAR5
FIXED INVESTMENT OF $6121TO BE MADE AT END OF YEAR6
FIXED INVESTMENT OF $8376TO BE MADE AT END OF YEAR7
FIXED INVESTMENT OF $9274TO BE MADE AT END OF YEAR8
FIXED INVESTMENT OF $10211TO BE MADE AT END OF YEAR9

ACTUAL TOTAL INITIAL INVESTMENT = $22000
TOTAL RETURN ON INVESTMENT =$160248

/FINANCIAL MANAGEMENT/RATE OF RETURN=21.965%

WOULD YOU LIKE TO RE-RUN PROGRAM WITH NEW DATA? (Y/N)?N
```

4.9   INVESTMENT ANALYSIS

Valuers are primarily concerned with predicting the most probable selling price of particular properties.   Ratcliff (1972) points out the price that an individual investor might be prepared to pay for a property could be quite different from the most probable selling price of the property.   This could occur when investors have different expectations about the anticipated return on their equity investment, different marginal tax rates, or access to different types of finance.

The property investor has three basic questions that he wants answered.   He wants to know how much he will have to pay to acquire the property, how much he can afford to pay for the property to achieve a specified return on his equity investment, and what return he will get if he buys the property at market value.   Provided the value to the investor is greater than the most probable selling price then the investor may proceed with the purchase.   If the value to the investor is less than the most probable selling price then the investor is unlikely to acquire the property.

In some cases valuers also act as investment consultants.   In such cases the basic investment analysis model is a further extension of the discounted cash flow procedure.

Computer programs for discounted cash flows first became available in the 1960's.   Initially these programs were used by economists and by investment analysts.   Simple discounted cash flow programs suitable for valuers were described by Ricks (1968), Graaskaamp (1969) and Hyson and Juengling (1970).   During the 1970's the discounted cash flow programs became much more sophisticated and began to more closely simulate investor behaviour.

A number of discounted cash flow models were evaluated by Wendt and Cerf (1979).   They stated the general mathematical basis for the models was expressed by the following formula:

$$V - D = E = \sum_{t-1}^{n} \frac{Rt-It-At-Tt}{(1+r)^t} + \frac{Pn-GT-UM}{(1+r)^n}$$

where V = Total cost or value,

       D = Debt,

       E = Equity,

     Rt = Annual net income in period t,

     It = Interest paid on mortgage in period t,

    At = Mortgage amortisation in period t,

    Tt = Income tax allowance in period t,

    Pn = Sales price or residual in period t=n,

    GT = Capital gain tax,

   UM = Unpaid mortgage,

     r = Rate of return.

4.9.1 Microcomputer Applications to Investment Analysis

The microcomputer programs that have been described so far in this chapter are relatively simple programs, suitable for use on most types of microcomputers.   The more sophisticated DCF programs described by Wendt and Cerf are generally too large to fit on a micro-computer.   This is because of the current memory limitations with most microcomputers.   Also, even when some of the large programs are modified to run on microcomputers they take a considerable amount of time to process the information.

Microcomputers can be interfaced with large computers over telephone lines by the use of a coupling device called a modem.   Thus, by using the microcomputer as a terminal the valuer could utilize the programs that can only be run on large computers.

Microcomputer programs suitable for quite complex investment analysis problems have been developed and are based on the concept of an electronic worksheet.   One such program is called 'Visicalc'. Fylstra and Kling (1981) describe the program as being akin to a large worksheet as might be required for developing an income and expenditure pattern for an investment property when using the income approach to valuation.   The program enables the user to ask 'what if' questions

relating to any proposed changes to the net income.   For example, a change to one expenditure item in a budget may mean that a number of other calculations will have to be reworked.   With the 'Visicalc' program it is possible for any number of changes to be made and the necessary recalculations performed by simply pressing the appropriate key.

The main disadvantage of the program is that users have to devote a considerable amount of time to learning to use the program, which is quite complicated, and to defining the relationships between the items on the worksheet as the 'Visicalc' worksheets or templates are developed.   For example, if a farm budget is considered for developing the income approach to valuation the analyst may ask the question, 'What if we increase the stocking rate 10 per cent?' For the program to be able to show how a 10 per cent increase in the stocking rate will effect the income and expenditure side of the budget the relationship between stock numbers and gross income needs to be quantified as does the effect of an increased stocking rate on the relevant items of expenditure.

Carlisle (1981) describes a specialised real estate application of the program.   The real estate templates are designed to make 'Visicalc' more 'user friendly'.   The templates are set up in such a way that all the typical income and expenditure items associated with urban investment real estate are included on the template as are the equations defining the relationships for the variables.

The program is able to calculate the investment position for a given property at any point after the first year, and also uses the cost and income approaches to make an estimation of the market value of the property at the date of analysis.

The templates have been designed to facilitate printing out the final calculations in a well set out and professional looking format. A template has been developed using similar basic information as contained in the example referred to in sections 4.6 and 4.7.   Part of the computer output from the example is presented in Table 4.14. Depreciation and taxation assumptions have been incorporated in the example.

Table 4.14:   Visicalc Real Estate Template

```
==================================================================================
 ACQUISITION DATE:        1  80      ANALYSIS DATE:          1  90
----------------------------------------------------------------------------------
    PROJECTED INVESTMENT POSITION:    CASH FLOW ANALYSIS:
    10.00 YR(S) AFTER ACQUISITION
                                      GROSS INCOME                    12733
 EQUITY REQUIREMENT          22000    VACANCY ALLOWANCE                 255
 RETURN (IN %) BEFORE TAX    29.66    EFFECTIVE GROSS INCOME          12478
 RETURN (IN %) AFTER TAX     10.77    ANNUAL OPERATING EXPENSE         2310
 INCOME APPROACH VALUATION  127100    COST OF ACQUISITION/SALE         1000
 COST APPROACH VALUATION    124025    NET OPERATING INCOME             9168
 PRESENT VALUE OF DEBT       15349    ANNUAL DEBT SERVICE              2643
 PV OF DEBT PLUS EQUITY      37349    NET CASH FLOW: BEFORE TAX        6525
 EQUITY POSITION: METHOD A   26651    INCOME TAX LIABILITY             4157
 EQUITY POSITION: METHOD B  110213    NET CASH FLOW: AFTER TAX         2369
==================================================================================
    PROJECTED EQUITY POSITION:

    A) ORIGINAL EQUITY INVESTMENT .....................    22000
          PLUS: PRINCIPAL REDUCTION SINCE ACQUISITION ... +   4651
       PROJECTED EQUITY POSITION:   METHOD A ...........    26651

    B) MARKET VALUE: AVG INCOME & REPL COST APPROACH ..   125562
          LESS: PRESENT VALUE OF DEBT ................. -   15349
       PROJECTED EQUITY POSITION:   METHOD B .... ......  110213
==================================================================================

 EXPENSE SCHEDULE:                    BASE YEAR ADJUSTED    $ PER
                                      EXPENSES  EXPENSES    M2
 --------------------------------     --------  --------    -----
 REAL ESTATE TAXES                                    74    0.04
 INSURANCE                               400         800    0.44
 MANAGEMENT FEE           5.00 %                     637    0.35
 SITE MAINTENANCE                        100         200    0.11
 ELECTRICITY                               0           0    0.00
 WATER & SEWER                             0           0    0.00
 LEGAL & ACCOUNTING                      150         300    0.17
 ADVERTISING                              30          60    0.03
 OFFICE SUPPLIES & EXPENSES               20          40    0.02
 MISCELLANEOUS EXPENSES                  100         200    0.11
                                                 --------    -----
 TOTAL ANNUAL OPERATING EXPENSES                    2310    1.28
 COSTS OF ACQUISITION & SALE ................       1000
                                                            -----
 NET OPERATING INCOME ...................................          9168
 ANNUAL RATE OF INFLATION OF EXPENSES ........    8.00 % / YEAR
 EXPENSE ADJUSTMENT FACTOR ...................    2.00 X BASE YEAR
==================================================================================
```

4.10 ESTIMATING DEBT SERVICING ABILITY

Valuation required for farm mortgage finance purposes normally requires the valuer to include a loan recommendation with the valuation report.   In making the recommendation the valuer has to decide if a loan offer should be made, the amount of the offer, and any special conditions that should be attached to the offer.   When considering a farm loan application the valuer will be concerned with what Nelson and Murray (1967) describe as the 3 C's of credit as a base for formulating the loan recommendation.   The 3 C's of credit relate to character (the personal element), capacity (debt servicing ability), and capital (the security being offered).   Of these three items the most important is the capacity or debt servicing ability.

Farm lenders are finding that existing farmers often have large amounts of security to offer and the amount that can be lent is usually limited by the amount of debt that can be serviced.   High interest rates on mortgages have put further emphasis on the debt servicing aspect of loan recommendations.   If the debt can be serviced then the security aspect is unlikely to be a problem.

In order to ascertain the debt servicing ability of a given farming enterprise the valuer has to prepare a budget.   The concepts used in the budget are somewhat different from those used in a standard farm management cash forecast budget.   Normally the debt servicing budget will consider the farm in a status quo position, in a typical climatic year, and using the applicant's standard of management to arrive at the expected performance levels.   The levels of product prices used in the budget will not necessarily relate to current prices since the lender is concerned with the ability of the farmer to service the debt both in good years and in poorer years. Lenders typically use 'conservative' product prices in these budgets if current prices are not considered indicative of long run prices.

The budget will be used by the valuer to determine the amount that can be applied to debt servicing and from this the maximum loan that can be recommended.

The debt servicing analysis becomes more involved when the question of taxation is considered because non tax deductible expenditure has to be paid out from after tax income. When considering a table mortgage the valuer does not know what the after tax income available for principal repayments will be until a specific loan amount is considered. In order to ascertain the maximum amount of principal repayments that can be serviced the valuer selects a number of mortgage amounts until debt servicing requirements are matched up with the amount available for debt servicing. As this method basically involves trial and error it can be rather time consuming. The following example shows how the debt servicing problem can be worked out manually.

Example:

The valuer is asked to make a loan recommendation on a North Island hill country sheep and cattle farm. The valuation of the land and improvements is $400,000 and the lending institution will lend up to a maximum of 60 per cent of the valuation($240,000). The budget shows the following information:

Gross farm income	$80,000
Total farm expenses (i.e. direct production costs)	$40,000
Depreciation	$2,000
Interest on stock on plant	$2,000

The farmer is considered to have a good personal factor and requires personal drawings of $5,000 per annum. For taxation purposes, income exemptions are $800 and the farmer qualifies for a tax rebate of $200.

Debt servicing ability will be considered for a 20 year table mortgage at 14 per cent interest.

The annual level of debt servicing per dollar of debt is .151.[6]
In the first year this will consist of interest .14, and principal .011.
The valuer will test various mortgage amounts to see if they can be
serviced.

For example, testing to see if $200,000 can be serviced from the
budget: the amount available after tax to meet principal repayments
will be as follows:

		$
Step 1:	Net farm income	36,000
	Less Interest on 200,000 @ 14%	28,000
		8,000
	Less Income exemption	800
	Taxable income	$7,200
	The tax on $7,200 (from 1980/81 tax tables) will be	1,393
	Less tax rebate	200
	Net tax	$1,193

Step 2:	Net farm income		36,000
	Less Drawings	$5,000	
	Interest payments	28,000	
	Net tax	1,193	34,193
	Available to meet principal repayments		$1,807

The principal repayments required in the first year for this
proposed $200,000 loan are $2,200 ($200,000 x 0.11). As the balance
of $1,807 available to service the principal repayments is less than
$2,200 then the proposed loan is clearly not feasible.

---

[6] From the formula $\dfrac{i(1 + i)^n}{(1 + i)^n - 1}$

where i = Interest rate,
      n = Number of years.

The following list shows four proposed loan amounts. The after tax balance available to service the principal repayments approximates the balance required at the proposed loan of $196,000.

Proposed loan	Balance available	Balance required
200,000	1,807	2,200
197,000	2,080	2,167
196,000	2,171	2,156
195,000	2,262	2,145

Since principal repayments will be at a minimum in the first year the prudent lender may wish to look ahead several years into the future and re-assess debt servicing ability.

Assuming that the debt servicing is re-assessed at year 5, then it is first necessary to calculate the percentage of the loan paid off after five years. One way to calculate this sum is to use the formula for the future value of an annuity.[7]/ The percentage amortised will be the future value of an annuity at 14 per cent for five years divided by the future value of an annuity at 14 per cent for 20 years.

This will be: $\frac{6.6101}{91.0249}$ = .07261

In the case of a loan for $190,000, $13,797 will have been paid off after five years leaving $176,203 unpaid. The annual mortgage payments on a 20 year loan at 14 per cent is $28,690. At year 5 the interest component will be $24,668 (.14 x $176,203) and the principal component $4022.

---

[7]/   The formula for the future value of an annuity is: $\frac{(1 + i)^n - 1}{i}$

      where i = Interest rate,

             n = Number of years.

		$
Step 1:	Net farm income	36,000
	<u>Less</u> Interest @ 14% on $176,203	24,668
		11,332
	<u>Less</u> Income exemption	800
	Taxable income	$10,532
	Tax on $10,532 (from tables)	2,559
	<u>Less</u> Tax rebate	200
	Net tax	$2,359

Step 2:	Net farm income		36,000
	<u>Less</u> Drawings	$5,000	
	Interest payments	24,668	
	Net tax	2,359	32,027
	Available to meet principal repayments		$3,973

Proposed loan	Balance available	Balance required
$190,000	$3,973	$4,022
$189,000	$4,058	$4,011

In this example a lender may be 'safer' to lend $189,000.

4.10.1   Computer Application

In order to speed up the debt servicing analysis process a computer program was developed at Massey University.   The initial development work was done by Mr A.F. McRae and Dr A. Wright of the Agricultural Economics and Farm Management Department.

From the case example described, it is apparent that the assessment of the maximum debt servicing ability is not a straight forward task.

The manual process basically involves an iterative procedure whereby the analyst uses trial and error to arrive at the correct answer. Frizzell (1979) uses an alternative method involving the use of average tax rates but this method still involves a large amount of manual calculation work. This type of iterative process is one computers are very good at. The program is set up to consider the maximum loan that can be serviced in the first year of a table mortgage.

The basic equations used in the program are as follows:

$$1) \quad TI = Y - FX - ASS - Itn - Dpn$$
$$2) \quad CS = Y - FX - ASS - Dt - L - NT$$

where TI = Taxable income,

      CS = Cash surplus,

       Y = Farm income,

     FX = Farm expenses,

    ASS = Personal insurance,

    Itn = Interest payment,

    Dpn = Depreciation,

     Dt = Amount of debt servicing,

      L = Living expenses,

     NT = Net tax.

The time that the computer takes to solve the equations depends on the power of the computer, the increments of the iterative procedure, and the starting point.

The original program started at a $10,000 table mortgage and used $10,000 increments. As $10,000 is rather too large a margin the increments were set to $1,000 and the program asks the valuer to give an estimate of the maximum loan. This input is used as the starting point and has been found to considerably speed up the operation of the program. (Valuers normally have a rule of thumb for roughly estimating debt servicing). Where the valuer has no idea of the starting point then a default value of $10,000 is used.

The program continues iteration until the cash surplus is
reduced to an amount less than $100.

Table 4.15 shows an example of the computer print out using the
information from the case example.

Table 4.15:   Computer Output From Maximum Loan Program

