JAMES A. GRAASKAMP COLLECTION OF TEACHING MATERIALS

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H. Presentations Sponsored by Other Universities

11. "Simulation Model for Investment Project Analysis of Income Producing Real Estate", presented at the Colloquium on Computer Applications in Real Estate Investment Analysis, University of British Columbia, February, 1968

Index

Colloquium on Computer Applications in Real Estate Investment Analysis
University of British Columbia, February 1-2, 1968

SIMULATION MODEL FOR INVESTMENT PROJECT ANALYSIS OF INCOME PRODUCING REAL ESTATE

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I

INTRODUCTION

A. Origins

There is an interdependency of real estate marketing objectives, real estate financial planning, and physical features of project design which is seldom thoroughly tested in adequate detail for any rental project. Market, finance, and design considerations are generally not integrated in the conceptual stage of any project; instead each is isolated to advance the viewpoint of a specialist in one or another of these areas. The architect uses market research to justify a preconceived design, the finance man uses the architect to generate as much leverage from a revenue forecast as possible, or the market researcher begins his study with a preconception of an architectural style or a financial package. The appraiser is then asked to serve as economic interpreter of value making decisions already reached by the architect, tax accountant, lawyer, and consumer analyst.

The simulation model described in this report begins with the basic objective of integrating market data, cost estimates and financial constraints into a single abstract process for progressively testing project assumptions as plans become more detailed in order to achieve a better relationship of land,

improvements, and financing, to profit objectives. The model represents an accumulation of ideas defined in algebra by the author, given a logic system for the computer by Mr. Robert Knitter of the University of Wisconsin Computer Center, and then tested by graduate student problems and field applications. (1) The work was financed jointly by Lambda Alpha, the honorary fraternity of land economics, and the University of Wisconsin Bureau of Business Research. At this writing some further refinements are in process to increase the capacity of output formats, to improve mechanics of financing working capital deficits as incurred, and to improve the precision of capital gains tax calculations. It is then anticipated that the program on cards or tape, together with an operating manual, input forms, and sample projects, will be made available at modest cost to anyone wishing to use the model. (2)

B. Objectives

Since alternative design solutions to any investment project or alternative offering prices and financial plans for existing projects will affect investment return, it is necessary to trace out the consequences of each choice. A basic premise of the model is that the criteria of choice will concern cash flow to the investor over time and the present value of these expected cash returns discounted at a yield to equity required by the investor.

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(1) Graduate students Robert Markwardt and Tom Turk were primarily responsible for testing input forms, computer routines, and output format.

(2) The program is written in Fortran IV for an IBM 1410 with 40,000 character memory and utilizes 2 of 5 tape drives. Execution time of a run is 1-5 minutes depending on volume of outputs. While Fortran IV is compatible with many machine systems, our pilot model requires overlays which may involve some reprogramming to fit other hardware systems. A memory capacity of 120,000 characters would eliminate need for overlays.

The discounting process resembles the internal rate of return approach recently outlined by Professor Paul Wendt in the Appraisal Journal but with the addition of variable, after-tax period returns. (3) Development of cash flow for each period is a tedious, extended, and repetitious operation well suited to the computer. With such a financial review available to suggest implications of alternative decisions, the designer can better fit his solutions to the investor calculus while the investor himself will enjoy a more accurate prospective measure of investment yield. The output of this cash flow analysis has been molded:

(1) To combine into one model a method of testing alternative designs for capital budgets, operating levels, and before and after tax yields over a time sequence.

(2) To utilize the internal rate of return approach for variable period incomes while providing comparison to traditional and familiar appraisal methods and language.

(3) To provide input forms which the average informed real estate investor or appraiser could complete ready for keypunching.

(4) To generalize all formulas including present value calculations in order to adapt to the user choice of time period, project descriptions, and levels of detail while still permitting individualized labeling of descriptive elements of the outputs.

(5) To anticipate possible expansion of the program in certain elements for special user needs without necessitating complete reconstruction of the program.

(6) To adapt to relatively small computer installations available in most metropolitan areas at lending institutions or data service companies.

(7) To provide outputs which summarize and analyze both the inputs and the outputs in forms familiar to the real estate investor and within an 8 1/2 by 11 page to allow insertion within the familiar standard written report form.

(8) To provide a variety of analytical summaries to serve such users as architects, mortgage lenders, management strategists, marketing analysts and appraisers.

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(3) Paul F. Wendt, "Ellwood, Inwood, and the Internal Rate of Return", The Appraisal Journal, October, 1967, page 561-574.

C. General Structure of Model

The basic structural concept of the model is to permit the analyst to define building blocks with which he can create alternative combinations of cost, operating characteristics, financial packages, and related cash flow dimensions. The basic building block is a component called a FEATURE, which can be given any kind of unit description, such as a square foot of area, a parking stall, a floor type, or even an entire building structure. The quantity of features used to describe any one project can be either varied or constant. VARIABLE FEATURES are combined into revenue generating elements, such as a one bedroom unit, or motel room, or office building floor. There may be different numbers of RENTAL ELEMENTS in a rental class, ranging from one element defined as a package of one site/one building to a rental mix of as many as 9 different types of apartment elements in different quantities in the same building. Rental elements not only have quantity and cost dimensions but a revenue and expense dimension as well. Aggregate quantities and cost determinations by the computer determine budget, capital structure and various measures of design efficiency. Aggregate revenue and expense calculations by the computer provide a basis for income, expense, and cash flow analysis as will be illustrated in detail in following sections. Period cash flow to the investor is then a basis for investment valuation.

A simplified flow chart is given in Chart I to suggest the type of outputs which can be generated if full details are available. However it should be emphasized that it is possible to generate valuable information from the sketchiest data. For example, a simple allocation of an offering price between building, equipment, and land where annual rent and expense ratios are known can produce a significant answer, although much additional marginal analysis of useable area efficiency, rental mix, or accounting accuracy will not be available for lack of required input. As frequently

CHART I

SIMPLIFIED FLOW CHART OF WISCONSIN REAL ESTATE INVESTMENT SIMULATION MODEL

INITIAL DATA INPUTS

1. feature unit cost
2. quantities of features in each rental class
3. rent, expense, and occupancy factors
4. indirect capital costs
5. capital financing schedule
6. capital depreciation schedule
7. time index adjustment factors
8. real estate and income tax data
9. appraisal and yield data

PHYSICAL IMPROVEMENT DATA PRINTOUTS

Total Quantity and Cost of Component Features

Feature Quantities and Costs of Rental Element Types

Indirect Capital Costs

Total Capital Finance Plan

Capital Depreciation Plan

Key Financial Structure Ratios

Key Physical Improvement Ratios

Simple Marginal Analysis Comparisons of Rental Mix

CASH FLOW DATA PRINTOUTS

Standard Income and Expense Statement

After Tax Cash Flow Statement

Net Worth Summary

Standard Financial Ratios

Current and Cumulative Yield Comparisons

INCOME APPRAISAL & YIELD PRINTOUTS

Summary of Capital Investment, Mortgage and Land Cost Data

Present Value of Income and Reversion Before Recapture or Financing at 7 Discount Rates Selected By Investor

Present Value of Income and Reversion With Consideration of Debt Service But Before Taxes at 7 Discount Rates Selected By Investor

Present Value of Income and Reversion After Allowance For Debt Service and Income Taxes at 7 Discount Rate Selected by Investor

Land Residual Value For Site Using Each of 3 Approaches to Property Residual Value at 7 Discount Rates

as desired by the analyst, the model will then appraise period cash income and resale values by means of three different value approaches which can be classified as traditional, mortgage-equity and after-tax methods. Both the property residual and land residual values for all three approaches at seven different discount rates are given to facilitate comparison of results and decisions on the range of returns to be expected.

