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A CASH FLOW COMPUTER PROGRAM TO ANALYZE INVESTMENT OPPORTUNITIE--ETC(U)
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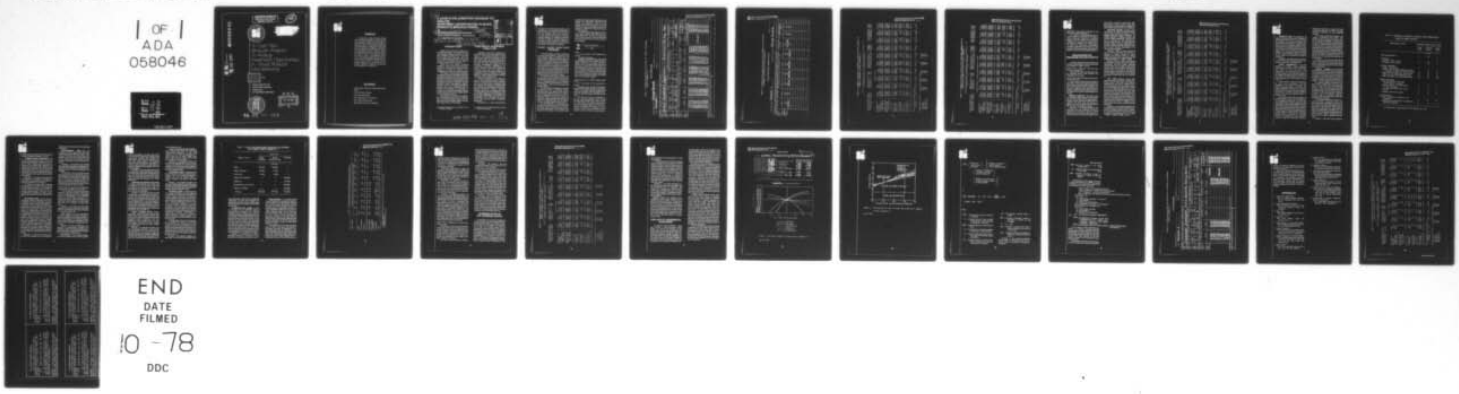

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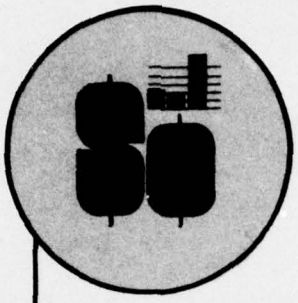

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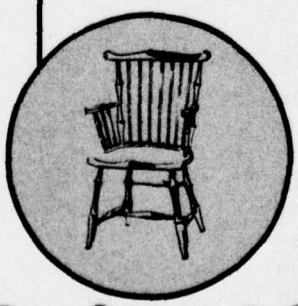
A Cash Flow Computer Program To Analyze Investment Opportunities In Wood Products Manufacturing

1978

Research Paper FPL 305
Forest Products Laboratory
Forest Service
U.S. Department of Agriculture



SUMMARY

Procedures for using a cash flow analysis (CFA) computer program to analyze turnkey and incremental investment opportunities in wood products manufacturing processes are illustrated using two hypothetical examples. The CFA program is designed to compute the after-tax time value of investment cash flows in terms of present value of investment, internal or composite rate-of-return, total unit cost of production, and maximum investment that can be made to yield a pre-specified rate-of-return. The analytic procedures and CFA computer program presented by this paper should aid the wood products industry and the research economist in structuring and expediting analyses of investment opportunities to final phases of consideration.

GLOSSARY

ADR, Federal Class Life Asset Depreciation Range

CFA, Cash Flow Analysis

CRR, Composite ROR

PVI, Present value of investment

IRR, Internal rate-of-return

ROR, Rate of return on investment

(6)

A CASH FLOW COMPUTER PROGRAM TO ANALYZE INVESTMENT OPPORTUNITIES IN WOOD PRODUCTS MANUFACTURING.

(10) By
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Forest Products Laboratory,[1/] *Forest Service*
U.S. Department of Agriculture

(11) 1978

(12) 27 p.

(9) Forest Service research paper,

(14) FSRP-FPL-305

INTRODUCTION

"What will be the rate of return on a proposed investment?" "How does the value of the proposed investment compare to alternative investment opportunities?" "How much will the total product cost per unit of output—including taxes and profits?". "How much money can be invested and still obtain a minimally attractive rate of return?"

These are four typical questions repeatedly asked by wood products manufacturers who are evaluating investment opportunities in turnkey new facilities or in modifications or additions to existing facilities.

The difficult, time-consuming evaluation of investment opportunities begins long before reliable cost estimates and final forecasts are completed. Preliminary analyses may be used solely to explore economic possibilities of new processes or products. Preliminary analyses may also be used to help establish a target investment cost for architectural-engineering purposes. Even after acceptable cost estimates and forecasts are developed, a number of manufacturing-marketing strategy combinations may need to be assessed before a final combination is found.

The purpose of this paper is to present a set of analytical procedures for a computer Cash Flow Analysis (CFA) program that can help structure and expedite analysis of investment opportunities to final phases.

1/ Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

ANALYSIS OF INVESTMENT CASH FLOW

Investment cash flow analysis is a technique that can be used to generate many types of time-valued economic criteria. However, the conventional measures of cash flow values, such as internal-rate-of-return (IRR) and present-value-of-investment (PVI), are also the most controversial areas of economic interpretation (*1,3,6,11*).[2/] Truly comparable investment opportunities will reflect identical functional feasibilities, economic lives, risks, and financial requirements whereby economic criteria can be indisputably used as yardsticks of relative feasibility. These conditions may be frequently assumed, but they seldom exist.