```
FARM INCOME 80000
FARM EXPENSES 42000
LIVING EXPENSES 4200
PERSONAL INSURANCE 800
TAX DEDUCTABLE DFCN 2000
TAX REBATE200
INTEREST RATE (%) 14
TERM OF LOAN 20
ENTER YOUR  ESTIMATE OF THE  MAXIMUM LOAN, (0 IF DONT KNOW)190000
CALCULATING
629.659729       190000
527.673722       191000
425.687721       192000
323.701721       193000
221.715714       194000
119.729713       195000
17.7437134       196000


MAX LOAN =196000
DEBT SERVICING =29593.2563
TAX =1589
CASH SURPLUS =17.7437134
```

4.11 MARGINAL ANALYSIS

Property developers often have to decide what type of development
to undertake on a given site.   The most profitable development will
be the one that results in the highest residual land value.   This
is said to be the 'highest and best use' of the site.

In practice the intensity of development on a given site will be limited by the physical nature of the site, bulk and location requirements under the planning ordinances, and the economics of the proposed development. The physical nature of the site and town planning ordinances will dictate the upper limit of the intensity of development. The following analysis leaves the planning and physical considerations aside and just considers the economic implications.

Economic theory says that the most profitable development will be that where the marginal revenue is equal to the marginal cost. This can be illustrated by using the following example.

Example:

An investor has acquired a small commercial site for $25,000. The cost of erecting a building on the site together with the estimated annual income and expenditure are shown in Table 4.16.

Table 4.16:   Alternative Building Costs and Returns

Number of floors	1	2	3	4	5
Cost of the building	60,000	110,000	170,000	240,000	325,000
Total estimated rental per year	9,000	16,000	21,000	25,600	30,000
Total estimated outgoing including depreciation	2,500	3,200	3,800	4,400	5,100

The interest rate on borrowed money and the required pre-tax return on equity investment is 8 per cent.

Marginal revenue (MR) is defined as the incremental revenue from an additional floor and marginal cost (MC) as the incremental costs associated with an additional floor.

Thus,

$$MR_n = TR_n - TR_{n-1}$$

and

$$MC_n = TC_n - TC_{n-1}$$

where MR_n = Marginal revenue for the nth floor,
       TR_n = Total revenue for the nth floor,
       MC_n = Marginal cost for the nth floor,
       TC_n = Total costs for the nth floor.

The marginal costs and marginal revenue for the case example
are shown in Table 4.17.

Table 4.17: Marginal Analysis of Development Alternatives

Number of floors	1	2	3	4	5
Annual outgoings (including depreciation)	2,500	3,200	3,800	4,400	5,100
+ 8% per annum on the building cost	4,800	8,800	13,600	19,600	26,000
Total annual cost including interest	7,300	12,000	17,400	23,600	31,100
Marginal cost	7,300	4,700	5,400	6,200	7,500
Marginal revenue	9,000	7,000	5,000	4,600	4,400
Marginal revenue less marginal cost	1,700	2,300	-400	-1,600	-3,100

It can be seen from the above analysis that one of the
difficulties in applying marginal analysis to real estate development
decisions is that land itself is a lumpy input and property develop-
ments come in multiples of units or floors which are indivisible.
This means that the developer will seldom be able to set marginal
costs exactly equal to marginal revenue and will need to select the most
feasible alternative.   In the example this is a two story building.

The development decision is further complicated by the need for
the analyst to consider likely future demand given the long term
nature of buildings.

4.11.1 Computer Applications

A computer program has been developed to automate many of the calculations involved in the marginal analysis procedure that has been described above. The program can consider up to 30 floors or units and given the inputs shown in the case example will automatically calculate the marginal costs and marginal revenues and print these out for each floor and unit. In addition, the computer output as shown in Table 4.18 prints out the percentage return on investment for all the options under consideration.

The program has been written so that the user can easily change part of the input data and recalculate without having to resubmit all the other data.

Table 4.18:   Marginal Analysis Tables

REAL ESTATE ANALYSIS
==== ====== ========

FLOOR	BUILDING COSTS	TOT EST RENTAL	TOT EST OUTGOINGS
1	60000	9000	2500
2	110000	16000	3200
3	170000	21000	3800
4	240000	25600	4400
5	325000	30000	5100

INTEREST RATE OF 8%

SITE ACQUISITION COST $25000

MARGINAL ANALYSIS

FLS	ANNL OUTGNS	INT ON BDG CST	TOT AN COST	MARG COST	MARG REV
1	2500	4799	7299	7299	9000
2	3200	8799	11999	4700	7000
3	3800	13599	17399	5400	5000
4	4400	19199	23599	6200	4600
5	5100	25999	31099	7500	4400

RESIDUAL ANALYSIS

FLS	NET RENT	LESS B/C %	ECON RENT	TOT CAP OUTLAY	NET %
1	6500	4799	1701	85000	7.64
2	12800	8799	4001	135000	9.48
3	17200	13599	3601	195000	8.82
4	21200	19199	2001	265000	7.99
5	24900	25999	-1099	350000	7.11

CHAPTER 5

THE COST APPROACH

5.1   COST AND VALUE

The cost approach is used for the valuation of structural
improvements such as buildings.   The replacement cost of the building
is calculated, an appropriate deduction is made for depreciation and
the depreciated value is then added to the land value which has been
estimated from comparable sales.

One of the contentious issues with the cost approach is the
relationship between cost and value.   Babcock (1932) recognised that
the added value of a new building may not equate with its replacement
cost.   It is possible to envisage cases where, in periods of low
demand or where inappropriate buildings are put on a site, the added
value of new buildings will be less than replacement cost.   Conversely,
in periods of high demand there are numerous examples where the added
value of a building exceeds replacement cost.

The majority of valuation theorists agree that replacement cost
will tend to set the upper limit on value because so long as properties
can be acquired at less than their replacement cost it will not pay
someone to build.   (Assuming appropriate adjustments for depreciation
and the time delays in actually building new properties have been
included in the replacement cost estimate).   This is often referred to
as the substitution principle and is based on the premise that over the
long run price will tend to equal value.   It has been argued by Wendt
(1974) that long run cost curves are not observable.

5.1.1   Depreciation

In addition to the difficulties of relating the cost to the value
of new buildings, the valuer is also faced with the problem of having
to value older buildings and to estimate depreciation.   Valuers define
depreciation as the difference between cost and value, regardless of the

cause of the loss in value.   It may, for example, be due to physical deterioration, functional obsolescence or economic obsolescence. Physical deterioration is the wear and tear that occurs to a building as it ages.

Functional obsolescence occurs when the building itself or fittings in the building become out of date and changes in demand mean that buyers discount this type of building.   An example would be coal ranges, and high ceilings in old villa houses.

Economic obsolescence is the term used in the literature for loss of value resulting from economic factors outside the building itself. For example, a noisy industrial plant such as a metal crusher located near a residential neighbourhood.   Ratcliff (1972) was highly critical of the cost approach, arguing that the assumptions used are unrealistic.   He was particularly critical of the valuers' concept of depreciation and stated that the separate estimation of the three depreciation items for buildings with a large amount of depreciation accrued was likely to produce a meaningless figure.   He said that often valuers 'fudged' the depreciation figure to make the answer reconcile with the answer from another valuation method.

The actual estimation of depreciation is a difficult task for valuers.   In Chapter 2, the method of deriving the net rate has been described.   This is a residual method that relies on an accurate estimation of the value of the land and other improvements in order to estimate the price paid per m^2 for the house.   Unless the valuer has sufficient sales evidence of vacant land the net rate may not be reliable. Mahoney (1974) examines the dangers in imputing vacant land sales for multi-unit development to areas where the predominant use is still for single family homes.   The net rate is basically a market approach. By analysing the net rate information for a wide variety of houses of different ages it is possible to construct a depreciation table showing the accrued depreciation as houses age.   This information can also be expressed in graphical form or as a mathematical equation.

There are a number of theoretical methods used for estimating depreciation.   Several of these methods have been devised by accountants for bookkeeping procedures and to satisfy taxation authorities.   Ring (1963) explains six of the most commonly used theoretical methods of depreciation and suggests that methods favouring accelerated depreciation or straight line depreciation do not generally approximate the reality of the real estate market.   He says that depreciation methods which show a small amount of depreciation in the initial years are more likely to approximate what is happening in the real estate market, particularly the housing market.

5.1.2   The Cost Approach in Use

Given the problems of using the cost approach in the valuation process it is somewhat surprising to find that valuers extensively use the cost approach in modern day practice.   In New Zealand, the main reason for reliance on the cost approach appears to come from the statutory requirements of the Valuation of Land Act 1951.   Under this legislation all real estate in New Zealand is valued on a five yearly cycle and the government valuers provide separate values for the land and improvements.   These valuations are used primarily for rating purposes under the Rating Act 1967.   Valuation reports that show a separate valuation for each individual improvement on a replacement cost less depreciation basis are likely to have the 'appearance' of a higher degree of accuracy than reports where the improvements are valued as a global sum.

Using the replacement cost approach enables the government valuers to adopt a reasonably standardised approach to the valuation of the improvements.   Zangerle (1924) argued that the replacement cost approach would assist in the uniformity of valuation and widespread continued use of the approach for rating and assessment valuation lends credence to Zangerle's argument.   According to W.G. Murray (1969) the success or failure of a valuation system for rating purposes will tend to revolve around the uniformity of values between properties rather than the absolute level of rating valuations in relationship to the market values.

The replacement cost approach appears to have become enshrined in New Zealand valuation practice because most private valuers have spent some years in the formative part of their careers working for the Valuation Department.   They appear to have taken the replacement cost method with them into private practice.   A number of lending institutions have report forms set out to encourage valuers to use the replacement cost method.

The replacement cost approach still dominates the work of valuers employed by the Housing Corporation who have traditionally been mainly involved in financing and supervising new housing construction.

Replacement cost valuations are also required for insurance purposes and this aspect of valuation forms a significant part of private urban valuation practice.

The emphasis on the replacement cost approach in New Zealand has resulted in considerable effort being put into accurate methods of building cost estimation.   The foundations for this work were laid in the 1940's when the New Zealand Institute of Valuers developed a concept known as the modal house.   In his textbook, 'Urban Valuation in New Zealand', Vol. 1, Jefferies (1978) reports that the modal house idea was pioneered by Mr L.E. Brooker in Wellington and later adopted nationally.   The term modal is derived from the statistical term the mode and was used because the standard house adopted represents the most commonly built type of house.   The modal house is similar to the typical house seen in many state and group housing suburbs throughout New Zealand.   Detailed plans and specifications for the modal house were drawn up and Jefferies reports that several modal houses were built by branches of the New Zealand Institute of Valuers to confirm the accuracy of the costing information.

Accurate information on the month by month cost of erecting a modal house in all the main centres in New Zealand is available from the Statistical Bureau publications of the New Zealand Institute of Valuers.   This information is derived from actual building contract prices for houses that are financed by the Housing Corporation.

A system has been devised by the Housing Corporation whereby building costs of houses similar to the modal can be adjusted back to arrive at the modal cost. A superior modal house was introduced by the New Zealand Institute of Valuers in 1943 to assist in the costings of larger houses with more expensive fittings and material. The cost of the superior modal was related back to the cost of the standard by a system of multiples. Unfortunately the superior modal was not widely used by valuers and the plans and specifications have not been kept up to date as for the standard modal. Superior houses tend to be subject to larger variations in their construction costs than modal type houses.

The modal house building costs can be related to the replacement cost of other buildings by a system called multiples. If the modal house costs \$400 per m^2 and a farm woolshed cost \$200 per m^2 then the multiple for the woolshed will be 0.5. The Statistical Bureau of the New Zealand Institute of Valuers has recorded cost information for many years and has published the multiples for various types of buildings in the 'Valuers' Handbook'. Multiples can also be used to index building costs over time and for variable cost adjustments within buildings. Riley (1972) showed how multiples could be used for the valuation of home units and Tomlinson (1976) calculated a series of multiples for different types of farm sheds.

In most valuations the estimation of replacement cost tends to be a mechanical process. In general the valuer does not need to exercise a great deal of judgement assuming that he understands how to make the necessary adjustments to modal costs. This approach to valuation lends itself to computer assisted estimation of replacement costs.

County assessors in the U.S.A. such as Hinshaw (1969) were amongst the first to use computers in the cost approach. This approach was also advocated by Large (1973). Although automated replacement cost procedures are used by a number of assessors in the United States, Stevenson (1979) reported that the Valuation Department had not used this approach in New Zealand, relying instead on multiple regression with the valuer using manual estimates of depreciated replacement cost.

While the cost approach has been severely criticised by many valuation theorists the fact remains that it is still widely used by valuers. In New Zealand valuers are likely to continue to use the approach for valuations for insurance purposes and for rating valuations.

5.2 ESTIMATING REPLACEMENT COSTS FOR FARM SHEDS

The relationship between the cost of the modal house and the cost of farm buildings can be established by the use of multiples. A multiple is an index which relates the costs of all types of buildings back to the modal house cost. The New Zealand Institute of Valuers' Statistical Bureau has kept a careful record of the building costs of a wide variety of buildings for many years and has published a list of recommended multiples in the 'Valuers' Handbook'. One of the basic assumptions when using multiples is that the relationship between costs for different types of buildings remains constant over time. The authors of the NZIV (1959) text 'Principles and Practice of Urban Valuation in New Zealand' support this contention and state on p. 146 that:

> *"It will be found that similar types of buildings will show remarkably similar multiples even when built many years apart"*

and,

> *"These (multiples) can then be compared with similar results obtained overseas and again the multiples will be found to be remarkably consistent if small allowances are made for the variation in standards between the countries".*

A legal precedent for the use of multiples is found in the Australian case of Grace versus Commonwealth of Australia (1953).

Although multiples are a tool widely used by urban valuers, rural valuers have been more cautious about using multiples.

Probably the most important development in the last ten years in the use of rural multiples occurred with the publication of Tomlinson's work. Tomlinson postulated that many farm buildings have a common

structural system.   He said:

> "*A simple haybarn of columns and roof can be progressively
> closed in on three sides to provide an implement shed,
> and on all sides to provide a granary or storage shed
> building.   Fitting out the building with perhaps stud high
> variations, will provide the basic wool-shed structure with
> necessary internal fittings added".*

After analysing a number of manufacturer's price lists,
Tomlinson developed a series of tables showing the multiples for
various sizes and types of farm sheds.   The starting point is the
multiple for a roof only building and then adjustments are made for
stud height, type of roof, size of building, doors, extent of exterior
cladding, bay size, type of construction material, and extras such as
insulation.

5.2.1   Computer Applications for Farm Sheds

A simple computer program has been developed based on the
Tomlinson tables.   The generalised equation that is the basis of the
program is as follows:

$$R = (N \times ((F + H + E + C) \times T \times X) \times F1) + (Y + I + J)$$

where N = Modal rate adjusted for distance from main centre,

R = Replacement cost,

F = Roof only multiple,

H = Stud height multiple,

E = Ends multiple,

C = Sides multiple,

T = Roof type multiple,

X = Type of framing material variable,

$F1$ = Size of shed (m^2),

Y = Lump sum amount for canopy,

I = Lump sum amount for insulation,

J = Lump sum for doors;

and

$$Y = (Z \times N \times M1)$$

where   Z = Size of the canopy,
       M1 = Canopy multiple;

and

$$I = (F \times N \times M2)$$

where M2 = Insulation type multiple;

and

$$J = (N \times M3)$$

where M3 = Doors multiple.

To illustrate the use of the program consider the case of a steel framed farm implement shed of 150 m^2 with a gable roof, 4.2 m stud height, and two ends and one side enclosed.   The shed is assumed to be 10 km from the nearest centre and the current modal rate is $400 m^2. A sketch illustrating this type of shed is shown in Figure 5.1.
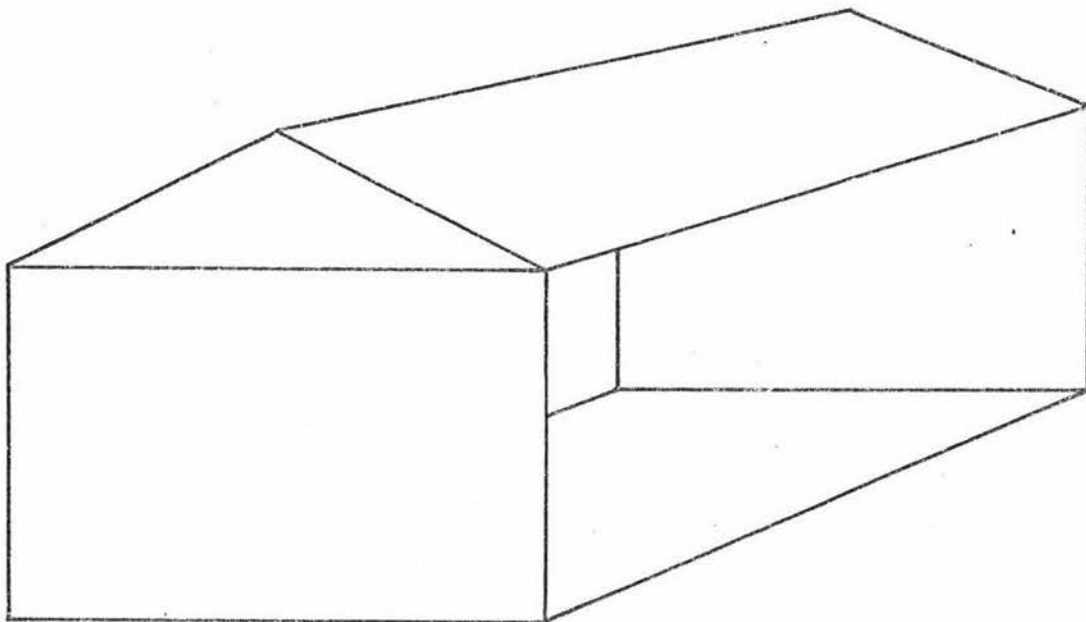
Figure 5.1:   Sketch Plan of Implement Shed

The computer program asks the user the following questions about the shed being valued.

1. The current modal rate,
2. The distance to the nearest centre,
3. The floor area of the shed,
4. If the shed has a gable or lean to roof,
5. If a lean to roof with a canopy, then the size of the canopy,
6. If the shed is insulated, the type of insulation,
7. The stud height,
8. The type of framing material,
9. The number of enclosed sides,
10. The number of bays with doors,
11. The number of enclosed ends.

The replacement cost is then estimated, as is the cost per m^2 and the overall multiple for the shed. The computer output for the case example is shown in Table 5.1.

Although the actual multiples used in the program are based on Tomlinson's charts there are some modifications and additions. The modal rate is adjusted for distance from the main centre using the figures suggested by Frizzell (1979) and based on the premise that building costs will increase the further the building is from centres of population. To simplify the program, there is an assumption that a wooden framed shed would have a roof only multiple of 82 per cent of that for a standard steel framed shed.

To check on the current validity of the Tomlinson charts the roof only multiples for a standard gable roof hayshed were compared with the 1981 multiples for a Manawatu based supplier of farm sheds. The results of the comparison are shown in Figure 5.2 and show that the 1981 figures appear to be about 10 per cent below the 1976 figures. It is possible that one of the reasons for the reduction in the multiples is that manufacturers of this type of farm building have become more efficient, relative to house builders, over the last five years. Further research work on updating the Tomlinson's charts will be required if valuers are to be confident about using this method.

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Table 5.1:   Output From Farm Shed Program

REPLACEMENT COST FOR STANDARD FARM SHED
==

ENTER CURRENT MODAL RATE($)?400

ENTER DISTANCE TO NEAREST CENTRE (KM)?10

ENTER FLOOR AREA (M*M) 150

  1 - GABLE ROOF
  2 - LEANTO ROOF
?1

  - IF LEAN TO WITH CANOPY,ENTER SIZE OF   CANOPY (M*M) (0 OTHERWISE)
?0

  0 - NO INSULATION

  1 - NETTING + BUILDING PAPER INSULATION
  2 - SISALATION + BUILDING PAPER INSLTN
?0

ENTER STUD HEIGHT
  1 FOR 2.438M (8 FT)
  2 FOR 3.049M (10 FT)
  3 FOR 3.658M (12 FT)
  4 FOR 4.267M (14 FT)
?4

ENTER FRAMING MATERIAL
  1 FOR STEEL FRAME
  2 FOR WOODEN FRAME
?1

ENTER DATA FOR SIDES
  2 FOR BOTH SIDES CLOSED IN
  1 FOR ONE SIDE CLOSED IN
  0 FOR NO SIDES CLOSED IN
?1

ENTER DATA FOR DOORS

TYPE THE NUMBER OF BAYS WITH DOORS, 0-5
?0
ENTER DATA FOR ENDS
  2 FOR BOTH ENDS CLOSED IN
  1 FOR ONE END CLOSED IN
  0 FOR OPEN ENDS
?2

REPLACEMENT COST   = 8400
MODAL RATE USED IS = 400
COST PER METRE SQUARED=56

Multiple

.11

.10

.09

.08

0

60   80   100   120   140   160   180   200

1976 Data

1981 data

Floor area m^2
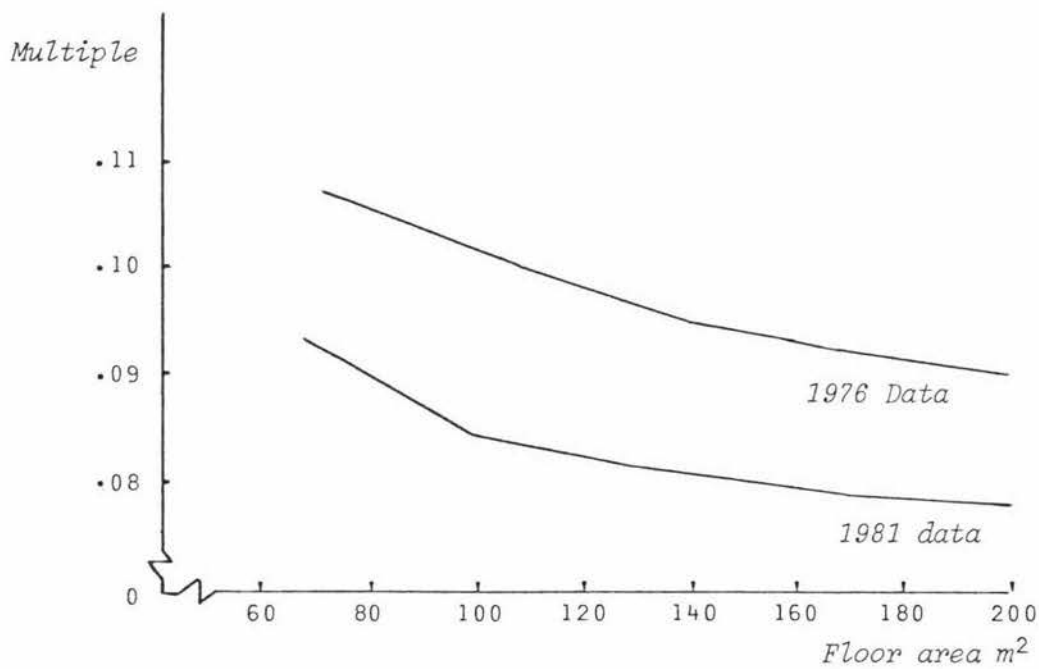
Figure 5.2:   Comparison of Roof Only Multiples for Standard Gable
               Hayshed

The computer program that has been described should be useful to
valuers in estimating the replacement cost of standard farm sheds.
The basic replacement cost equation could be extended to include more
items, particularly for specialised adaptations of the standard shed.
The primary purpose of developing this particular program was to
refine the Tomlinson approach and to provide simple programs that
would be useful on a wide variety of buildings that are fairly similar
and common to most farms.

5.3   THE MODAL HOUSE

The modal house is based on a set of plans and specifications
drawn up by the New Zealand Institute of Valuers.   The house is
92.9 m^2 in size.   A plan of the modal house is shown in Figure 5.3.
For the modal house, the static or fixed costs comprise approximately
25 per cent of the total costs, with the remaining costs being variable
costs.   Houses built to modal specifications that are smaller than
92.9 m^2 in size will cost more per m^2 than modal costs and houses that
are larger will cost less per m^2.   The effect of spreading the fixed
cost elements over a range of house sizes is illustrated in Figure 5.4.

In addition to the size adjustment as described, valuers use a
system of multiples within the modal house to cope with variations in
variable costs.   If a house is similar in all respects to the modal
except for the type of roof then it is possible to cost out the
difference between the type of roof used on the modal and the type of
roof used on the subject house.   If the subject house has a metal tiled
roof (decramastic) and the modal has a corrugated iron roof then the
metal tiled roof is likely to cost $929 more than modal.   By dividing
the additional cost of the metal tiled roof by the size of the modal
the cost per m^2 can be converted to a multiple by dividing by the
current modal rate.   Thus, if the additional cost of a decramastic
roof is $10 per m^2 and the current modal rate is $400 per m^2 then the
multiple for this roof type will be .025.

The validity of using multiples for adjustments to the variable
costs in a house is based on the assumption that the variable cost items
will change at the same rate as the modal rate changes.   According to
Housing Corporation officers interviewed in Palmerston North this
assumption appears to be valid over the short term, i.e. for periods
of not more than six months to a year.   The system of multiples within
the modal house has not been tested sufficiently in valuation practice
to support the contention that multiples remain consistent over periods
of several years.

Once the variable cost multiples have been calculated the valuer
is saved from the job of costing out in dollar terms the different
variable cost items for the modal house every time a replacement cost
valuation is completed.

NATIONAL MODAL HOUSE — PLAN

elevation B
scale 1:100

12 090 mm

2896

100

100

hwc

Kitchen

Porch

Laundry

wc

Bath

Bedroom 3

high lights

2743

100

100

dresser
cupd over

Passage

2362

2337

Dining

1572

Hall

wd

linen

coats

wd

wd

wd

high lights

7040 mm

5029

fireplace

Porch

Bedroom 2

Bedroom 1

C

Porch

Lounge

B

2896

3962

100

100

100

3357

100

100

area 92·9 m² over plates

plan

scale: 1 100

A

A
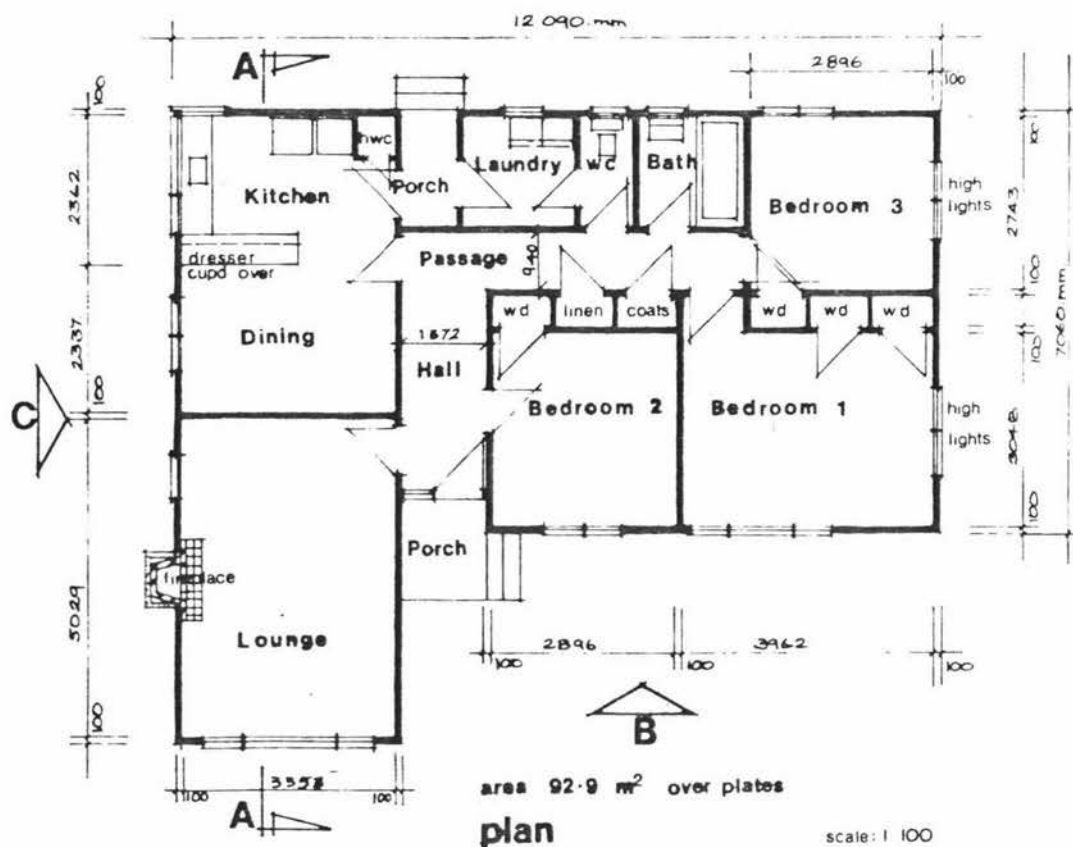
Figure 5.3:   National Modal House - Plan
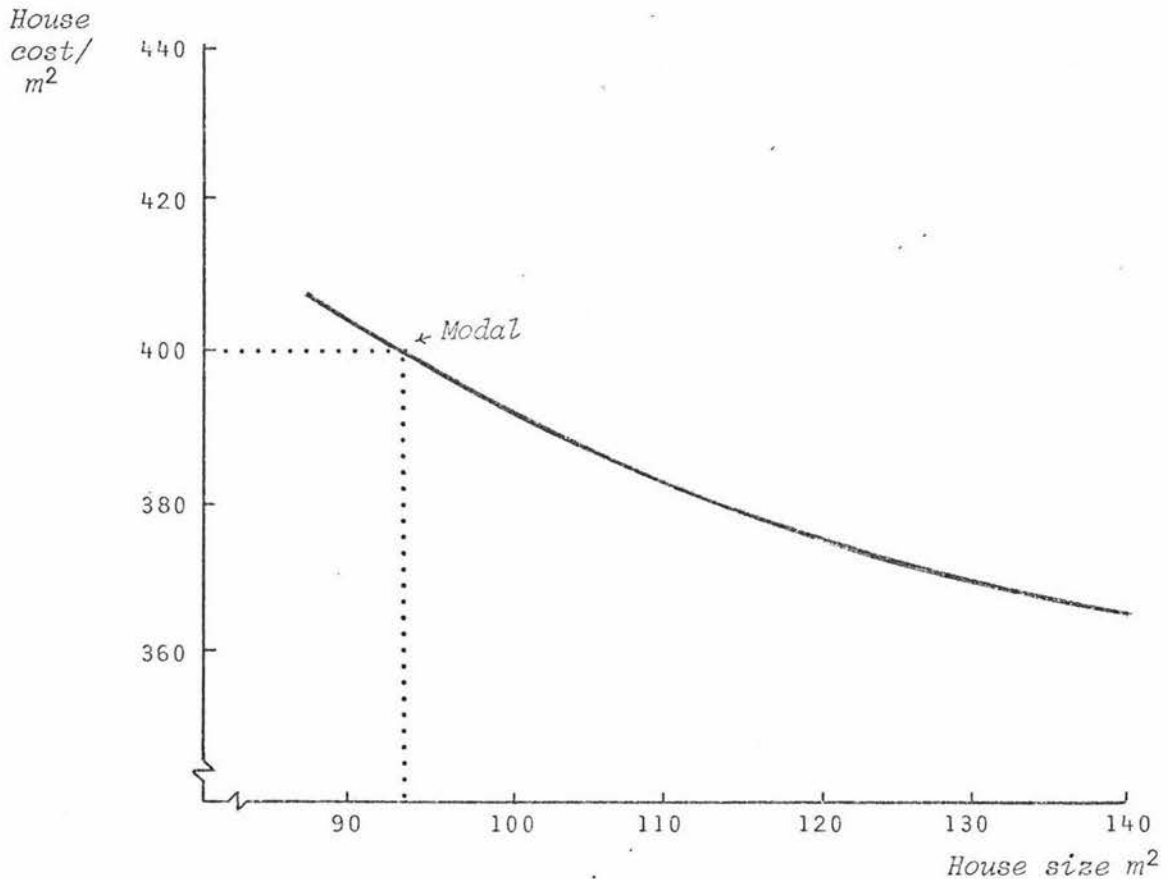
Figure 5.4: Cost per m² Variation With Different House Sizes

A similar approach can be used for fixed or static cost items in relation to the modal. For example, the modal house does not have a shower box. If a house has a shower then the multiplier for a shower box will be the cost of the shower divided by the modal rate. For example, a seratone lined shower box with mixer valve costs $346 more than the modal.

If the modal rate is $400 per m^2 then the multiplier is .865. Knowledge of multipliers alleviates the need for the valuer to continually have to find out the cash amount of static item adjustments.

The two examples given are cases of additions to the modal. The same principles apply if the subject house is inferior to the modal in some respects. In this case a deduction will be made.

The generalised equation for the estimation of replacement cost based on the modal house rate is as follows:

$$RC = (SA + VC + SC) \times S \times MR$$

where   RC = Replacement cost,

       SA = Proportion factor for size adjustment,

       VC = Total multiples for variable costs,

       SC = Total multipliers per m^2 for static costs,

       S = Size of subject in m^2,

       MR = Current modal rate per m^2,

       MS = Modal size in m^2,

       T = Cost per m^2 for subject considering only size adjustment;

and

$$SA = \frac{(.75 \times S) + (.25 \times MS)}{S}$$

and

$$T = SA \times R$$

The above formula can be rearranged to solve for the modal rate (MR) where replacement costs are already known. (This is a useful modification since few houses are ever built to exact modal specifications).

Thus: $MR = \dfrac{RC}{(SA + VC + SC) \times S}$

The valuers employed by the Housing Corporation use the modal house as the basis for comparing the tender prices submitted by builders for new houses financed by the Housing Corporation.

5.3.1   Computer Application

Estimating the replacement cost of houses is a computer application that is already used quite extensively in the United States. The best known example is the Marshall and Swift computerised cost estimation service for valuers, described by the American Institute of Real Estate Appraisers (1981).

An interactive computer program has been developed to automate some of the computerised aspects of using the modal house approach. The program asks the valuer a series of questions about the house being valued and then estimates the replacement cost based on the current modal rate and the system of multiples and multipliers as previously described.   Table 5.2 lists the questions that the program presents to the valuer.

As this is an extensive list of questions, valuers will find it easiest to work from a set of actual plans and specifications for the subject house or from a specially prepared check list.

To illustrate the use of the program, a case example is used. The example is worked out manually and then by the computer.

Case Example:

The subject house is different from the modal in the following respects:

A.   Variable Cost Items
    1.   Roof type = decramastic (modal, corrugated iron);
    2.   Exterior cladding = clinker brick (modal, weatherboard);
    3.   Insulation = R14 Batts in ceiling (modal, not insulated).

B.   Static Cost Items
    1.   Ranchsliders 2 m (modal, no ranchsliders);
    2.   Electric Night store heater 15,000 B.T.U. (modal, no night store);
    3.   Separate shower with seratone lining and mixer valve
          (modal, no shower).

C.   Size
    1.   Subject = 110 m^2 (modal, 92.9 m^2).

Replacement Cost Valuation Using Multiples:

Table 5.2:   Questions From the Modal House Program

QUESTION		QUESTION	
1.	Size of subject (m^2)	41.	Length of pelmets (m)
2.	Current modal rate (m^2)	42.	Number of stair treads
3.	Number of rooms	43.	Stair handrail (Yes/No)
4.	Type of foundations (1-9)	44.	Bath type (1-3)
5.	Height of additional base	45.	Basin type (1-5)
6.	Length of additional base	46.	Type of water heater (1-4)
7.	Number of roofbreaks (0-10)	47.	Under bench water heater (Yes/No)
8.	Type of Spouting (1- 5)	48.	Type of shower (1-3)
9.	Type of Roof (1-12)	49.	Formica shower lining (Yes/No)
10.	Lean to Roof Data	50.	Shower mixer (Yes/No)
11.	Beamed ceilings (Yes/No)	51.	Type of laundry tub (1-5)
12.	Size of beamed ceilings (m^2)	52.	Chimney type (1-3)
13.	Type of exterior sheathing (1-26)	53.	Parallel chimney (Yes/No)
14.	Brick veneer pointing (Yes/No)	54.	Brick veneer chimney (Yes/No)
15.	Type of interior lining (1-6)	55.	Fuel Box (Yes/No)
16.	Whisper ceilings (Yes/No)	56.	Ashpit (Yes/No)
17.	Gib.Foil lined walls (Yes/No)	57.	Type of Firebox (1-5)
18.	Lounge entrance (Yes/No)	58.	Type of oil fired heating (1-5)
19.	Laundry entrance (Yes/No)	59.	No. of ducted outlets
20.	Separate laundry (Yes/No)	60.	Gas connection (Yes/No)
21.	W.C. in bathroom (Yes/No)	61.	Gas heating (Yes/No)
22.	Length of extra int. partitioning (m)	62.	Type of electric heating (1-5)
23.	Number of window sashes	63.	Presence of basement (Yes/No)
24.	Type of window sashes	64.	Size of additional face blockwork (m^2)
25.	Number of exterior doors	65.	Basement concrete floor (Yes/No)
26.	Number of pairs of casement doors	66.	Reinforced floor (Yes/No)
27.	Length of ranchsliders	67.	Number of Basement doors
28.	Number of shutters	68.	Total Basement Floor Area (m^2)
29.	Type of shutters (1-3)	69.	Amount of excavations (m^2)
30.	Type of Front door	70.	Laundry in Basement (Yes/No)
31.	Number of interior doors	71.	Size of timber deck (m^2)
32.	Type of interior doors (1-3)	72.	Size of concrete terrace (m^2)
33.	Length of folding doors	73.	Size of terrace roof (m^2)
34.	Type of folding doors (1-2)	74.	Length of terrace rail (m^2)
35.	Number of wardrobes	75.	Type of terrace rail (1-4)
36.	Length of kitchen cupboards (m)	76.	Type of carport (1-3)
37.	Type of cupboard facing (1-3)	77.	Size of carport (m^2)
38.	Length of sinkbench	78.	Type of garage (1-3)
39.	Type of sinkbench (1-3)	79.	Size of garage (m^2)
40.	Type of pelmets (1-3)	80.	Type of insulation (1-9)

Static items (using multipliers):

Ranchslider	.628
Shower	.867
Night store heater	.413

$$1.908/110 \ m^2 = \ .017$$

Variable items (using multiples):

Decramastic roof	.025
Clinker bricks	.1161
R14 Batts	.014
% size adjustment	.961
	1.1332

$$110(m^2) \times 400(\$m^2) \times 1.1332 = 49,862 \ (Replacement \ Cost)$$

If the valuer was given the estimated replacement cost figure of $49,862 from a builder's quote, then he could ascertain the modal rate as follows:

$$MR = \frac{49,862}{S \times 1.1332}$$

$$MR = \frac{49,862}{110 \times 1.332}$$

$$MR = \frac{\$49,862}{124.652}$$

$$MR = \$400$$

The computer output from the modal house program is shown in Table 5.3.

Table 5.3:   Computer Output From Modal House Program