The model may be termed heuristic, for it runs through a single set of inputs and stops without searching for an optimal solution. Since the combination of alternative inputs is infinite, it is presumed that the analyst has narrowed his choices to a limited set of practical alternatives on the basis of his own judgment and experience. The product of the model is an extension of decisions already made or modified as a result of previous runs on the computer. It lacks the glamour of an optimizing model or decision making model, but it is doubtful that the art of real estate investment can either be made conclusively mechanistic or could be accepted as such by practitioners if it were. Any model builder must anticipate the resentment any computer system generates among real estate practitioners, and this model deliberately avoids infringing on matters of "judgment".

II.

CAPITAL BUDGET AND FINANCIAL STRUCTURE

A. Project Features

The flexibility of this project simulation model can be suggested by reference to the input forms which appear in Appendix I and output forms which are inserted as Charts II - VII. Both sets of information describe some hypothetical 40-unit apartment building. The basic building block is a FEATURE, which can be divided between features which will vary for each rental element and those which are constant for any one run of the model. The name of such features and the unit of description is limited only by the imagination of the analyst and 20 card spaces. In the example on

page 1 of Appendix I and Chart II, there is a square foot of living area, but the unit might have been one entire floor plan type of an office building. For the example functional areas are described by the square foot "SF", furniture by the piece "PC", and outside parking by the stall "STL". The first 10 features may vary for each type of rental element while the number of parking stalls for the project has been limited by the design to a constant of 40 units. Public area for corridors, lobbies, and whatever else the designer might define as public, has been limited initially to a constant ratio of 1 square foot of public area for each 5 square feet of rentable space, indicated by .2. Each feature is given two essential dimensions:

1. DIRECT COST PER UNIT is the essential piece of information which determines the detail level for any one project run. It is possible to allocate the offering price for an existing property between building, equipment, and land if that is the only cost data available. If more is known about cost, any type of unit definition is possible. If costs include indirect charges such as engineering fees, then it is unnecessary to include these items in the indirect cost input forms. The unit could be the price of the entire site or could be land per square foot at the discretion of the analyst. Furniture could be by piece, per room, per apartment or per floor depending on the flexibility of detailing desired or available to the analyst.
2. CSC - CAPITAL SCHEDULE CODE is a means of classifying each kind of feature according to the method of its financing or the formula for its tax depreciation. Rentable space is always classified as CSC #1, non-rentable space as CSC #2, and land as CSC #3 to allow

CHART II

REAL ESTATE CAPITAL STRUCTURE & BUDGET PAGE 3

PROJECT FEATURES - COMPONENTS

CODE		PER UNIT	ADDITIONAL UNITS CONST.	PER REA	TOTAL UNITS	COST
1 LIVING ROOM	SF	6.500	.000	.000	8976.0	58344.0
2 KITCHEN	SF	15.000	.000	.000	4088.0	61320.0
3 BEDROOM 1	SF	6.500	.000	.000	5796.0	37674.0
4 BEDROOM	SF	6.500	.000	.000	2794.0	18161.0
5 FOYER	SF	6.000	.000	.000	996.0	5976.0
6 STORAGE	SF	10.000	.000	.000	2210.0	22100.0
7 FURNITURE	EA PC	50.000	.000	.000	72.0	3600.0
8 BASEMENT STORAGE	SF	4.500	.000	.000	1900.0	8550.0
9 LAND	SF	1.500	.000	.000	55200.0	82800.0
10 BATHROOM	SF	20.000	.000	.000	2184.0	43680.0
11 PUBLIC AREA	SF	7.000	.000	.200	5788.8	40521.6
12 OUTSIDE PARKING	STL	300.000	40.000	.000	40.0	12000.0
TOTAL DIRECT CAPITAL COST						394726.6

RENTAL ELEMENTS

RENTAL CLASS TYPE 1	NUM.	RENT	FIXED EXPENSES		VARIABLE EXPENSES	
EFFICIENCY APT	4.	120.00	1.20	.02	1.50	.02
FEATURE - COMPONENT		#UNITS	COST		AREA	
1 LIVING ROOM	SF	300.00	1950.00	37.6%	300.00	67.7%
2 KITCHEN	SF	50.00	750.00	14.4%	50.00	11.2%
6 STORAGE	SF	20.00	200.00	3.8%	20.00	4.5%
8 BASEMENT STORAGE	SF	25.00	112.50	2.1%	25.00	5.6%
9 LAND	SF	800.00	1200.00	23.1%	.00	.0%
10 BATHROOM	SF	48.00	960.00	18.5%	48.00	10.8%
TOTAL			5172.50		443.00	

RENTAL CLASS TYPE 2	NUM.	RENT	FIXED EXPENSES		VARIABLE EXPENSES	
1 BEDROOM APT	14.	140.00	1.70	.02	1.50	.02
FEATURE - COMPONENT		#UNITS	COST		AREA	
1 LIVING ROOM	SF	216.00	1404.00	18.2%	216.00	32.8%
2 KITCHEN	SF	108.00	1620.00	21.0%	108.00	16.4%
3 BEDROOM 1	SF	161.00	1046.50	13.5%	161.00	24.5%
5 FOYER	SF	74.00	144.00	1.8%	24.00	3.6%
6 STORAGE	SF	50.00	500.00	6.4%	50.00	7.6%
8 BASEMENT STORAGE	SF	50.00	225.00	2.9%	50.00	7.6%
9 LAND	SF	1200.00	1800.00	23.3%	.00	.0%
10 BATHROOM	SF	48.00	960.00	12.4%	48.00	7.3%
TOTAL			7699.50		657.00	

RENTAL CLASS TYPE 3	NUM.	RENT	FIXED EXPENSES		VARIABLE EXPENSES	
2 BEDROOM APT	16.	160.00	2.20	.02	1.50	.02
FEATURE - COMPONENT		#UNITS	COST		AREA	
1 LIVING ROOM	SF	216.00	1404.00	14.7%	216.00	26.4%
2 KITCHEN	SF	108.00	1620.00	16.9%	108.00	13.2%
3 BEDROOM 1	SF	161.00	1046.50	10.9%	161.00	19.7%
4 BEDROOM 2	SF	127.00	825.50	8.6%	127.00	15.5%
5 FOYER	SF	30.00	180.00	1.8%	30.00	3.6%
6 STORAGE	SF	65.00	650.00	6.8%	65.00	7.9%
8 BASEMENT STORAGE	SF	50.00	225.00	2.3%	50.00	6.1%
9 LAND	SF	1600.00	2400.00	25.1%	.00	.0%
10 BATHROOM	SF	60.00	1200.00	12.5%	60.00	7.3%
TOTAL			9551.00		817.00	

RENTAL CLASS TYPE 4	NUM.	RENT	FIXED EXPENSES		VARIABLE EXPENSES	
2 BEDROOM FURNISHED	6.	180.00	2.20	.02	4.00	.02
FEATURE - COMPONENT		#UNITS	COST		AREA	
1 LIVING ROOM	SF	216.00	1404.00	13.8%	216.00	26.4%
2 KITCHEN	SF	108.00	1620.00	15.9%	108.00	13.2%
3 BEDROOM 1	SF	161.00	1046.50	10.3%	161.00	19.7%
4 BEDROOM 2	SF	127.00	825.50	8.1%	127.00	15.5%
5 FOYER	SF	30.00	180.00	1.7%	30.00	3.6%
6 STORAGE	SF	65.00	650.00	6.4%	65.00	7.9%
7 FURNITURE	EA PC	12.00	600.00	5.9%	.00	.0%
8 BASEMENT STORAGE	SF	50.00	225.00	2.2%	50.00	6.1%
9 LAND	SF	1600.00	2400.00	23.6%	.00	.0%
10 BATHROOM	SF	60.00	1200.00	11.8%	60.00	7.3%
TOTAL			10151.00		817.00	

the computer to calculate building efficiency, land improvement ratios, and other related items. Beyond this minimum classification restraint the analyst may have as many as six additional capital schedule classifications as there are financing methods and depreciation schedules as will be further described below.

B. The Rental Element

The RENTAL ELEMENT is defined by combining various quantities of features. For example on Chart III in the demonstration project there are 4 rental elements, efficiency apartments, one bedroom apartments, 2 bedroom apartments and 2 bedroom apartments furnished. There can be as many as 9 elements consisting of various quantities of 10 different variable features. Each type of element is given a code number, and for each run of the computer it is necessary to specify the quantity of each type of element in the rental mix. The quantities of features per element multiplied by the number of elements and then summarized for all elements aggregate to the total quantity and cost of each feature which are added to constant feature costs to obtain total direct capital cost. This breakdown of rental elements allows the investor to test different mixtures of rental elements, modification of feature specifications in each element, and distinct element costs relative to rents and expenses for each. The definition of a rental element and its name tag are left to the discretion of the analyst. It could be as limited as an entire building investment defined as a combination of 3 features - building, equipment and site or as a rental package such as a full floor of office space plus parking spaces, or 1,000 square feet of retail space and one parking stall, or a single revenue unit such as a theater seat, motel room, a table for four, or a display window. Each rental element has an income and an expense dimension found on page 2, Appendix I and Chart IV:

1. RENT PER PERIOD is the gross rent for one rental element of each rental class type. It is important that all calculations related to time have the same common denominator. If mortgage payments are to be calculated for a regular monthly payment mortgage, then rents must be stated per month. If the rental class type is simply defined to include an entire building as a single type, then the rent must be given for the gross expected from all rental elements in the building. In this illustration there are 4 efficiency apartments each renting for $110 per month.
2. FIXED EXPENSES refer to those expenses that are constant in any one period regardless of occupancy. These expenses can be stated as a fixed amount per period (a month in this case) for each rental element or they can be determined by relating expenses per square foot to the total area enclosed by a single element. Some services offer expense cost per square foot of rental area and some developers maintain records in similar fashion. The aggregate fixed expenses for any one period consist of the number of units for rent times the expense per unit plus the number of square feet for rent or rented times so many cents a square foot.
3. VARIABLE EXPENSES are designed to fluctuate with occupancy. The expense item may be constant for each period or per square foot or a combination of both. The variable expense for each unit times the number of elements in each rental class times the occupancy factor for each rental class as explained further in III-D is combined into the period expense statement which is printed as part of the operating income summary.

Each rental element is analyzed in terms of quantities, costs, and areas of those feature components which were used to define the element as in Chart III. Total cost for a single rental element represents direct cost only and is allocated as a percentage to each feature item as well. Area allocations include only those features classified by the capital schedule code number #1 for rentable area or #2 as nonrentable area. Quantities of features in each rental element multiplied by the number of each element are then summarized in Chart II and then given as an aggregate cost labeled total direct construction cost. Accuracy of the descriptive word "direct" depends on the ability of the analyst to describe feature unit cost with precision as distinct from accounting definitions of indirect cost for carrying charges, professional fees and the like during construction.

C. Indirect Capital Budget Allowances

The TOTAL CAPITAL BUDGET is a summary of all direct costs on the capital schedule and provision for indirect costs which would be capitalized. Reference to page 3 of Appendix I reveals a card for INITIAL EXPENSES, those items of indirect cost and carrying charges which should be allocated to the capital budget rather than initial operation. These expenses can be introduced as a fixed amount, as a percentage of the first period rents, or as a percentage of direct capital cost or as any combination of these three. Engineering fees, insurance costs, and other related items of work, and premiums paid for financing might be expressed as initial fixed amounts or as a percentage of cost. Expenses expressed as a percentage of rent would generally refer to marketing costs related to renting projects or carrying the project during the start-up period. If the loan ratio is a high percentage of the direct capital cost, then the discounts and loan fees could be expressed or converted to a percentage of cost base. The

CHART IV

REAL ESTATE CAPITAL STRUCTURE & BUDGET PAGE 5

CAPITAL SCHEDULE

CODE #-CAP. SHCED.	DEPRECIATION %BASE	TERM	METH	MORTGAGE / FINANCING %BASE	TERM	INTEREST	PAYMENT	TOT. COST
1 BUILDING RENTABLE	100.	480.	2.00	80.	300.	.50%	1318.52	255805.00
2 BUILDING NONRENTABLE	100.	480.	2.00	80.	300.	.58%	228.29	40521.60
3 LAND	.	.	.00	80.	300.	.58%	466.48	82800.00
4 PARKING	90.	120.	2.00	80.	300.	.58%	67.60	12000.00
5 INITIAL EXPENSES	90.	480.	2.00	80.	300.	.58%	276.24	49032.66
6 FURNITURE	100.	72.	2.00	90.	60.	.66%	65.57	3600.00
TOTAL PERIOD DEBT SERVICE							2422.71	
TOTAL CAPITAL BUDGET								443759.26

TOTALS

TOT BLDG AREA TBA	34732.80
TOT RENTABLE AREA TRA	28944.00
LAND COST LC	82800.00
TOT IMPROV COST TCB-LC	360959.26
TOT CAP BUDGET TCB	443759.26
TOT DEPRECIABLE BASE DB	354855.99
TOT MORTGAGES TM	355367.40

IMPORTANT RATIOS

BLDG EFFICIENCY TRA/TBA	83.33%
GR PER UNIT AREA GR/TRA	$ .21
BLG COST/UNIT TCB-LC/TBA	$10.39
DEBT RATIO TM/TCB	80.0%
LAND RATIO LC/TCB	18.6%

MISCELLANEOUS EXPENSE INPUTS

R.E. TAXES .20% OF TOTAL CAPITAL BUDGET PER PERIOD

PLUS $ .FIXED DOLLAR BASE

ANNUAL INCOME TAX RATE- 30.0%

INITIAL EXPENSES- $ 5000. FIXED, PLUS 75.00% OF FIRST PERIOD RENT

PLUS 10.00% of DIRECT CAPITAL COST

advantage of such a treatment would be that financing charges would adjust automatically as the scale of the project or design changes modify direct capital cost and size of loan. Initial expenses must be given a capital schedule code number and can be financed, and depreciated individually or as part of other items on the schedule code. For those expenses which can be charged against operating income during the initial periods of operation, it is possible to introduce those into the operating statement by use of time index factors to be discussed later in III-D of this report.

III.

CASH FLOW INPUTS AND ANALYSIS

A. General Expense Items

In addition to rent and direct costs related to each rental element, there are expenses related to the overall project and demands on cash for financing charges, amortization, income taxes, and returns to the equity investor. General expense items which are not easily charged to any one rental class would include:

1. PROPERTY TAXES stated as a fixed amount per period for an existing property investment or as a percentage of capital cost for proposed project where design elements may change for each run of the computer. In either case the tax computed represents only the initial period property tax for this amount is modified in future periods by the time index factor for real estate taxes. To determine the rate of the property tax per period it is important to convert the property tax rate in any community to a cost of replacement base, then reduce for the community equalization factor, and then divide by the number of periods per year appropriate

to the period chosen for the model. The basic tax calculation is applied to total capital budget to determine the basic tax for the initial period, but this basic tax can be modified by the index factor discussed below to recognize long term trends towards rising property taxes in any particular community or short term adjustments due to relationship of completion dates to assessment dates, partial assessments during construction, or other abatements appropriate to the project. Such tax adjustments need only be related to the tax base and then introduced by use of the index factor.