```
REPLACEMENT COST=49877.6
 REPLACEMENT COST PER M2=453.432728
 PERCENTAGE SIZE ADJ=.961136364
 TOTAL ADJUSTMENT FOR STATIC COSTS=763.2
 ADJUSTED STATIC COSTS PER M2=6.93818182
 TOTAL ADJ. FOR VARIABLE COSTS=.1551
 VARIABLE COST ADJ. PER M2=1.41E-03
```

A full listing of the questions that the program asks the valuer, together with the various options given to answer these questions, is shown in Appendix 3.

One of the criticisms that some valuers have of the multiples and multipliers approach to housing cost estimation is that they feel more comfortable using cash adjustments and that the building contractors that they deal with echo similar sentiments.   In some cases valuers need to be able to explain to builders why they consider the builder's price is too high.   This usually results in analysing the tender price out item by item.   The valuer will find it much easier to communicate with the builder on the basis of cash adjustments which is the method builders commonly use.   This difficulty can be overcome by simply getting the computer to print out the cash amounts for the adjustments, either individually or in total.

5.4   FINDING THE AREA

One of the first tasks in estimating the replacement cost of a building is to measure the outside dimensions of the building.   This is normally done by the valuer measuring the building with a tape measure and recording the measurements in a field note book.   The valuer may (should) check to see if the measurements on each side add up before completing the inspection.   Except for simple buildings, estimation of the floor area is usually completed by the valuer in the office.

Range finding devices that substitute for tape measures are available but appear to be seldom used by valuers in the measurement of buildings.   Range finding devices are likely to have more application for taking paddock measurements on the rural scene although they are not widely used by valuers as aerial photographs are usually available.

5.4.1   Computer Application

A computer program to estimate the area of an orthogonal polygon has been developed to run on an Apple II microcomputer.   This program is based on the work of M.J. Cooper (1981) who has developed a similar program to use on a programmable calculator.

The valuer chooses any corner of the building as a starting point and enters the direction and length of the first side of the building. The direction is defined as either north, south, east or west and the distance is entered in metres.

Several checks have been built into the program to help minimise the chance of errors.   The first of these checks is to see if the lengths for the opposite sides of the building add up.   If they do not add up then the program prints out an error message.   Similarly if an infeasible direction letter is entered then the user is asked to re-enter the letter.

Although the calculation of the area of a building is a relatively simple task it is surprising how often valuers make mistakes doing it. The computer can either be used as a check on, or a substitute for, the manual calculation.   In either case, potential time savings are available, particularly with more complex buildings.   While this particular program is limited to calculating orthogonal polygons, Cooper has developed a program to calculate the area of an irregular polygon.

The computer output shown in Table 5.4 is based on a hypothetical building of the dimensions shown in Figure 5.5.
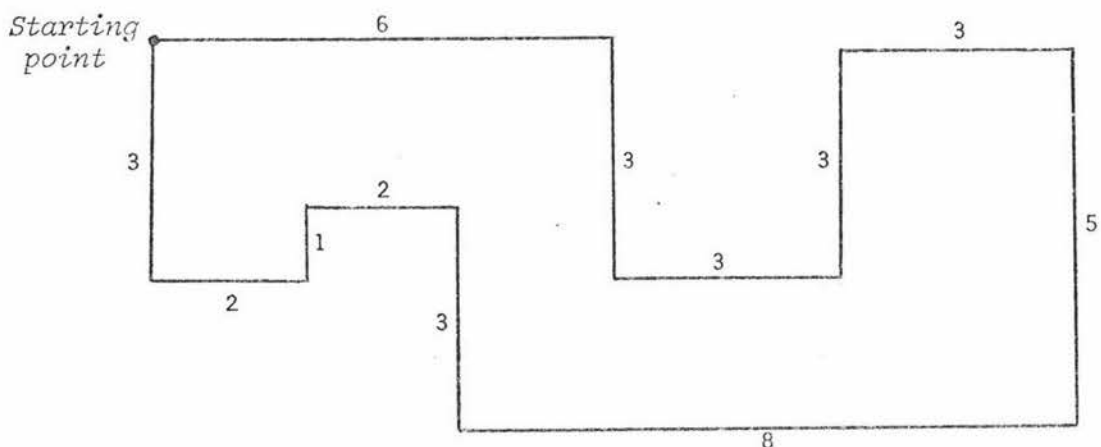
Figure 5.5:   Outline Plan of Hypothetical Building

Table 5.4:   Output From Area Measurement Program

AREA OF ORTHOGONAL POLYGON
==============================

ENTER DIRECTION --

    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?W

DISTANCE OF EDGE ? 6
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?S

DISTANCE OF EDGE ? 3
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?W

DISTANCE OF EDGE ? 3
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?N

DISTANCE OF EDGE ? 3
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?W

DISTANCE OF EDGE ? 3
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?S

DISTANCE OF EDGE ? 5
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
, ?E

DISTANCE OF EDGE ? 8
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?N

DISTANCE OF EDGE ? 3
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?E

DISTANCE OF EDGE ? 2
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?S

DISTANCE OF EDGE ? 1
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?1

DISTANCE OF EDGE ? 2
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?N

DISTANCE OF EDGE ? 3
    E - EAST
    W - WEST
    N - NORTH
    S - SOUTH
    C - CALCULATE AREA
?C

AREA OF ORTHOGONAL POLYGON
==============================

AREA IS 41

CHAPTER 6

SUMMARY AND CONCLUSIONS

New Zealand valuers appear to be 'followers' rather than 'leaders' in computer applications to the valuation process.   An examination of the current overseas literature in this area shows that valuers in the U.S.A. and United Kingdom seem to be several years ahead of New Zealand valuers in using computers as valuation tools.   Featherston (1980) initiated a section in 'The Appraisal Journal' called the *Computer Connection* to encourage United States valuers to exchange information on computer programs and equipment.   Articles in this section by Berry (1980), Dunn (1981) and Dorchester (1981) all give broad, and generally optimistic views on microcomputer applications for valuers. Dilmore has been prominent in supplying listings of computer programs with his articles.

A number of short articles on computer applications for valuers in the United Kingdom have begun to appear in the 'Chartered Surveyor' over the last two years.   Sawyer (1980) has written about computer selection decisions.   Yarwood (1980) described using microcomputers in agency work, and Farrington (1980) outlined a computerised property register.   To date, the New Zealand valuation literature does not reflect the same degree of interest in computer applications.

This dissertation has examined a number of computer applications to the three methods of valuation that are traditionally used by valuers. The main emphasis has been on computer applications to the comparable sales approach, with lesser emphasis on the income and cost approaches.

The majority of the valuation work that is done in New Zealand relies on the comparable sales method and this method requires up to date sales data.   The introduction of the microfiche sales system described in Chapter 2 has resulted in a considerable improvement in the speed that sales information is distributed to valuers.   There is still room for improvement, however, as in some cases it takes several

months for sales to be processed. The slowness of lawyers in notifying sales to the Valuation Department appears to be the main reason for the delay.

The incorporation of real estate listing information with the existing sales data base would help to overcome some of the present data limitations. Residential multiple listing information shows a number of features about the interior and exterior of houses that are likely to be important to buyers and are not shown on the microfiche. It is possible real estate agents could be encouraged to provide listing information to valuers on the basis that a credit was given for information provided, and that this could be offset against the cost of receiving sales information from the NZIV.

When implemented, the proposed Land Information System (LIS) will be of considerable assistance to valuers in many aspects of the data gathering part of the valuation process. However, given the current economic climate, the large scale of the proposed LIS system, and the technical difficulties with certain aspects of the project it appears unlikely to this author that such a system will become a reality for at least five years. In the interim the valuation profession should set up its own system of electronic transmission of data as valuers will fall behind other professions unless they begin to make use of this technology. Initially the data base would just be concerned with sales information. Later the building cost data presently contained in the NZIV Statistical Bureau publications could be added to the data base along with rental information, up to date information on real estate finance, and perhaps an index of recent court decisions relevant to valuers.

Two data base programs suitable for the storage and retrieval of sales information were described in Chapter 2. Neither of these programs is ideal for valuation purposes but they both perform sufficiently well to provide valuers with considerable potential time savings. The selection of a suitable data base program is one of the most important software purchase decisions that a valuer will make. The 'ideal' program should be: easy to learn to use, fully interactive, able to interface with other data analysis programs, to interface with

another computer through a modem, search both mathematical and
alphanumeric symbols, and to print out any desired set of sales data
using a minimum amount of paper.   This would mean that a valuer in
Auckland could telephone the NZIV computer in Wellington and obtain
all relevant sales information.   This information would then
automatically be added to the valuer's in house data base on a desk
top computer and printed out as required.

If the data base program does not meet the above specifications
the valuer may be faced with a considerable amount of extra expense in
having to transfer data between programs manually.   Experience at
Massey has shown that this exercise is almost certain to increase the
number of errors in the original data.   There is a large market for
data base programs as most computer users require such a program.
This means more efficient programs are likely to become available due
to the competition between software houses for this segment of the
computer program market.

Having a large amount of sales information on the computer makes
it more feasible for valuers to contemplate using MRA as a valuation
tool.   MRA is now within the capabilities of valuers outside the
Valuation Department, although in the author's opinion it is likely to
be some years before significant numbers of private valuers begin to
make serious use of MRA.   The reasons for this are two fold.   Firstly,
the present sales data base appears to be inadequate for all the classes
of properties analysed in Chapter 3.   The land use and rating valuation
information contained on the microfiche only explained about 75 per
cent of the variation in selling prices between properties and the
standard error was above 10 per cent of the average selling price.
While this level of accuracy may be a reasonable starting point for
a mass appraisal operation it is unlikely to be sufficiently precise
to justify the cost of developing regression equations for private
valuers faced with one off valuations.   The single family homes, and
home units analysed with MRA were all relatively homogeneous groupings
and it is very likely that the results would have been less acceptable
with more heteregenous properties such as high cost housing.
Secondly, most busy private valuers are unlikely to be prepared to
devote the amount of time that is required to develop useful equations,

to understand the equations, and feel comfortable with the MRA methodology.

One of the interesting points that emerged from this MRA study was that the asking prices of properties were highly significant in predicting the selling prices for the period studied. Asking price information is an area which warrants further study over a longer period, as the data used was mostly from the second half of 1981 when the market was moving up rapidly. It would be possible to use computers to constantly monitor the relationship between asking prices and selling prices, for both individual properties and for various classes of properties. Asking price appeared to adjust rapidly to changes in the market conditions during the second half of 1981. It is possible that time adjustments to historical sales information will be able to be improved if asking price information is incorporated into the analysis. For example, if the sales projections indicated a level of prices that was greater than the current asking prices for a particular type of property then the projection would clearly be unreliable.

Another possibility in the application of MRA would be for the NZIV to negotiate access to the MRA data that is being collected by the Valuation Department. It is probable that the addition of these variables would improve the predictive ability of the regression equations.

This study confirms earlier work showing that the existing government rating valuation is usually the single most important factor (apart from listing price) in predicting the selling price of a property.

Given the difficulties that have been outlined in applying MRA to the valuation process it seems more likely that valuers will begin to use computer programs to analyse sales information in much the same way that they are currently analysing the information manually.

The net rate analysis program described in Chapter 2 follows the same step by step process that a valuer uses manually. The computer assists by speeding up the process and providing the valuer with a printed copy. The results of the analysis are very dependent on the

validity of the assumptions that the computer program has been provided with. The valuer is likely to be encouraged to retest several of the key assumptions because the computer enables this to be done very rapidly. It is felt that the net rate analysis program is one that some valuers are likely to make use of soon after they adopt computer technology. The reason for this is the obvious immediate time saving that can be achieved. The rural sales analysis program which formed the basis for the net rate program is now being successfully used by a practising South Island rural valuer.

The analysis of vacant land sales is another promising area for computer analysis. The area adjustments program described in Chapter 2 offers the valuer a useful tool that can be used to adjust sales information that might otherwise be excluded from a sales analysis because of lack of size comparability with the subject property. The computer programs in this area are very much at the pioneering stage since valuers are still learning to use the power of computers to mathematically explain size/price relationships.

The impact of this type of computer analysis is likely to be greatest in the valuation of urban land types where the valuer currently uses depth tables to adjust the price per metre of frontage. In addition to being able to write computer programs that will output depth table information for any given depth, it is possible to use computers to search out the best depth curve to fit any set of sales information. Not only does this offer valuers potential time savings, but it also means that valuers are less likely to slavishly adopt one of the existing depth tables. This type of development is unlikely to occur until there is much more detailed information available on the micro-fiche sales system about section sales.

A number of computerised applications to the income approach to valuation were discussed in Chapter 4. All of these approaches are variations on the basic discounted cash flow model that has long been advocated by economists as a useful valuation tool. The capitalisation of income approach, which is favoured by many valuers, is discussed in the context of discounted cash flow analysis.

The computer programming requirements for the generalised discounted cash flow approach to valuation are relatively straight-forward since all the programs are based on one or more of six simple equations derived from the compound interest formula.   The computer programming requirements become more complex when a program is written that completely automates a specific existing valuation procedure. In such cases the computer has to be programmed to ask all the relevant questions about the cash inflows and cash outflows associated with the project.   This information then has to be put into a series of income and expenditure statements for each time period that is under consideration, and the net income discounted at the appropriate rate.

Two computer programs have been developed to automate the mechanical calculations involved in the property residual method of valuation.   In addition to being used as a teaching program at Massey the hypothetical subdivisional development program described in Chapter 4 is now being used by a practising North Island valuer.   The main advantage with these automated procedures is that the computer makes it very easy to quickly change the assumptions and recalculate.   In addition, the valuer can incorporate the computer output directly into the report to the client, provided a suitable quality printer is used.

To remain competitive in the business environment, valuers have to strictly budget their time.   The time consuming nature of the conventional manual approach to discounted cash flows has generally meant that it has been uneconomic for valuers to use this approach.   This position may change when the automated income and expenditure programs described in Chapter 4 are combined with discounting programs since considerable time savings can be achieved.

Probably the most important aspect of computer assisted income valuations is the potential it offers valuers to become more involved in the area of investment analysis and consulting.   Graaskamp (1978) argued that conventional valuations that provide the client with a single point estimation of market value at a given time are becoming increasingly irrelevant in the modern business world.   As well as knowing what the property is likely to sell for, the sophsticated investor is likely to want to know how much he can afford to pay for the

property and achieve a given rate of return under a particular set of financing and taxation assumptions.   In addition, the client may need information about the current, and projected future, highest and best use of a site.

Valuers are often in a very good position to provide the answers to these types of questions but this work is increasingly being done by laywers, accountants, real estate agents, and property consultants because they are providing the clients with the information that they want and not with a standard report simply giving the physical details and market value of the property.   In the past, valuers have been able to offer a unique service based on their knowledge, experience and the information locked up in their filing cabinets in the form of previous reports.   The computer revolution has begun to unlock the valuer's filing cabinets in the sense that the valuer no longer has a monopoly over most of the information needed to do a valuation. With sales information now more readily available, it is possible that MRA could be used by a lending institution such as a bank, to predict the value of properties within an acceptable range.   Low level staff could furnish a report on the physical condition of a property. This whole process could be completed without reference to a registered valuer, and probably will be unless valuers can offer a better service themselves.

Computer programs that are designed to answer the individual property investor's questions are becoming increasingly available. The real estate adaptations of the 'Visicalc' program described in section 4.9 are a powerful valuation tool that can be used to answer the 'what if' question for investors.   The marginal analysis program described in section 4.11 is another example of a computer assisted valuation technique that is oriented towards investment analysis.   This program automates the step by step procedure used when considering an optimum site development.

In making a mortgage recommendation on a rural property the valuer is not only concerned with the security offered but he is often more concerned with the ability of the mortgagor to service the proposed loan.

Working out debt servicing ability involves a budgeting exercise.
The calculation becomes complicated when the amount available for
debt servicing depends on the amount of tax that has to be paid which
in turn depends on the mortgage payments.   Solving this problem by
manual calculations is slow because it involves a trial and error
process until the amount available for debt servicing is matched up with
the amount required for a given loan recommendation.   A computer program
to solve this problem is described in section 4.10.   This program can
save valuers significant amounts of time.

Two computer programs that can be used to estimate the replacement
cost of buildings are described in Chapter 5.   Both of these programs
utilize costing procedures based on the NZIV modal house.   There is
likely to be a significant expansion in the computer programs that
estimate building cost information as other professions begin to use
computer techniques.   Quantity surveyors, architects and engineers
all need building cost information, and it is likely that New Zealand
valuers may be able to follow the example of overseas counterparts and
utilize programs developed for other professionals associated with
buildings.

An area that warrants further research is the expansion of the
present modal house concept to include a superior modal house.   There
are significant difficulties in applying the existing modal approach
to expensive housing because of the large number of adjustments necessary.
The NZIV have previously done some development work on superior modals.
This information now requires an updated set of plans and specifications
based on current building technology.

Computer assisted valuation procedures in the replacement cost
area are likely to have an immediate effect on replacement cost
estimations for insurance and current cost accounting purposes.   This
type of work is now a significant part of urban valuation practice.

There is a danger in suggesting possible computer applications
to valuation in isolation from the valuers that are likely to use these
methods as some valuers may consider many of the computer uses described
in this thesis are highly impractical.   A survey by Hargreaves (1982)
showed that less than 20 valuation organisations in New Zealand were

using computers for valuation purposes. Valuers were using computers mainly for the storage and retrieval of sales data, word processing, the analysis of sales data, accounting, and estimating the replacement cost of buildings. The survey revealed that a further 66 valuation firms were planning to use computers in their work within three years.

The NZIV has a major opportunity to bring the valuation profession into the computer age by establishing a system that would enable sales data to be supplied to members electronically. The survey showed that the majority of the organisations surveyed were definitely very interested in such an idea. The most feasible option appears to be for the NZIV to obtain access to computing facilities. There are major potential advantages in a centralised and co-ordinated approach. Considerable overall cost savings are possible if one computer is used as the main data base. Duplication in programming costs is also likely to be minimised by this approach.

At the present time all the valuers that are using computers for storing sales information have to keypunch the data from the micro-fiche back into their own computers. This is because of NZIV reluctance to release the computer tapes containing the sales information. Cost savings for valuers and an improvement in the accuracy of the information will be achieved if the additional key punching step can be eliminated. The potential cost savings should justify the acquisition of computing facilities by the NZIV at an early date. The success achieved by the SREA sales data bank in North America and other data banks such as 'Educare', which is based at the University of Wisconsin, illustrate the benefits that valuers can achieve by pooling resources.

Computer technology has been changing very rapidly over the last three years and the early adopters of this technology have had to pay a price in that their equipment has rapidly become obsolete. The AIREA (1981) survey of a group of U.S. computer users indicated that the average life of the computer systems used was less than two years. It is very difficult to predict if the future rate of change in computer technology will continue at the same pace, but the indications are that the rate of change will slow down.

In any case, the future rate of technological change may not be particularly relevant to New Zealand valuers since the capacity of the current generation of computers is more than adequate for most valuation related uses. It is really the question of the capital cost of a computer system versus the existing labour costs of a manual system, that is likely to influence the buying decisions of most valuers in New Zealand. In addition to the actual cost of the computer equipment and the programming costs, valuers are also faced with the costs of learning to use the new system while maintaining existing manual systems.