2. Tax deductible expenses related to initial marketing efforts or inefficient operations during the shakedown period can be introduced by modifying the normal operating base figures for fixed and variable expenses with the index factor device.

3. Short term working capital deficits for expenses which are not capitalized through the indirect capital cost category are assumed to be financed at a specified interest rate called working capital loan interest (WK. CAP. LOAN) on page 3 of Appendix 1. Short-term loans are only amortized by full application of net after-tax cash income and no spendable cash is assumed to be available for the investor until working capital loans are repaid. This assumption has been made explicit in the model under preparation for publication and will appear on the outputs as indicated on the dummy output in Chart VI.

B. Mortgage Finance

The financing for each component of the capital schedule code is specified on page 3 of Appendix 1. In the model now being programed, period calculations will be internalized to simplify inputs to annual figures only but for the present:

1. % RATIO refers to the ratio of the loan to capital budget and not to appraised value. In the day of certified cost, this is not an unreasonable assumption. Where the capitalized value of the project design finally selected indicates additional mortgage money is available and the default ratio is low, the ratio in this column can be changed to produce a higher mortgage figure for the final analytical run of the program.

2. TERM of the mortgage is the amortization period for level payment mortgages. The time period factor must be consistent with the period chosen for analysis, just as in determining useful life for depreciation. If mortgage financing is to be on a monthly basis, then this mortgage term is stated in months and all other time factors for the model must also be available in months, including rent, expenses, depreciation, real estate taxes, and time index factors. If mortgage payments are to be quarterly, all other time related factors must also be quarterly.

3. INTEREST is stated as the interest per period chosen for mortgage payments. It may refer either to level term mortgages or to CONSTANT PAYMENT mortgages where an even dollar amount can be specified for payment on principal each period. The generalized formula for amortization on a level payment basis is built into the program so that separate interest and principal payments on each financing component are calculated for each period. Each interest item and principal item is then aggregated for print-out on the period summaries of interest and principal as required.

C. Provisions for Income Taxation

In addition to tax deductible cash expenses, the income tax computation involves determination of non-cash charges for depreciation, determination of net taxable income before and after cumulative tax loss carry-forwards, and capital gain taxes upon sale of the building.

1. DEPRECIATION requires a statement of the percentage of each capital schedule code class which can be depreciated, that is 100% less expected salvage value. The useful life of the class is described as the TERM in periods, defined to be consistent with the common time denominator of all period entries. ACCOUNTING METHOD refers to the accounting modification of straight line depreciation to be used by the investor. The computer begins by calculating straight line depreciation per period and then multiplies this figure by the factor chosen to determine depreciation per period. Straight line depreciation would be indicated by 1.0, 150% declining balance by 1.5, 200% declining balance by 2.0 or any other factor for the depreciation plan. The computer does not use the sum-of-the-digits method.

2. INCOME TAXES are expressed as a percentage of net income. The rate can be an average of the marginal rate paid by the investor in this range of income; it may combine federal and state rates, or can reflect a weighted rate for a corporation or syndicate of investors. Capital gain tax computation is necessary to determine after tax cash returns to the investor upon resale, and extension of the Ellwood technique to after-tax problems. In the present model the approach has been simplified by always using one half

CHART V

REAL ESTATE CAPITAL STRUCTURE & BUDGET PAGE 6

MARGINAL ANALYSIS BY ELEMENT CLASS

	GR	TRA	TCB	%INC/%COST
TOTAL PROJECT	6080.00	28944.00	443759.26	
AS A % OF TOTAL				
EFFICIENCY APT	7.89%	6.12%	6.06%	130.20%
1 BEDROOM APT	32.23%	31.77%	31.56%	102.13%
2 BEDROOM APT	42.10%	45.16%	44.77%	94.04%
2 BEDROOM FURNISHED	17.76%	16.93%	17.60%	100.92%

GROSS INCOME 6		36480.00	RESALE VALUE	465947.22
EFF. GROSS %OCC.OF	25.%o	9120.00	LESS PRIN.BAL.	352188.38
LESS FIX. EXP.	4803.60		NET WORTH	113758.84
LESS VAR. EXP.	3923.28			
LESS R.E. TAX	5325.11		CURRENT PD. RETURN	-.200221
NET INCOME		-4931.99	PROJECT RETURN	-.15131
LESS DEPREC.	10019.06		PRODUCTIVITY RATE	-.0105
LESS INTEREST	11357.26		CASH RETURN	-.2202
TAXABLE INCOME		-26308.32	EXPENSE RATIO	.385
TAX OFFSET	-22871.01		DEFAULT RATIO	.783
LESS TAXES	.00		DEBT COVER RATIO	-.339
PLUS DEPREC.	10019.06			
LESS PRIN. PMT.	3179.0		CUR. PRIN. PMT/CUR.DEPREC.	.317
CASH INCOME		-19468.30	TOT. AMOR./TOT. DEPREC.	.317

the income tax rate on the taxable gain on sale. The taxable gain is computed simply by subtracting the undepreciated balance of total capital budget from resale value, without adjustment for disallowed accelerated depreciation in excess of that recognized by the 1964 IRS code. The program now in process is attempting to calculate readjusted depreciation for capital gain purposes without loss of flexibility as to time period denominator. Nevertheless, it should be emphasized that it was not felt necessary to compute the full marginal tax schedule with accounting accuracy as the model is designed to forecast rather than provide for historical accounting.

3. To apply income tax loss carry-forwards to taxable income, it is necessary to instruct the computer as to the number of periods in which to accumulate negative taxable incomes before the potential tax credit expires. The input position follows directly on the statement of the income tax rate to be applied to taxable income on the bottom of page 3, Appendix 3. For a model assuming a monthly time denominator, a permissible five year carry-forward would require specification of a 60 period moving total of negative taxable income. As the real estate project is assumed to stand alone without complementary income sources, a full tax loss offset would generally be applied to future income from the project. If the investor wishes to apply taxable income loss offsets to other income, it is only necessary to carry forward enough periods in a model to represent one taxable year.

D. Time Index Factors Adjustments

Revenue and cost inputs in dollars to this point represent base period figures which may be adjusted by indexes per period for rent, real estate taxes, fixed expenses, variable expenses, resale price, and occupancy by rental element class. Indexes give the model a means of recognizing the time line of development, rentup periods, and the various cycles of revenue cost and resale values (See III-G) which characterize dynamic real estate investment. There is no necessity that the base period for the cash flow items above be the first month of normal operation. Revenues may be held to zero during a construction period while fixed costs gradually rise to an operational level, shakedown, and only then reach the normal point indicated for fixed and variable expenses. Rental revenues can begin at zero build as occupancy improves, and then reflect changing price levels by changes in the rent index. Beginning with the assumption that the time unit for the index is the same period chosen for mortgage amortization, it is only necessary to make assumptions as to the cycle of the index numbers for each category so to account for each period in sequence to the point where the computer is to stop computations:

1. BASE PERIOD need not be the first month of normal operation. It simply marks the beginning of cash flow analysis as opposed to capital outlays for development. It is necessary to indicate the next base period each time the index changes and to finally indicate where the computer is to stop computations by placing a 99 in the base period column. The analyst may have as few or as many period outputs and index adjustments as desired.
2. PER CENT OF BASE assumes that original cash flow inputs represent an index of 100 and that the analyst can cycle these items over time