The NZIV can play a key role in coordinating the development of new computer software for New Zealand valuation practice. Given the relative smallness of the valuation profession in New Zealand, the market for valuation orientated computer programs is unlikely to be particularly profitable for either professional computer programmers or 'amateur' valuer programmers. To avoid duplication in programming effort there are likely to be advantages if the NZIV have key programs written on contract. These programs could be sold to members at cost. For example, a replacement cost valuation program based on the modal house is likely to require an updating every few months as the multiples and multipliers used in the program are likely to change. It would probably be uneconomic for most private valuers to undertake the research necessary to keep the model up to date but it would be important for the Housing Corporation to keep the program up to date on a regional basis. In this case the Housing Corporation could be given a credit for information supplied that could be offset against the costs of belonging to the system.

Computer assisted valuation methods present some very real human problems for the current generation of valuers who have become accustomed to using conventional methods. Despite what the advertisements for computers say, it is the author's experience that a considerable investment of time is required to learn how to use computers and to be confident about using them. Perhaps the greatest human difficulty for many valuers in adopting computer methods is that there is a very real fear that computers will somehow take over the

traditional role of the valuer and that the valuer will be reduced to the role of a data gatherer.   This attitude has probably resulted from over enthusiastic statements regarding the benefits of computers, particularly in the area of mass appraisal.   Education and experience can help to overcome these human difficulties and this takes time. There are likely to be real dangers in attempting to impose a computer system on valuers that are not ready for it.   Valuers in New Zealand are likely to be most attracted to a simple, foolproof system that begins by automating existing valuation procedures and that can be extended to more complex analysis if this is required later.

The computer uses discussed in this dissertation have been confined to applications to the three main valuation approaches and only scratch the surface of potential valuation related uses.   The potential uses for computers in valuation may ultimately only be limited by the imagination of the users.

If overseas trends are followed in New Zealand then word processing and computer graphics will be important future computer uses.   As soon as valuers have equipment to access sales data from a centralised data base they will also be able to access other data bases both in New Zealand and overseas.

MARKET DATA CENTER INC

SINGLE FAMILY RESIDENTIAL SALES DATA

COUNTY: SANTA CLARA

MAP CODE / CITY / CENSUS TRACT	PROPERTY ADDRESS / UNIT	$ SALE PRICE	TYPE	CASH DOWN	% 1ST MTG	SALE DATE MO/YR	SALE CLOSED	LOT SIZE OR AREA	FLOOD	OBSOLESCENCE	HS WATER	STYLE	STORIES	FLOOR PLAN	COND QUALITY	YEAR BUILT	ROOMS	BDRMS	OTHER ROOMS	BATHS FULL	HALF	SQ.FT. LIVING AREA	BSMT AREA	FINISH	A/C PARKING	POOL	FIREPLACE	EQUIPMENT	REMODELED	OTHER IMP	HEATING	FUEL	EXT TYPE CONSTR WALLS	ROOF	FLOORING	AMENITIES	LEASEHOLD	TYPE OWNER	TYPE IMP
63 -D2	2599 VISTA VERDE	49,200	F			8-76	Y	6,050			PP				G	67	8	4		2		1,849	C		A2			R			A	G	F C	C	C				S T
63 -D3	3144 PEANUT BRITTLE	45,000	C	10%	80%	12-76	Y	6,000	RN	N	PP	RNC	1	A	AF	74	7	4	FR	2		1,364	C		A2	1		RDG			A	G	F S	C	C				S T
63 -D4	3050 LYNVIEW DR	45,900	F			9-76	Y	6,136			PP				G	67	7	4		2		1,504	C		A2			RD			A	G	F C	C	C				S T
	3009 STEVENS LN	41,600	C	10%	89%	11-76	Y	6,000	RN	N	PP	RNC		G	AG	70	6	4		2		1,480	00	00	B2	1		RDG			A	G	F S	X	W			P	S
	TAFFY CT	44,500	F			10-76	Y	6,000			PP		1		G	62	6	4		2		1,554	C		A2	1		RD			A	G	F C	C	C				S
2920 S WHITE RD	55,900	C	20%	80%	10-76	Y	7,373	RY	N	PP	RNC		A	AE	76	8	4	FR+DR	2		1,547	C		A2	1		RDG	FD		A	G	F S	X	C				S
63 -D5	2834 WESTBRANCH DR	46,200	F			9-76	Y	7,000			PP				G	73	6	4		2		1,469	C		L A2			RD			A	G	F C		C				S T
63 -D6	3446 ANNANDALE PL	46,900	F			10-76	Y	6,500			PP		1		G	73	6	4		2		1,336	C		L A2	1		RD			A	G	F C		C				S T
	3628 TANKERLAND CT	7,900	O	48%	83%	1-77	Y	6,835	RN		PP	RNC	1	G	A	73	4	2		2		989	C		A2	0		RDG	PF		A	G	F S	C	C				S
63 -E3	3211 SIMBERLAN DR	57,300	C	79%	20%	8-76	Y	7,000	RN	N	PP		2	G	GG	76	8	3	FR+DR+OT	2	1	1,788			A2	1		RDG			A	G	F S	X	C				S
63 -E4	3064 AUTUMNWOOD CT	60,800	C	20%	80%	8-76	Y	7,200	RN	N	PP	RNC	3S	A	AG	76	7	3	FR+DR+AT	2	1	1,783	S		A2	1		RDG	FL		A	G	F S	X	C				S
	3072 AUTUMNWOOD CT	70,100	C	19%	80%	9-76	Y	7,200	RN	N	PP	RNC	2	A	AG	76	7	5	FR+DR+AT	3		2,432	C		A2	1		RDG	FL		A	G	F S	T	C				S
	3083 OLDWOOD CT	60,400	C	10%	90%	10-76	Y	7,732	RN	N	PP	RNC	1	A	AG	76	8	4	FR+DR+AT	2	1	1,729	C		A2	1		RDG	F		A	G	F S	X	C				S
63 -E6	3087 OLDWOOD CT	54,900	C	20%	80%	4-76	Y	7,755	RN	N	PP	RNC	1	A	AG	76	7	3	FR+DR+AT	2		1,538	C		A2	1		RDG	F		A	G	F S	X	C				S
63 -F6	4112 AMOS WY	59,100	C	19%	80%	10-76	Y	76X106	RN	N	PP	RNC		A	AE	76	8	4	FR+DR	2		1,786	C		A2	1		RDG	F		A	G	F S	X	C				S
	4089 LAWTHER CT	78,000	C	20%	80%	10-76	Y	9,458	RN	N	PP	RNC	1+	G	GG	76	9	4	FR+DR+OT	2	1	2,280	C		B2	2		RDG	FL		A	G	F S	X	C				S
	3107 MOSSHALL WY	63,100	C	19%	80%	10-76	Y	8,680	RN	N	PP	RNC	3S	A	AG	76	8	4	FR+DR+AT	2	1	1,938	C		A2	1		RDG	FL		A	G	F S	X	C				S
	3123 MOSSHALL WY	59,700	C	10%	90%	8-76	N	1,780	RN	N	PP	RNC	1	G	GG	76	8	4	FR+DR	2	1	1,780	C		A2	1		RDG			A	G	F S	X	C				S
	3131 MOSSHALL WY	64,900	C	29%	70%	10-76	Y	70X120	RN	V	PP	RNC	2	G	GG	77	9	5	FR+DR	2	1	2,267	C		A2	1		RDG	FL		A	G	F S	X	C				S
	3054 OLDFIELD WY	55,900	C	20%	80%	11-76	Y	8,040	RN	N	PP	RNC	1	A	AG	76	6	3	FR+AT	2		1,590	C		A2	1		RDG	PF		A	G	F S	X	C				S
	3108 OLDFIELD WY	54,700	C	10%	90%	11-76	Y	72X110	RY	V	PP	RNC	1	G	GE	76	6	3	FR	2		1,545	C		A2	1		RDG	F		A	G	F S	X	C				S
	3120 PANMURE CT	66,500	C	24%	75%	1-76	Y	104X104	RN	N	PP	RNC	2	G	GE		9	5	FR+DR	2	1	2,267	C		A2	1		RDG	FL		A	G	F S	X	C				S
	3199 STIMSON WY	57,900	C	34%	65%	1-77	N	6,500	RN	N	PP	RNC	1	A	AA	77	8	4	FR+DR	2		1,805	C		A2	1		RDG			A	G	F S	X	C				S
	3230 STIMSON WY	61,300	C	9%	90%	1-77	N	71X113	RN	V	PP	RNC	1	G	GE	76	8	4	FR+DR	2		1,782	C		C A2	1		RDG			A	G	F S	X	C				S
	3236 STIMSON WY	65,500	C	26%	73%	9-76	Y	71X113	RN	V	PP	RNC	1+	G	GE	77	8	4	FR+DR	2	1	1,938	C		A2	2		RDG	FL		A	G	F S	X	C				S
64 -D5	21970 VIA REGINA	104,000	C	20%	80%	11-76	Y	1.00	RN	V	N PP	RNC	1	G	AA	56	8	3	DN+FR+DR	3		2,714	00	00	A2	1		RDG			E	E	F S	Q	H				S
64 -E1	7967 FOLKESTONE AV	91,700	C	19%	80%	1-77	N	1.00	RN		PP	RNC	1	A	AGG	67	8	4	FR+DR	2		1,877	C		A2	1		RDG	FL		A	G	F S	X	C				S
64 -E6	21271 GLENMONT DR	155,000	C	21%	71%	12-76	Y	25,000	RN	VHN	PP	HRN	2	G	GG	75	9	4	DN+FR+DR	2	1	3,152	C		A2	2		RDG	PF		A	E	F L	X	C				S
64 -F2	1652 BROOKVALE DR	42,500	C	9%	89%	12-76	Y	982	RN	N	PP	CON	1+	G	GG	73	5	2	DR	1	1	982	S		B1	H		RDG			A	G	F S	X	C	CP	C		T
	20809 MAUREEN WY	120,000	C	29%	70%	10-76	Y	13,900	RN	N	PP		1	G	G	68	8	2	FR	2	1	2,524	C		A2			RDG			A	G	F S	X	C				S
64 -F6	20661 5 ST	55,000	C	39%	60%	1-77	Y	60X140	RN	N	PP	BUN	1	A	FF	20	4	2		1		682	C		D1						H	G	K L	C	C				S
	20760 FOURTH ST 10	45,000	C	10%	90%	10-76	Y	917	RN	N	PP	HRN	2	G	GG	71	4	2		1	1	917	C		D1	1		RDG	FD		A	G	F S	X	C	S+	C		R
65 -A1	6591 HANOVER	63,000	C	38%	62%	10-76	Y	6,720	RN	N	PP	RNC	1	G	AG	61	8	4	FR+DR	2	1	1,475			A2	1		RDG	PF		A	G	F S	W	C				S
65 -A2	1679 ARDENHOOD	59,000	C	10%	90%	12-76	N	55X132	RN	N	PP	RNC	1	A	AG	60	6	3	FR	2		1,291	C		A2	1		RDG	P		A	G	F S	C	H				S
	1586 S BLANEY AV	57,900	C	10%	90%	8-76	Y	61X103	RN	N	PP	RNC	1	G	AG	57	5	3		2		1,400	C		A2	1		RDG			A	G	F S	W	C				S
	1613 S BLANEY AV	58,000	C	20%	80%	1-77	Y	60X103	RN	N	PP	RNC	1	G	GA	58	5	3		2		1,389	C		A2	1		RDG	PF		A	G	F S	X	C				S
65 -A3	12715 FREDERICKSBURG	140,200	C	79%	20%	10-76	Y	12,800	RN	N	PP			G	GG	66	9	4	DN+FR+DR	2	1	2,630			E3	P	1	RDG	P		A	G	F S	X	C				S
65 -A5	14031 SHADOW OAKS WY	126,500	C	60%	39%	4-76	Y	21,000	RN	N	PP			G	GG	55	9	4	FR+DR	2	1	2,740	C		A2	H 2		RDG	F		A	G	F S	X	H				S
65 -B2	6448 IVY LN	61,500	C	20%	80%	12-76	Y	6,016	RN	N	PP	CON		G	AG	62	8	4	FR+DR+AT	1	1	1,560	C		C A2	1		RDG			A	G	F S	X	C				S
	19661 LADERA CT	120,000	C	66%	33%	8-76	Y	12,000	RN	N	PP			G	GG	65	9	4	DN+FR+DR	2	1	2,811	C		A3	2		RDG	PF		A	G	F S	X	C				S
65 -B3	12198 MILLER AV	118,900	C	32%	67%	1-77	Y	12,000	RN	N	PP	RNC		G	GG	65	7	4	DR	2	1	2,038	C		A2	H	1	RDG	FL		A	E	F S	X	H				S
65 -B4	19682 SOLANA DR	125,000	C	49%	50%	1-77	N	90X120	RN	N	PP	HRN		G	GE	72	10	5	DN+FR+DR	3		2,737	C		A2	2		RDG	FL		A	E	F S	X	H				S
65 -C2	19329 VIA CRECENTE CT	126,000	C	20%	79%	1-77	N	13,824	RN	N	PP	RNC		G	GG	69	8	4	FR+DR+EP	3	1	2,354	C		A2	H 2		RDG	PF		A	G	F L	X	C				S
	12550 BROOKGLEN DR	113,500	C			8-76	Y	16,242	RN	N	PP			G	GG	62	8	4	FR+DR	2	1	2,116	00	00	A2	P 2		RDG	PF		A	G	F L	X	C				S
	18941 SUNNYBROOK CT	109,000	C	20%	79%	1-77	N	16,000	R	H		RNC		G	GE	57	9	4	DN+FR+DR	2	1	2,169			A3	H	1	RDG	X		A	G	F S	X	C				S
65 -C3	18677 COX AV	58,900	C	18%	74%	12-76	Y	88X135	RN	N	PP	BUN	1	A	AG	51	5	2	DR	2		1,265	S		A2	H		H	FL		H	G	F S	G	C				S
65 -C4	18732 WOOD DELL CT	127,000	C	25%	74%	12-76	N	11,000	RN	N	PP	RNC		G	GG	74	7	3	FR+DR	3		2,529	C		A2	H 2		RDG	PF		A	G	F S	X	C				S
	19058 BONNET WY	108,000	C	20%	80%	1-77	N	10,284	RN	N	PP	RNC		G	GG	75	8	4	FR+DR	2	1	2,209			A2	1		RDG			A	G	F S	X	H				S
65 -C5	19539 VINEYARD LN	83,900	C	22%	77%	1-77	N		RN	N	PP	HRN	2	G	GG	74	5	2	DN	2	1	1,783	S		B3	1		RDG	F		A	G	F S	H	C	CP	P		T
	13750 HARLEIGH CT	137,000	C	30%	69%	1-77	N	17,000	RN	N	PP	RNC	1	G	GG	62	8	4	FR+DR	2	1	2,367	C		B3	1		RDG	F		A	G	F S	X	C				S
65 -D1	5281 FOREST CREEK CT	65,000	C	15%	84%	11-76	Y	12,384	RN	N	PP	RNC	1	G	GG	63	6	3		2	1	1,529	C		A2	1		RDG			A	G	F S	X	C				S
	5094 GOLDEN DR	91,000	C	20%	80%	10-76	Y	15,000	RN	N	PP	RNC	1	G	G	59	6	3	DR	2		1,546	C		A2	1		RDG			A	G	F S	X	C				S
	5181 LASSEN AV	61,000	C	20%	80%	1-77	N	75X 94	RN	N	PP	RNC	1	A	AA	59	6	4		2		1,436	C		A2	1		RGH	F		A	G	F S	X	H				S
65 -D3	5226 RHONDA DR	78,000	C	29%	70%	1-77	Y	8,375	RN	N	PP	RNC	1	G	GE	59	6	3	FR+EP	2		1,794	C		A2	2		RDG	PL		A	G	F S	X	C				S
65 -D4	5150 SHALEN CT	60,000	C	20%	80%	12-76	Y	7,000	RN	N	PP	RNC	1	G	AG	60	6	4	FR	2		1,233	C		A2	1		RDG			A	G	F C	C	C				S
	2427 GRANDBY DR	88,800	F			10-76	Y	6,264			PP				G	60	6	4		2		1,302	C		A2	1		R			A	G	F C	C	C				S T
	5068 KINGSTON WY	58,000	C	20%	80%	11-76	Y	7,000	RN	N	PP	RNC	1	G	AG	61	7	4	FR	2		1,687	C		A2	1		RGH	A	F	A	G	F C	C	C				S
65 -D5	4874 HORDEN DR	44,000	C	10%	90%	6-76	Y	75X100	RN	N	PP	CON	1	A	AA	59	6	3		2		1,195	C		B2	1		RH			H	G	F S	X	W				S
	5272 YORKTON WY	50,000	C	10%	89%	12-76	Y	62X 97	RN	N	PP	CON	1	A	AA	50	5	3		2		1,039	C		A2	0		RDG	C		A	G	F S	C	H				S
	5006 PEACH TE	48,000	C	10%	89%	12-76	N	1,225	RN	N	PP	RNC	2	A	AG	73	5	3		2		1,225	S		C1	H		RDG			A	G	F S	C	C				S
	4940 POPLAR TE	40,500	C	9%	90%	9-76	Y	8.60	RN	N	PP	RNC	1+	G	AG	73	5	3		2		1,187	S		C1	H		RDG			A	G	F S	X	C	CP	C		S
65 -D6	5104 WESTMONT AV	45,000	C	24%	74%	12-76	Y	850	RN	N	PP	MED	2	A	AG	68	4	2		2	1	1,088	C		B1	H		RDG	F		A	R	E S	X	C	CP	P		R
	107 ALTURA VISTA	83,900	C	18%	81%	5-76	Y		RN	N	PP		2	G	GG	76	7	3	FR+DR+OT	2	1	2,200			A2	H 2		RDG	F		A	G	F L	H	C	P			S
	149 ALTURA VISTA 10	87,900	C	28%	73%	8-76	N		RN	N	PP	CON	1	G	GG	76	7	3	DN+DR	2	1	2,266	C		A2	H 2		RDG			A	G	F L	G	C	P			R
	151 ALTURA VISTA	91,100	C	19%	80%	8-76	N		RN	N	PP	CON	2	G	GG	76	7	3	DN+DR	2	1	2,266	C		A2	H 2		RDG	D		A	G	F L	G	C	C+			R
	153 ALTURA VISTA	88,900	C	20%	80%	7-76	N		RN	VLN	PP	CON	2	G	GG	76	7	3	DN+DR	2	1	2,266	S	U	A2	H 2		RDG			A	G	F L	G	C	C+			R
	119 CALLE NIVEL	72,000	C	10%	90%	11-76	Y	3,500	RN	V	N PP	MED	2	G	GE	75	6	3	FR	2	1	717	C		C A2	1		RDG	FD		A	G	F S	X	C	S+			R
	231 MORE AV	86,000	C	58%	41%	11-76	Y	75X112	RN	N	PP	RNC	1+	G	GG	67	7	4	FR	2	1	1,824	C		B2	H	1	RDG	PF		A	G	F S	X	C	P			R
	117 VISTA DEL LAGO	66,900	C	44%	55%	8-76	Y	1,584	RN	N	PP	RNC	2	G	GG	76	5	2	DN	2		1,375	C		D2	H	1	RDG	LD		A	G	F S	T	C	SP			R
65 -E1	1357 GARRANS DR	50,000	C	10%	80%	1-77	Y	8,470	RN	N	PP	RNC	1	G	AG	58	5	3		2		1,322	S		A2	0		RG	PF		A	G	F S	X	C				S
65 -E2	4144 MORELAND WY	43,800	C	22%	77%	1-77	Y	81X125	RN	N	PP	CON	1	A	AG	48	6	3		2		1,702	S		C1	1		RG	PF		H	R	G F	G	C				S
65 -E3	4668 MOSSBROOK CR	69,300	C	20%	79%	12-76	Y	10X560	RN	N	PP	CON	1	A	AG	63	8	3	FR	2		1,747	C		L A2	1		RDG		H	H	R	G F	B	C				S
	2888 DEL LOMA DR	53,000	C	43%	56%	12-76	N	60X100	RN	N	PP	RNC	1	A	AA	63	6	3	FR	2	1	1,204	C		A2	1		RDG	F		A	G	F X	X	C				S
	1703 PALO SANTO DR	56,900	C	9%	80%	12-76	Y	60X100	RN	N	PP	RNC	1	A	AA	58	5	3	FR	2		1,372	C		A2	2		RDG	F		A	G	F X	X	C				S
	2182 HESTON DR	50,000	C	15%	80%	11-76	Y	6,000	RN		PP	RNC	1	A	AA	59	5	3		2		1,128	C		A2	1		RGH			A	G	F S	C	H				S
65 -E4	2249 DORVAL DR	50,500	F			8-76	Y	6,104	RN		PP		1	G	G	60	7	3		2		1,490	C		A2	1		R			A	G	F C	C	C				S T
	4653 LAGE DR	44,200	C	20%	79%	1-77	Y	56X107	RN	N	PP	BUN	1	G	A	61	5	3		2		1,167	E	C	UA	G		RGH			A	G	F S	C	C				S

** THE ABOVE DATA BELIEVED TO BE RELIABLE BUT ACCURACY IS NOT GUARANTEED

-- 27 --   NORTHERN CALIFORNIA

063 -D2 / 065 -E4

APPENDIX 1 — SREA SALES DATA

154.

APPENDIX 2

OPERATING PROCEDURES FOR NET RATE PROGRAM

The operating procedures for the Net Rate Analysis Program are shown in Figure A2.1 below.