CHART VI

DUMMY FORMAT OF CASH FLOW STATEMENTS
FOR SECOND GENERATION REAL ESTATE INVESTMENT ANALYSIS MODEL

REAL ESTATE CAPITAL STRUCTURE & BUDGET

GROSS INCOME 6		33600.	RESALE VALUE	425453.	
EFF. GROSS OCC. OF	25%	8400.	LESS PRIN. BAL.	321239.	
LESS FIX. EXP.	4804.		LESS WK.CAP. LOAN	18474.	
LESS VAR. EXP.	3923.		NET WORTH	85740.	
LESS R.E. TAX	4862.		CHANGE IN N.W.	2940.	
NET INCOME		-5189.			
LESS DEPREC.	9374.		CURRENT PD. RETURN		.0021
LESS INTEREST	10273.		PROJECT RETURN		.0342
TAXABLE INCOME		-24537.	PRODUCTIVITY RATE		.0121
TAX OFFSET	-21320.		CASH RETURN		.0000
LESS TAXES	0.		EXPENSE RATIO		.404
PLUS DEPREC.	9074.		DEFAULT RATIO		.796
LESS PRIN. PMT.	3011.		DEBT COVER RATIO		.090
CASH INCOME		-18474.			
WORKING CAP. LOAN	18474.		CUR. PRIN.PMT/CUR. DEPREC.		.321
CASH TO INVESTOR		0.	TOT. AMOR./TOT. DEPREC.		.321

GROSS INCOME 12		33600.	RESALE VALUE	425453.	
EFF. GROSS OCC. OF	82.%	27720.	LESS PRIN. BAL.	318228.	
LESS FIX. EXP.	4804.		LESS WK. CAP. LOAN	18378.	
LESS VAR. EXP.	3923.		NET WORTH	88847.	
LESS R.E. TAX	4862.		CHANGE IN N.W.	3107.	
NET INCOME		14131.			
LESS DEPREC.	8703.		CURRENT PD. RETURN		.0132
LESS INTEREST	10178.		PROJECT RETURN		.0362
TAXABLE INCOME		--4750.	PRODUCTIVITY RATE		.0332
TAX OFFSET	-28946.		CASH RETURN		.0000
LESS TAXES	0.		EXPENSE RATIO		.404
PLUS DEPREC.	8703.		DEFAULT RATIO		.796
LESS PRIN. PMT.	2916.		DEBT COVER RATIO		1.079
CASH INCOME		1037.			
WORKING CAP. LOAN	-17437.		CUR. PRIN.PMT/CUR. DEPREC.		.345
CASH TO INVESTOR		0.	TOT. AMOR./TOT. DEPREC.		.333

by stating the index as a percentage of the initial input. For example experience may indicate that real estate taxes will rise an average of 2% a year for a 5-year investment term. So for the first 12 monthly periods real estate taxes will have an index of 100, for the next 12 periods an index of 102, then 104, etc.

3. ENDING PERIOD defines the length of time the index on any one line prevails for each of the categories. It is possible to vary the ending period in any way so long as the time unit is consistent. For example during the rentup period it might be desirable to vary the occupancy factor every 3 months; during the initial years of normal operation, revenue and cost might be held constant for 2 years at a time, and then after the fifth year inflationary or deflationary expectations could be indicated yearly. In short occupancy might vary significantly over short periods initially; revenues and expenses might shift at different rates over the intermediate term reflecting less elasticity of rent than expenses; and resale values may shift with alternative assumptions as to inflation, local markets, and economic obsolescence.

E. Capital Budget Output Analysis

Once all of these inputs are available, some useful outputs may be at hand. In addition to the cataloging of input data and assumptions for those who read the final outputs which appear in Charts II - IV,(4) some useful computations begin to make their appearance on Chart Iv, i.e. some totals and ratios relative to the scale of the project. The captions on these summary statements are self-explanatory and of course the calculations involving area can only be performed where some of the feature components are defined in terms of floor area and are classified as either #1 or #2 in the capital

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(4) In addition there are complete checks on card inputs and sequence areas which have been omitted from the charts.

schedule code. Some simple marginal analysis of these totals as on Chart V is possible for those projects where rentable area can be allocated to various rentable classes and a further limiting assumption can be made that there should be a relationship of gross rental power to total capital budget allocated to each rental class. In this analysis the gross rent and rentable area allocations are easily identified from the data concerning each rental class detailed on Chart II. The total capital budget is allocated to each rental class according to the proportion of direct cost per class generated from element cost times number of elements.

1. The revenue power of any one rental class relative to the others in the project is then suggested by the ratio of the percentage of total income generated to the percentage of total capital budget allocated to that rental class. To a lesser extent the percentage of gross rent generated relative to the total rentable area allocated also measures the efficiency of investment in any one type of rental class.

2. For example, in the results on Chart V, efficiency apartments provide 7.9% of gross revenue rental potential while occupying only 6.1% of total rentable area and requiring about 6% of the total capital budget, suggesting 32% more income per dollar spent than would be realized by investing in two-bedroom furnished apartments. By the same token the investor is alerted that two-bedroom apartments (unfurnished) either offer too much space or too many features as represented by the total capital budget allocation for the rent money charged. Either the plan is too generous or the rent too low. Presuming rents are established from the market, the inference is that the architect has been somewhat liberal with features and investment in this rental class. Of course,

such analysis could be modified if rental class rents were adjusted to reflect different vacancy levels or tax free cash returns as modified by furnishings, etc., or where rental elements were known to have significantly different expense ratios.

Of course the final standard of capital budget expenditures is the relationship of capital cost to investment value as examined later in the paper.

F. Cash Flow Outputs

An income statement summary and an analysis of current results is one major basis for investment evaluation. The program can be instructed to compute income and expense figures per period, and aggregate results until summary is requested for print-out. In this example on Chart V, the computer was instructed (See page 3, Appendix I) to summarize monthly results each six months and then to appraise these results assuming resale every five years (60 months). In this case gross income represents potential revenue while effective gross represents net rents received for each rental class as adjusted by the occupancy index. Per cent of occupancy is a calculation derived from $9,120/36,480 and is not the per cent of occupancy assumed for six months. It is the weighted average of monthly results. The balance of the cash flow statement has been derived and aggregated from the inputs examined earlier and appears in a format on Chart V which should be self-explanatory.

Cash income footing in the present model does not go far enough for purposes of analysis, and so the need for short term loans to cover working capital deficits has been made explicit. All cash deficits will be accumulated in the new version as in Chart VI and then paid off from future cash income before cash is made available to the investor. Cash available to the investor after all claims on cash flow have been met are assumed to be distributed

CHART VII

REAL ESTATE CAPITAL STRUCTURE & BUDGET PAGE 10

APPRAISAL ANALYSIS OF PROJECT

INITIAL COSTS- TCB 443759.26, LC 82800.00, TIC 360959.26

TM 355367.40, CASH EQUITY REQUIRED 88391.86

VALUE BASED ON INCOME USING THREE DIFFERENT APPROACHES

PRESENT VALUE OF RETURNS, LESS $ 360959.26 TIC, EQUALS RESIDUAL LAND VALUE

	PROPERTY APPRAISAL			LAND APPRAISAL		
%	TRADITIONAL	B/4 TAX	AFT TAX	TRADITIONAL	B/4 TAX	AFT TAX
5.20	542198.24	524148.12	489343.50	181238.98	163188.86	128384.24
6.00	523655.74	517638.56	483982.25	162696.48	156679.30	123022.99
7.00	501446.92	509846.21	477567.92	140487.66	148886.95	116608.66
10.00	440778.58	488587.02	460088.98	79819.32	127627.76	99129.72
12.00	404833.93	476013.48	449767.30	43874.67	115054.22	88808.04
15.00	356838.93	459256.30	436032.93	-4120.33	98297.04	75073.67
20.00	290283.65	436096.17	417100.09	-70675.61	75136.91	56140.83

GROSS INCOME 66		40128.00	RESALE VALUE		510323.14
EFF. GROSS %OCC.OF	96.%o	38522.88	LESS PRIN.BAL.		314422.77
LESS FIX. EXP.	5283.96		NET WORTH		195900.37
LESS VAR. EXP.	4315.60				
LESS R.E. TAX	5857.62		CURRENT PD. RETURN		2.12408
NET INCOME		23065.69	PROJECT RETURN		.05451
LESS DEPREC.	7037.79		PRODUCTIVITY RATE		.0451
LESS INTEREST	10144.84		CASH RETURN		.0809
TAXABLE INCOME		5883.04	EXPENSE RATIO		.385
TAX OFFSET	-.01		DEFAULT RATIO		.737
LESS TAXES	1764.91		DEBT COVER RATIO		1.630
PLUS DEPREC.	7037.79				
LESS PRIN. PMT.	3998.04		CUR. PRIN.PMT/CUR.DEPREC.		.568
CASH INCOME		7157.88	TOT. AMOR./TOT.DEPREC.		.443

as dividends. It is this cash dividend in each period which is discounted as an internal period return to arrive at present value of the income for the mortgage-equity approach and the after tax mortgage-equity approach.

G. Net Worth Analysis and Investment Yield

With every cash flow statement there is a review of net worth prior to a statement of yields according to various investment theories. Resale value represents total capital budget as modified by the depreciation time-index factor. This time factor may represent a number of elements in investment expectations. Should the investor also be the contractor whose profits and overhead were not included in the capital budget, the resale index could reflect an immediate write-up of value. Of course resale value should always be stated as net of any brokerage or resale costs, to represent liquidating cash value of the project. If total capital budget were presumed equal to market price, the resale value index might be 95% to reflect 5% transaction costs. With an index less than one, net worth will always reflect the true equity cushion and the change in net worth will reflect the maximum cash recovery potential of cash used to reduce the balance of debt. After such initial adjustments by means of the resale index, the index can be used to indicate market recognized depreciation or appreciation of the property. In this way taxable income can reflect tax definitions of depreciation while investment yield will reflect anticipated true erosion of capital, if any. Any index of resale value is an arbitrary, prospective assumption, but once other variables in the model have been decided upon, the final runs of a project can be based on a resale index assuming the most probably foreseen up-side and down-side value fluctuations in order to produce a definition of yield range expectations similar to the graph in Ellwood.

Net worth is resale value less the balance due on debt on the capital schedule code and short term working capital loans. For some measures of investment yield we are interested in discounting change in net worth from the previous reporting period as well as cash flows and remainders. These relationships will be made more explicit in the format on Chart VII.

IV

INCOME YIELD AND APPRAISAL VALUATION

A. Criteria of Investment

Investment in rental real estate is presumed to be conditional on a satisfactory rate of cash dividends per period and capital gain on resale consistent with investor determination of risk and alternative investment opportunities. This model offers several criteria for dividend evaluation, for discounting capital gains, and for comparing alternative investment yields. The model presumes that the discount rate chosen by the investor makes adequate allowance for risk and so the risk factor is left implicit. However the same tools for portfolio management by means of probability statements (as discussed by Gerald Work at this symposium) in the next generation of investment models. Of course cost and revenue estimates with probability dimensions presume statistical data banks on these items such as some of the large life insurance investors in real estate are beginning to collect. However, for this model the final judgment as to whether rate of return in any of the forms given is adequate must be made by the investor for the model says nothing objective about risk.

B. Dividend Yield Measures

Reference to Chart V will indicate a number of period yield calculations. In reading the model returns, it is important to remember that the yield is for the six month period summarized and must be multiplied by two to approximate an annualized rate of return. In the program now in process, the computer

will automatically annualize the yield figures to state them in a form more familiar to the investor. To meet various investor needs, yield determinations are made as follows:

1. CURRENT PERIOD RETURN is measured by adding spendable cash for the period (one month) to the change in net worth from the previous period and then dividing by net worth at the beginning of the period. Change in net worth is overstated whenever the index on resale value changes in an upward direction, thus jolting current period returns from its previous pattern.
2. PROJECT RETURN is a moving aggregate of the previous six periods for each of the elements in the current period return calculations. The reason for this adjusted rate of return is to smooth out the rate pattern due to changes in the resale value index in any single period. This ratio may be the most significant analytical tool of the model for it measures when and to what degree the rate of return is falling or rising as leverage and tax cover decline and the liquidating value of the equity grows due to amorization and inflation. It could suggest timing of refinancing or resale.
3. PRODUCTIVITY RATE is the traditional measure of rate of return on invested capital, calculated by dividing net income before interest or depreciation by the total resale value of the property. It is a measure of the overall capitalization rate on invested capital and a reciprocal of this figure would represent the net income multiplier.
4. CASH RETURN is a direct ratio of cash income for the investor after all claims in cash have been received for the period divided by net

cash originally invested, that is the difference between total capital budget and total mortgage financing, thereby offering a measure of cash dividend returns to the investor.

C. Financial Ratios

For the mortgage lender and the tax accountant cash flows are also analyzed in terms of the expense ratio to gross income, the default ratio including expenses and debt service as a percent of gross income, and a ratio of net income available for interest and principal payments. For the tax accountant there is a ratio of principal payments to total depreciation cover to suggest how many tax free dollars are absorbed by loan payments, or conversely, what portion of the depreciation shelter is available for cash to the investor.

D. Appraisal of Investment Value

The final standard of investment performance is the relationship of the sum of all discounted returns to the investor to the total capital budget necessary to create the investment opportunity. The analysis of this relationship as defined for the model is demonstrated on Chart VII. This type of analytical output is produced as often as required by the investor, and in this case was triggered for seven selected discount rates at the end of each five years or ten six-month summary cash flow statements. The required input instructions can be seen on the bottom of page 3 of Appendix I. Instructions for printout appear under the PERIODS OF PROJECTION - income statement and valuation statement. Bases for rate of return, in this case 5.2 to 20%, are stated as an annual rate or nominal rate and then reduced to a rate per period by instructing the computer as to the number of periods in a year--twelve in the example.

The output format for present value analysis as seen in Chart VII then provides a review of total capital budget, land cost, total improvement cost, total initial debt, and cash equity required to facilitate comparison with present values derived for each of seven discount rates. It is important to note the distinction in the language which describes this process as appraisal of investment value because this value is only true for a very specific set of design, financing, and tax assumptions and may not reflect market price in any way. It suggests only the highest price which an investor might pay under the specific conditions set and still realize the rate of return specified for the equity position. The property residual type of appraisal in the first three columns minus the total imporvement cost contemplated produces the residual land value in the right hand three columns. Selection of the proper investment mix of input variables by the individual investor could involve a matrix of criteria such as that investment which produces the highest land value in excess of $82,800 at no less than 12% return after taxes, has the lowest cash equity required, and has a total capital budget of less than $450,000. In addition, there could be other dimensions relative to loan ratio, default ratio, expense ratio, dividend yield, etc.

The present value methods can each be described as follows:

1. The TRADITIONAL discount method is the present value of each period net income, including negative income periods as negative values, plus the present reversion value of the net resale price. As in traditional appraisal theory there is no recognition for interest or taxes on income, and recapture of investment is at a rate implicit in the Inwood process. As the equity rate is applied to

the total income, there is naturally a sharp reduction in value of the total project with each increase in the discount rate. In this case a discount rate of about 9% would produce an investment value about equal to the total capital budget required, suggesting that the project has an overall rate of return on capital of about 9%, a result consistent with the annualized productivity rate calculated per six month period earlier.