```
ENTER APPROPRIATE LETTER
        L - LOAD PREVIOUS DATA SET
        N - CREATE NEW DATA SET
        F - CHANGE CURRENT DATA SET
        D - DISPLAY CURRENT DATA BASE
        S - SAVE CURRENT DATA SET
        C - CREATE WORKING SET
        A - ALTER WORKING SET
        P - PERFORM CALC.ON WORKING SET
        V - VIEW WORKING SET
        R - REMOVE A DATA SET
        E - END
```

Figure A2.1:   Program 'Menu'

N - Create New Data Set

Assuming that the data for this analysis has not previously been entered into the computer, the user will type in 'N' and then will be asked to provide information on the features shown in Figure A2.2 for the property.   In addition, each sale has to be identified in some way.   In many cases it will be convenient to use the street address or assessment number.

```
FEATURES ARE -

   MONTH
   YEAR
   AREA (HA)
   SALE PRICE
   CAPITAL VALUE
   LAND VALUE
   HOUSE SIZE (M*M)
   OTHER IMPROVEMENTS ($)
   OTHER IMPROVEMENTS AT SALE ($)
   EST.LAND VALUE AT SALE

EXTRA FEATURES TO BE ADDED (Y/N) ? N

NOW ENTERING SALES
```

Figure A2.2:   Details of Input Data

The first seven features in Figure A2.2 can be taken directly from the New Zealand Institute of Valuers sales lists.   The feature 'other improvements' refers to the value of the improvements excluding the house at the time of the last roll value.   This feature would not normally be available to valuers outside the Valuation Department and would need to be estimated.   Similarly the value of other improvements at sale and the land value at sale would need to be estimated by the valuer.

The program also has the capacity to add additional features that the valuer may wish to analyse.

L - Load a Previous Data Set

Sales data that has previously been entered into the computer on the program disc is recalled.   The program has the capacity to store up to 20 sales in a data set and can store a number of data sets. Figure A2.3 shows an example listing several different sets of data.

In this case the analyst has pressed '1' to recall the Palmerston North data.

```
ENTER NUMBER TO CHOOSE DATA SET

0   ENTER OWN DATA SET
1   PN TEST
2   TEST URBAN
3   TESTR6 PN
```

Figure A2.3:   Load Previous Data Set

D - Display Current Data Base

    The valuer may not remember exactly what sales are filed in a data set and before going on with the calculations he may wish to view the data set.   The program has the capacity to display on the screen or to print out, both individually and collectively, all the sales in a data set.   Figure A2.4 shows the data from one of the sales in the case example.

```
SALE 1 IDENT 1

          SALE
MNTH YR PRICE    AREA
3    81 64500    .0754

          VALUE
CAPITAL  LAND    IMPROVEMENTS
53000    14500   7500

HOUSE SIZE (M*M) 145

OTHER IMPROVEMENTS AT SALE ($) 8600

EST.LAND VALUE AT SALE 15500
```

Figure A2.4:   Displaying Current Data Base

C - Create a Working Set

Having either created a new data set or recalled an existing data set the analyst then needs to decide if all the sales from the data are required in the analysis. Any number of sales within a given data set can be analysed. The analyst will try to use a reasonable number of sales so that there is more confidence in the final result.

F - Change a Data Set

This program sub-routine gives the user the ability to add to or delete from the data set and, perhaps more importantly, to change existing sales information. Figure A2.5 shows an example where the user has decided to change feature no. 10 being the estimated land value at sale. Once the valuer is satisfied there are no more required changes he types in '0'.

S - Save Current Data Base

This sub-routine is normally used when a new set of data has been entered and the valuer wishes to save the information on disc. The user is required to specify a name for the data set.

R - Remove a Data Set

Sales information is likely to become out of date over time and no longer useful when estimating market value. By typing in 'R' and specifying the number of the data set, this data set is then erased from the disc. This sub-routine is shown in Figure A2.6.

```
ENTER A - ADD TO DATA SET
        D - DELETE FROM DATA SET
        C - CHANGE SALE INFORMATION
        F - FINISHED?C

ENTER NO.OF SALE TO CHANGE (0 IF DON'T  KNOW ) 1

ENTER FIELD TO CHANGE-CHANGING ID 1

0 - NO CHANGE
1 - MONTH                          3
2 - YEAR                           81
3 - AREA (HA)                      .0754
4 - SALE PRICE                     64500
5 - CAPITAL VALUE                  53000
6 - LAND VALUE                     14500
7 - HOUSE SIZE (M*M)               145
8 - OTHER IMPROVEMENTS ($)         7500
9 - OTHER IMPROVEMENTS AT SALE ($)8600
10 - EST.LAND VALUE AT SALE        15500
?10


CHANGING EST.LAND VALUE AT SALE -CURRENTLY 15500

NEW VALUE ? 15900

ENTER FIELD TO CHANGE-CHANGING ID 1

0 - NO CHANGE
1 - MONTH                          3
2 - YEAR                           81
3 - AREA (HA)                      .0754
4 - SALE PRICE                     64500
5 - CAPITAL VALUE                  53000
6 - LAND VALUE                     14500
7 - HOUSE SIZE (M*M)               145
8 - OTHER IMPROVEMENTS ($)         7500
9 - OTHER IMPROVEMENTS AT SALE ($)8600
10 - EST.LAND VALUE AT SALE        15900
?10
```

Figure A2.5:   Changing a Data Set