2. The B/4 TAX discount value is shorthand for an approach similar to the Ellwood mortgage-equity approach to value (5) and the textbook view (6) but computed with variable incomes (7) rather than the normalized income to which weighted average capitalization rates or split rates are applied. The method computes the present value of net income less interest and principal payments each period plus the present value of the reversion to equity (resale less mortgage balance due), the sum of which is added to the original balance of total mortgage debt. As presently constructed, it treats periods of negative income by adding a negative present value for each period to the present value sum for the periods, an approach which introduces a significant distortion in value where cash deficits are prolonged over many periods or appear in the later stages of the projection period to be appraised. Deficit cash flows should appear as an addition to total equity required or as a compounding charge against other positive period returns. It is for this reason that working capital loans to meet any period of negative cash income were introduced as in Chart VI to charge future income with the

(5) L.W. Ellwood, Ellwood Tables, Second Edition, American Institute of Real Estate Appraisers, Chicago, 1967.

(6) Richard U. Ratcliff, Real Estate Analysis, McGraw-Hill Book, Co., New York, 1961; See Chapter VI.

(7) Paul F. Wendt, Op. Cit.

interest cost of borrowed money and to reduce the reversion value by the full amount of the debt rather than a discounted value of the debt.

3. AFTER-TAX valuation of returns to equity represents a further departure from current income appraisal methods. This value represents the total present value of cash to investor (which is reported after taxes) per period plus the present value of net worth. In this case the net worth is the undepreciated balance of the investment less the capital gains tax computed less mortgage balance and short term loans due at the end of time of sale. To this present value product is added the value of the original mortgage debt, which of course is the present value of debt service payments excluded in the determination of spendable cash. The productivity of short term capital is implicit as interest for the money was charged to taxable income and repayment was made prior to determination of spendable cash or net worth remainders.

The array of values for seven alternative rates of return and three methods of discounting makes it possible to estimate equivalencies as between traditional, mortgage equity, and after-tax rates of return. For example in this case a 9% overall rate of return is equivalent to about an 18% return to equity before taxes and a 14% return to equity after taxes. These can be derived through interpolation of these results or through modification of selected rates of return and a second run of the model. These equivalent yields make it possible to compare the real estate investment to specific alternative investment opportunities in real estate, bonds or stocks.

V.

APPLICATIONS OF A SIMULATION MODEL

A. Design Analysis

The simulation model has been tested in a number of actual investment situations. It has worked best as an analytical tool in its present form on a student housing project in which student rooms were a standard, modular product, and where room shortage was such that the building was fully rented as soon as completed at well established contract rates. The investor-developer was very knowledgeable on cost of construction and operation and his costs were based on the modular unit.

Effective design analysis with this model assumes that the designer has reliable cost per unit estimates, though these need not be elaborate. The typical apartment builder is often unable to distinguish the cost of bathroom space and livingroom space. His only modular cost figure is $9.33 per square foot of gross area on his most recently completed 16-unit building. The model would work using that simple cost figure, but more detail may be desirable for feasibility analysis of critical alternative design decisions.

For example, on one project involving a pair of apartment towers, the engineer had designed a standard square shaft for elevator, stairway, circulation corridor and utility core for the center of each square tower. This center portion was given a constant cost for 10 floors. The issue was then to test several floor plans for the rentable area. In addition to basic structure costs, we added the cost per running foot of sound wall, interior apartment partitions, carpeting, tile, and cabinetry. There was also a square foot cost for exterior wall and window. Four different towers in terms of gross floor area and typical apartment floor plans were tested to choose the best design concept for further refining.

For those seeking a computer model to test economic feasibility in the office of the architect or engineer, the model suggests a measure of feasibility more sophisticated than holding cost within a budget or to an overall rate of return. For example it would be possible to reduce the basic building block of features into further sub-sets of 10 cost items each, or additional sub-sub-sets making it possible to handle quantity costs for as many as 1,000 individual items. Further refinement of the time index feature would permit simulation of the impact of alternative critical paths of development on investment value or the desirability of staged development. These expansions of the basic model would require more computer capacity than we can command on no research budget, but the possibilities are well anticipated in a recent book on the dynamics of cost, time, and value of engineering-construction projects by John W. Hackney, entitled Control and Management of Capital Projects.(8) Such a model does more than discipline the designer within the constraints of cost, time, cash flow, and value. Rather than holding to a clients budget, the designer is permitted to challenge the budget assumption itself, using variable revenue projections of the client and his experts, the cost expertise of the architect and the property manager, and the financial criteria of those committing capital to the project. How often has an architect or packaging developer presented his proposal in terms of values generated by the concept of internal rate of return on fluctuating cash flow?

B. Purchase Offer Analysis

The simulation model has been used to scan multiple listing offerings and develop offering prices which will produce a certain level of return

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(8) John W. Hackney, Control and Management of Capital Projects, John Wiley & Sons, Inc., New York, 1965

upon implementation of a property management plan by the investor. Recent debate on component capitalization methods such as the Ellwood method has served to remind the real estate investor to provide for his profits as an explicit factor in determining his purchase bid. There is an old adage in real estate to the effect that profit is made because you buy well rather than because you sell dear. A cursory review of a listing sheet, inspection of the property, and some knowledge of the market should make it possible to define the opportunity in terms of a possible purchase offer, allocated to features identified as improvements, site, equipment, and additional $100 units of remodeling or furnishing required. Given knowledge of appropriate rents, operating ratios, and financing terms, it would be possible to frame a financial outline of several alternative offers which would suggest the range of bargaining and the impact of alternative offers on rate of profit.

C. Mortgage Loan Application Analysis

Many lenders today screen loan applications with Ellwood method capitalization of income estimates to determine if the value derived will support the loan amount requested and the cost of the project as estimated. However, correlation of this income method and the cost approach based on normalized income is no assurance of the financial sanity of the project or the adequacy of equity resources of the developer. A model which analyzes cash flow deficits during rentup and the shifting demands on cash of the income tax burden gives a better picture of financial risk than current methods using static normalized income statements. Moreover, rate of return to equity and the residual value of the land based on alleged costs is a more revealing measure of investor motivation and credibility. With increasing interest in long term equity accumulation by those lenders seeking equity

participation in exchange for favorable financing, there is greater desire to scrap the assumption of normalized income in favor of forecasting period incomes shifting with changing operating ratios, price levels, and after-tax residuals.

D. Government Policy Analysis

One of the most interesting applications of the model to date has been to test the likely result of Madison density zoning bonus features for high density multi-family districts. With the aid of another University of Wisconsin computer model (9), all the sites zoned R-5 and R-6 have been identified in a 300 square block area around the University which can be acquired in different price ranges, such as $5-6, $6-7, and $7-8 a square foot. One of our graduate students has designed modular standard efficiency, one, and two bedroom apartments with costs for several alternative construction methods. Test sites for each standard design building class with different rental mixes are being run with the model to determine how many apartment units could be built at a cost related to student rentals which would justify the estimated land cost. It should then be possible to project the maximum supply of rental units which might be built by 1975 for private profit under different FAR maximums under various provisions in the code on available supply of sites. For example, the standard FAR is 2.0 with a 50% site coverage assumption, 3.0 FAR with 30% site coverage (thereby requiring elevator construction) and 3.6 FAR under a controversial bonus provision to encourage construction of student apartments. First results indicate that it is virtually impossible to realize much financial advantage from these bonuses unless one owns a minimum of 3 lots - i.e. 99 X 132 feet. We can measure

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(9) A model developed by Richard Garrigan of University of Wisconsin Construction and Planning Department to forecast group purchase prices of selected properties for institutional budgeting of future property assemblages.

the increment in plottage value with considerable precision and the likelihood that the value of existing improvements on given sites would encourage purchase and redevelopment. As an alternative to zoning bonuses for student housing, it will be possible to test the influence of 40 year financing through a state agency or of real estate tax modifications as stimulants to student housing, given current level of site acquisition costs.

E. Application to Valuation Theory

The investment model outlined here is simply the model-T of the next generation of valuation models for real estate. The thrust of these models might take several directions, including generations of new forms of capitalization rates, specialized models for specific real estate development problems such as subdividing, simplified models for use by real estate brokers, data bank models to generate comprehensive operating data, and finally better dynamic combinations of the design-construction-valuation process.

It should be possible to build tables of capitalization rates which add to the Ellwood coefficients some recognition of the influence of depreciable asset ratios to total value at progressive steps in the income tax rates. One of our graduate students suggested a set of nomagraphs for this purpose and prepared and illustrated an example. A computer program related to graphic output analysis might produce basic nomagraph sets for common investment ratios.

At the University we are already building a model for land development investment analysis and pondering on a point of connection between investment model constraints and the constraints of the Land Use Intensity graphs of FHA multi-family performance standards. With time we would like to develop a model in which capital costs, revenues, expenses, and resale values

could be given range estimates with a probability distribution which in turn could produce probability statements on the rate of return expectation for equity as suggested at this symposium by Gerald Work of the Wells Fargo Bank. Dynamic investment models can modify planning theory, urban land policies of government agencies attempting to channel private investment activity, and investigation of the true cost of building code obsolescence, design forms without function, or consumer idiocyncracies.

One tenet of appraisal valuation theory deserving close examination is that of the three independent approaches to value, the market comparison, the income and the cost approaches, which should all converge on the same conclusion as to value. Rather than a correlation of these three disparate views of value, why not a synthesis of the valid elements of each of these traditional methods into a single approach to value by means of a dynamic simulation model? Revenue is estimated by market comparison of rents and prices of comparable properties. Market analysis and consumer surveys might provide data on the relationship of rents and amenities for the commodity "rental space". The engineering cost approach might be the source of capital budget and operating budget data, which would determine outlays of revenue. Defining revenue to include all cash receipts whether from equity, mortgages, rents, or resale, it would be possible to match revenues with outlays over time to determine net productivity. This productivity could be discounted by the capitalized income approach which would best characterize investor patterns of financing, taxing, and profit taking. It is more logical to correlate revenues, outlays, and profits over a sequence of time periods than it is to rationalize differences between three independent unrelated static valuation methods. Could it be that appraisers must use static

models to derive long term values because methods are not available to practitioners for treating mathematically the large number of variables in a more sophisticated, dynamic model of long term values? Could it be that the obvious lag in appraisal technique relative to investment technique has encouraged lawyers, architects, engineers, planners, and amateur investors to presume expertise in matters of investment analysis?

A dynamic model for evaluation of the design-time-finance constraints of real estate investment might provide a common denominator for economic feasibility to be shared by all of these groups. Certainly it could provide discipline and sophistication to professional education in the many fields which bear on real estate investment.

IBM

GENERAL PURPOSE CARD PUNCHING FORM

JOB

BY

DATE

PUNCHING INSTRUCTIONS

WRITTEN AS:

PUNCH AS:

FEATURE NUMBER	FEATURE NAME	ORIG. COST/ UNIT	CSC	ADD'L FEATURE UNITS CONSTANT	ADD'L FEATURE UNITS PER RENT. ELEM. AREA
1	LIVING ROOM SF	6.50	1		
2	KITCHEN SF	15.00	1		
3	BEDROOM 1 SF	6.50	1		
4	BEDROOM 2 SF	6.50	1		
5	FOYER SF	6.00	1		
6	STORAGE SF	10.00	1		
7	FURNITURE EA PC	50.00	6		
8	BASEMENT STORAGE SF	4.50	1		
9	LAND SF	1.50	3		
10	BATHROOM SF	20.00	1		
11	PUBLIC AREA SF	7.00	2		2.5
12	OUTSIDE PARKING STL	300.00	4	4.0	

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GENERAL PURPOSE CARD PUNCHING FORM

PAGE 2 OF

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PUNCHING INSTRUCTIONS

WRITTEN AS:

ELEM. NUM.	RENTAL ELEMENT NAME	NUM. OF ELEM.	FEATURE REQUIREMENT PER RENTAL ELEMENT									
			1	2	3	4	5	6	7	8	9	10
1	EFFICIENCY APT	4	300	50				20		25	800	48
2	1 BEDROOM APT	14	216	108	161		24	50		50	1200	48
3	2 BEDROOM APT	16	216	108	161	127	30	65		50	1600	60
4	2 BEDROOM FURNISHED	6	216	108	161	127	30	65	12	50	1600	60

E. NO	RENT/ PRD.	EXPENSES FIXED PER UNIT	EXPENSES FIXED PER UNIT AREA	EXPENSES VARIABLE PER UNIT	EXPENSES VARIABLE PER UNIT AREA
1	120.00	1.20	.025	1.50	.02
2	140.00	1.70	.025	1.50	.02
3	160.00	2.20	.025	1.50	.02
4	180.00	2.20	.025	4.00	.02

	INI FIXED $ AMT.	EXPENSES % OF RENT	EXPENSES % OF COST	C S C
5	5000	75	10	

C S C	CAPITAL CLASS NAME	DEPRECIATION % DEPR	DEPRECIATION TERM IN PDS.	DEPRECIATION ACC. METH	MORTGAGE / FINANCING % MTGD	MORTGAGE / FINANCING TERM IN PDS.	MORTGAGE / FINANCING % INTER PER PD.	MORTGAGE / FINANCING FIXED $ CONST PAYMT
6 1	BUILDING RENTABLE	100	480	2.0	80	300	.58	
6 2	BUILDING NONRENTABLE	100	480	2.0	80	300	.68	
6 3	LAND	0			80	300	.58	
6 4	PARKING	90	120	2.0	80	300	.58	
6 5	INITIAL EXPENSES	90	480	2.0	80	300	.58	
6 6	FURNITURE	100	72	2.0	90	60	.66	

	Property Taxes $/ PRD.	Property Taxes % Cap. Cost/PRD	Annual Inc. Tax Rate	Periods of Projection Inc. Loss	Inc. Stat	Val Stat.	Bases for Rates of Return -- annual rates (As a percent) Lowest → Highest	Pds per yr	W.K. Cap. Loan Rate
17		.2	30	60	6	60	5.2 60 70 10.10 12.0 15.0 20.0	12	

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GENERAL PURPOSE CARD PUNCHING FORM

PAGE ___ OF ___

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BY

DATE

PUNCHING INSTRUCTIONS

WRITTEN AS:

END	PR	PERCENT OF BASE RENT	TAX	EXPENSES FIXED	EXPENSES VAR	RE-SALE	PERCENT OF OCCUPANCY BY RENTAL ELEMENT 1	2	3	4	5	6	7	8	9
18	003	1.00	1.00	1.00	1.00	1.05	0.10	0.10	0.10	0.10					
18	006	1.00	1.00	1.00	1.00	1.05	0.40	0.40	0.40	0.40					
18	009	1.00	1.00	1.00	1.00	1.05	0.75	0.75	0.75	0.75					
18	012	1.00	1.00	1.00	1.00	1.05	0.90	0.90	0.90	0.90					
18	018	1.01	1.01	1.01	1.01	1.07	0.95	0.95	0.95	0.95					
18	024	1.02	1.02	1.02	1.02	1.07	0.96	0.96	0.96	0.96					
18	048	1.04	1.04	1.04	1.04	1.10	0.96	0.96	0.96	0.96					
18	060	1.05	1.05	1.05	1.05	1.12	0.96	0.96	0.96	0.96					
18	120	1.10	1.10	1.10	1.10	1.15	0.96	0.96	0.96	0.96					
18	180	1.15	1.15	1.15	1.15	1.18	0.96	0.96	0.96	0.96					
18	240	1.20	1.20	1.20	1.20	1.20	1.20	0.96	0.96	0.96					
	99														
19	APARTMENT RUN - FURNISHED & UNFURNISHED WITH ACCELERATED DEPRECIATION														

1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80