```
        ENTER NUMBER TO CHOOSE DATA SET

        1   FN TEST
        2   TEST URBAN
        3   TESTR6 FN


        ?2

        ARE YOU SURE YOU WISH TO DELETE
                TEST URBAN (Y/N) ? ?N
```

Figure A2.6:   Removing a Data Set

V - View Working Set

This sub-routine simply allows the user to display the data that has been put into the working set on either the screen or printer.

A - Alter Working Set

Once the data is moved from a data set to a working set sub-routine 'F' cannot be used to make alterations to the sales used in the analysis.   This sub-routine enables the user to make further changes if so desired.

E - End

This is self explanatory.

P - Perform Calculations on Working Set

This is the most extensive sub-routine in the program.   The various steps have been described in Chapter 2.

APPENDIX 3

DETAILED QUESTIONS FROM MODAL HOUSE PROGRAM

MODAL HOUSE REPLACEMENT COST
THIS PROGRAMME USES MULTIPLES AND MULTIPLIERS TO CALCULATE REPLACEMENT COST
ENTER THE SIZE OF SUBJECT HOUSE IN M2

ENTER THE CURRENT MODAL RATE PER M2

ENTER THE NUMBER OF ROOMS, 4-8

ENTER NUMBER FOR TYPE OF FOUNDATIONS, 1-9
--1 FOR CONTINUOUS REINFORCED CONC.
--2 FOR CONC. 80
--3 FOR BRICK VENEERED PLASTERED
--4 FOR BRICK VENEER
--5 FOR CONC CNR PROFILE AND PILES
--6 FOR CONC PILES WITH 1/4 FLAT ASB
--7 FOR CONC PILES WITH BASEBOARD
--8 FOR WOOD PILES WOOD BASE
--9 FOR CONC FLOOR

ENTER THE HEIGHT (OVER0.6M AND UPTO 1.52M) OF ANY ADDITIONAL BASE

WHAT IS THE PERIMETER LENGTH (M) OF THIS ADDITIONAL BASE

ENTER THE NUMBER OF ROOF BREAKS 0-10

ENTER THE NUMBER FOR SPOUTING TYPE 1-5
-1 FOR GALVANISED IRON
-2 FOR ZINC
-3 FOR COPPER
-4 FOR MARLEY
-5 FOR TAYLOR FASCIA/KASS

ENTER NUMBER FOR ROOF TYPE 1-12
-1 GC IRON(26G)
-2 LONGRUN IRON
-3 CONC OR CLAY TILE - HIP
-4 CONC OR CLAY TILE - GABLE
-5 DECRA - HIP
-6 DECRA - GABLE
-7 MONIER - HIP
-8 MONIER -GABLE
-9 TROUGH SECTION IRON ON SARKING
-10 TROUGH SECTION SARKING ON PURLINS
-11 TROUGH SECTION ALUMIN.SARKED
-12 SUPER SIX CORRUGATED ASBESTOS

ENTER (1) FOR LEAN TO ROOF AND CEILING
ENTER(2) FOR LEAN TO ROOF AND LEVEL CEILING
ENTER(3) IF DOES NOT APPLY

ENTER(1) FOR BEAMED CEILINGS
ENTER (2) IF NO BEAMED CEILINGS

ENTER M2 OF BEAMED CEILINGS

ENTER NUMBER FOR SHEATHING TYPE 1-26
-1 FOR 150MM BB WEATHERBD
-2 FOR 150MMRUSTIC RIMU WEATHERBD
-3 FOR 150MM CEDAR RUSTIC WEATHERBD
-4 FOR BB WEATHERBD
-5 FOR VERTICAL WEATTHERBD
-6 FOR WEATHERSIDE
-7 FOR FIBROPLANK
-8 FOR WOODGRAIN FIBROPLANKS
-9 FOR DUROCK SIDING-PLAIN
-10 FOR DUROCK SIDINGS-PAINTED
-11 FOR MONTANA WEATHERBD
-12 FOR FLAT ASBESTOS SHEET
-13 FOR SHADOWLINE,HIGHLINE,ETC

-14 FOR STUCCO ON SOLID BACKING
-15 FOR SPANISH STYLE PLASTER
-16 FOR 200MM CONC BLK STRAPPED AND TIED
-17 FOR SPLIT STONE VENEER
-18 FOR PLAIN RED BRICK VENEER
-19 FOR PLIMMERTON - PLIMTEX
-20 FOR PLIMMERTON - ROMAN
-21 FOR HUNTLY BRICK
-22 FOR HUNTLY - CARRIBEAN
-23 FOR 100MM FLAIN BRICK VENEER
-24 FOR CLINKER BRICK
-25 FOR ALUMIN WEATHERBD
-26 FOR NO FINES CONCRETE

IS THE BRICK VENEER POINTED 1=YES,2=NO

ENTER NAME FOR INT LINING
-1 FOR GIB BD WALLS + FIBR CEILING
-2 FOR FIBR WALLS + FIBR CEILINGS
-3 FOR GIB BD WALLS + PINEX TILE CEILING
-4FORGIB BD WALLS + GIB BD CEILINGS
-5 FOR GIB BD WALLS + PINEX CEILINGS
-6 FOR RLS + P WALS AND CEILINGS

ARE THERE WHISPER CEILINGS - 1=YES,2=NO

ARE THERE GIB FOIL LINED WALLS?
-1 = YES
-2 = NO

IS THERE A LOUNGE ENTRANCE(1=YES,2=NO)

IS THERE A LAUNDRY ENTRANCE(1=YES,2=NO)

IS THERE A SEPARATE LAUNDRY(1=YES,2=NO)

IS THERE A WC IN THE BATHROOM(1=YES,2=NO)

ENTER LENGTH OF EXTRA INT. PARTITIONING(M)(0-30)

ADJUSTMENTS FOR EXTERIOR JOINERY
MODAL HAS 23 WINDOW SASHES
ENTER NUMBER OF SASHES FOR SUBJECT

ENTER TYPE OF SASHES
-1 FOR TIMBER
-2 FOR WHITCO
-3 FOR STANDARD ALUMINIUM
-4 FOR COLORED ADONISED
-5 FOR POWDER COATED JOINERY

ENTER NUMBER OF EXTERIOR DOORS
MODAL HAS 3 EXTERIOR

ENTER NUMBER OF PAIRS OF CASEMENT DOORS(0IFNONE)

ENTER LENGTH OF RANCH SLIDERS (0IFNONE)

ENTER NUMBER OF SHUTTERS(0IFNONE)

DOES SUBJECT HAVE AN 8 PANEL RAISED FRONT DOOR(1=YES,2=NO)

ENTER NUMBER OF INTERIOR DOORS(MODAL=8)
EXCLUDE FOLDING DOORS

ENTER MAIN TYPE OF INTERIOR DOORS
-1 FOR MAHOGANY FACED
-2 FOR WALNUT FACED
-3 FOR SLIDING

ENTER THE LENGTH OF FOLDING DOORS(M)(0IFNONE)

ENTER THE TYPE OF FOLDING DOORS
-1 FOR MODERN FOLD
-2 FOR PANEL FOLD

ENTER NUMBER OF WARDROBES
MODAL HAS 3 WARDROBES

ENTER KITCHEN CUPBOARD DATA
MODAL HAS 3.72M CUPBOARDS
WHAT LENGTH CUPBOARDS FOR SUBJECT(M)?)

ENTER MAIN TYPE OF CUPBOARD FACING
-1 FOR STANDARD WOOD(MODAL)
-2 FOR FORMICA FACED
-3 FOR MAHOGANY FACED

ENTER LENGTH OF SINK BENCH(M)
MODAL HAS 1.67M

ENTER TYPE OF SINK BENCH
-1 FOR FORMICA
-2 FOR STAINLESS STEEL
-3 FOR OTHER

ENTER DATA FOR PELMETS
-1 FOR BUILTIN PELMETS
-2 FOR BOX TYPE PELMETS
-3 FOR NO PELMETS

ENTER LENGTH OF PELMETS(M)

IF STAIRS, ENTER NUMBER OF TREADS(OIFNONE)

ENTER-1IF STAIR HANDRAIL -2 IF NOT

ENTER DATA FOR PLUMBING
BATH TYPE
-1 FOR NO BATH
-2 FOR CAST IRON BATH
-3 FOR PLASTIC OR STEEL BATHS

ENTER DATA FOR BASIN TYPE
-1FOR POCELAIN STAND ALONE
-2FOR PLASTIC STAND ALONE
-3 FOR PLASTIC COLOURED STAND ALONE
-4 FOR PEDESTAL TYPE
-5 FOR VANITY UNIT

ENTER NUMBER FOR TYPE OF WATER HEATER
-1 FOR 136 LITRE ELECTRIC
-2 FOR 182 LITRE ELECTRIC
-3 FOR 68 LITRE GAS
-4 FOR 90 LITRE GAS

IS THERE AN ADDITIONAL UNDER BENCH WATER HEATER
-1FOR YES
-2 FOR NO

ENTER TYPE OF SHOWER
-1 FOR NO SHOWER
-2 FOR SEPARATE SHOWER
-3 FOR SHOWER OVER BATH

```
SELECT NUMBER FOR LAUNDRY TUB TYPE
-1FOR NO TUBS
-2 FOR CONCRETE SINGLE
-3 FOR CONCRETE DOUBLE
-4 FOR STAINLESS DOUBLE
-5 FOR STAINLESS SINGLE

SELECT NUMBER FOR CHIMNEY TYPE
-1 FOR NO CHIMNEY
-2 FOR MODAL TYPE CHIMNEY
-3 FOR VISOR TYPE CHIMNEY

IS THERE A PARALLEL CHIMNEY(1=YES,2=NO)

IS THE CHIMNEY BRICK VENEER (1=YES,2=NO)

IS THERE A FUEL BOX(1=YES,2=NO)

IS THERE AN ASHPIT(1=YES,2=NO)

SELECT FOR ENCLOSED FIREBOX TYPE
-1 FOR NO ENCLOSED FIREBOX
-2 FOR MCKAY TYPE IN CHIMNEY
-3 FOR MCKAY WITH FLUE KIT
-4 FOR WARMAIRE WITH FLUE KIT
-5 FOR POT BELLY

SELECT FOR OIL FIRED HEATING
-1 NO OIL FIRED HEATING
-2 ACE 50,000 B.T.U. UNDER FLOOR
-3 ACE DUAL 50,000 B.T.U.
-4 PREMIER UNDER FLOOR50,000 B.T.U.
-5 KENT UNDER FLOOR 50,000 B.T.U.

IF OIL SYSTEM DUCTED SPECIFY NO OULETS,0-10

IS GAS CONNECTED(1=YES,2=NO)

GAS SPACE HEATING(1=YES,2=NO)

SELECT NO FOR ELECTRIC SPACE HEATING
-1 FOR NO ELECTRIC NITESTORE
-2 FOR 750W NITESTORE
-3 FOR 1000W NITESTORE
-4 FOR 1500W NITESTORE
-5 FOR 2000W NITESTORE

IS THERE A BASEMENT(1=YES,2=NO)

ENTER M2 OF ADDITIONAL BLOCKWORK(FACE)

IS THERE A CONCRETE FLOOR(1=YES,2=NO)
IS THE CONCRETE FLOOR REINFORCED(1=YES,2=NO)
```

ENTER M2 OF CONC. FLOOR

ENTER THE NUMBER OF DOORS IN BASE,0-6

ENTER TOTAL BASEMENT FLOOR AREA,M2

ENTER M3 OF EXCAVATION

ENTER-1- FOR LAUNDRY IN BASEMENT
ENTER-2- FOR LAUNDRY IN HOUSE

ENTER M2 OF TIMBER DECKING,OIF NONE

ENTER M2 OF CONCRETE TERRACE,OIF NONE
ENTER M2 OF ROOF OVER TERRACE

ENTER LENGTH OF TERRACE RAIL(M),OIF NONE

ENTER TYPE OF TERRACE RAIL
-1 FOR NO RAIL
-2 FOR WROUGHT IRON RAIL
-3 FOR PIPE RAIL
-4 FOR WOODEN RAIL

ENTER DATA FOR THE CARPORT
-1 IF NO CARPORT
-2 IF CARPORT HAS CONC FLOOR
-3 IF CARPORT HAS NO FLOOR

ENTER SIZE(M2) FOR CARPORT,OIFNONE

ENTER DATA FOR GARAGE
-1 FOR NO GARAGE
-2 FOR BASIC WEATHERBOARD
-3 FOR BASIC BRICK

ENTER SIZE (M2) OF GARAGE,OIFNONE

ENTER DATA FOR INSULATION
-1 FOR NO INSULATION
-2 FOR SISALATION WALLS ONLY
-3 FOR SISALATION WALLS+CEILINGS
-4 FOR ACRAFIBRE WALLS ONLY
-5 FOR R14 BATTS CEILING ONLY
-6 FOR R19 BATTS CEILING ONLY
-7 FOR R11 WALLS,R14 CEILINGS
-8 FOR R11WALLS ,R19 CEILINGS
-9 FOR R11WALLS,R19 CEILINGS,SISALATION UNDERFLOOR

APPENDIX 4

SUMMARY OF COMPUTER PROGRAMS DISCUSSED IN TEXT[1]

Text reference	Program name and purpose	Program developed by:
2.3.1	'Famulus' - General purpose data base - particularly suited for bibliographies, used for sales data base management.	Shaw, A. (et al.)
2.3.2	'Visi Dex' - General purpose data base management, used for storage and retrieval of sales data.	Personal Software Inc.
2.4	'Net Rate' - Analysis of net rate per m^2 for houses.	Harris, C., Hargreaves, R.
2.5	'Area Adjustment' - Adjusting land sales data for size variations.	Dilmore, G.
3.3	'SPSS' - General purpose statistical program.	Nie (et al.)
4.3.2	'Lessee's Interest' - Calculates the lessee's interest in a lease.	Hargreaves, R.
4.4.4	'Development Valuation' - Calculates the residual land value for a hypothetical building development.	Traill, S., Hargreaves, R.
4.4.4	'Hypothetical Subdivision' - Calculates the residual land value for a proposed residential subdivision.	Harris, C., Hargreaves, R.
4.5.1	'Ellwood' - Uses the Ellwood formula to value income properties.	Harris, C.
4.6.1	'Income and Expenditure' - Budget program for income projections.	Harris, C.
4.7.1	'Internal Rate of Return' - Calculates internal rate of return.	Poole, L.
4.8.1	'Financial Management Rate of Return' - Calculates FMRR.	Poole, L.

[1] The complete listings of the actual computer programs developed by the author are available on request.

Summary of Computer Programs Discussed in Text - <u>continued</u>

Text reference	Program name and purpose	Program developed by:
4.9.1	'Visi Calc' - Electronic work sheet.	Personal Software Inc.
4.9.1	'Visi Calc - Real Estate Templates' - Specialised real estate investment application for electronic work sheets.	Colony Realty Inc.
4.10.1	'Max Debt' - Calculates debt servicing ability.	Wright, A.
4.11.1	'Marginal Analysis' - Uses marginal analysis to calculate optimum building development.	Traill, S., Hargreaves, R.
5.2.1	'Farm Shed' - Calculates replacement cost for farm sheds.	Hargreaves, R., Harris, C.
5.3.1	'Modal House' - Calculates replacement cost for houses.	Hargreaves, R.
5.4.1	'Find Area' - Calculates floor area for building.	Cooper, M.

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