Investment opportunities, by their very nature, are speculations typically differentiated by amounts and tenures of investments and amounts and timing of operating costs and revenues. Consequently, investment cash flow analyses do not necessarily provide comparative investment criteria. Analytical methods usually must be adopted to provide an acceptable degree of standardization to be comparable (*1,5,9,10,13*). For this reason, the CFA program in this Paper was written so that standardized time, investment, and rate-of-return values could be used for investment evaluations.

Procedures for using standardized

2/ Underlined numbers in parentheses refer to literature cited at the end of paper.

methods of CFA investment evaluation will be illustrated by two hypothetical examples. A sawmill investment venture is the first example. This example could have included a computer-sawing control system as part of investment strategy. The additional investment required to install the computer-sawing control system is used, instead, for a second example to illustrate the concept and the uses of an analysis of incremental investment.

CASH FLOW ANALYSIS PROGRAM

The CFA program is written in Fortran IV for use on Univac 1108 and 1110 systems. (The CFA program listing is available from the author.) Minor modifications may be needed to adapt its use to other systems. The program is written for analyzing conventional manufacturing investments for periods from 2 to 20 years. Outputs of the program are formulated to provide a one- or two-page summary of cash flows and computational results that may be used for economic assessments. A two-page summary will be printed only when the analysis time frame exceeds 10 years.

For brevity, the CFA program does not list all input data in output formats. Procedures for preparing and entering data into the program and for analyzing results will be explained following the CFA Data-Coding Record of data inputs (tables 1 and 2) and printed CFA program outputs.

The CFA program is designed to compute after-tax-time value of investment capital, operating costs, and revenue cash flows by four principal investment criteria: (1) Present value of investment; (2) rate of return on investment (ROR); (3) total unit cost(s) of production, including taxes that profit; and (4) maximum investment(s) and can be made to obtain a minimally attractive rate of return.

The PVI depends on the discount rate entered in the CFA program, that is, PVI is the net present worth of the stream of annual net cash flows discounted by the discount rate entered into the analysis. If the discount rate specified is the same as the ROR that could be realized from alternative investments with similar risk (opportunity cost of money capital), the PVI may be used as a basis for comparing projects evaluated through CFA analysis to alternative investment opportunities *(1,3,5,13)*.

The CFA program calculates two types of ROR criteria: Internal ROR (IRR) and composite ROR (CRR). The IRR is the particular rate of interest required to discount the stream of annual net cash flows to a present value of zero *(1,3,5,13)*:

$$\sum_{1}^{n} \frac{\text{(annual net cash flow)}}{(1 + \text{IRR})^{j}} \quad j = 0$$

where

n is the number of time periods considered:

j, a given time period.

The second type of ROR calculated is CRR that expresses the ROR to equity capital invested at initiation of a project. The CRR is referred to as a "composite" ROR because it is computed in conjunction with the rate of interest specified for monies borrowed and the rate of interest specified for reinvested cash surpluses (table 3). The CRR is the compound rate of interest required to yield a future value from the equity investment equal to the ending value of an investment project:

$$\text{(Original equity)} \times (1 + \text{CRR})^{n} = \text{ending equity}$$

where

n is the number of time periods considered.

The lowest value that the CFA program will compute for either the IRR or the CRR is -0.999. For complex investment projects with more than one ROR, the CFA program computes only the ROR closest to the discount rate used.

The total unit cost of production is the unit price(s) computed which yield an after-tax profit consistent with either an IRR or a CRR equal to the discount rate entered into the CFA analysis *(12,14)*. The break-even price(s) indicate(s) the price(s) at which products must be sold to generate revenues required to cover all costs, including taxes,

Table 1.--Coding instructions and entries for sawmill investment venture (example 1)

CFA DATA CODING RECORD

Date _____

Estimates prepared by George Harpole

Data confidence level _____

Project Example 1

Comments _____

CARD TYPE 1: Title card. First card only, columns 2 through 79.

Data entry: Sawmill Investment Opportunity * * 30MMFPM/250 Day Year

CARD TYPE 2: Data and program control card. Second card only.

Data description	Selling expense (F6.4)	Working capital (F6.4)	Tax rate (F6.4)	Discount rate (F6.4)	Years considered (12)	Output copies (Max. 9@) Financial analysis	Price/cost break-even	Facilities break-even	Original cash investment (F9.0)	Short-term rate Borrow (F4.4)	Reinvestment (F4.4)	Card
Cols.	1-6	7-12	13-18	19-24	29-30	34	38	42	46-54	58-61	65-68	80
Data entry	.07	.06	.5112	12	10	1	1	1		.0875	.0650	2

CARD TYPE 3: Annual price-volume-cost data. One card for each year, up to 21 cards.

Data description	Unit price (F7.3)	Unit sales (F8.0)	Unit manufacturing costs (F10.3)	Other variable costs (F10.0)	Fixed manufacturing costs (F10.0)	Overhead costs (F10.0)	Facilities costs (F10.0)	Investment tax credit Depreciation (F10.0)	Year No.	Card
Cols.	1-7	8-15	16-25	26-35	36-45	46-55	56-65	66-75	79	80
Data entries							4,614,000	276,800	0	3
	175.000	24,000	65.538	652,256	197,580	941,800		655,383	1	3
	183.770	30,000	68.815	856,086	207,459	988,890		583,383	2	3
	192.938	30,000	72.256	898,890	217,832	1,038,335		453,783	3	3
	202.581	30,000	75.868	943,845	228,724	1,090,251		382,102	4	3
	212.714	30,000	76.662	991,027	240,160	1,144,764	263,000	324,759	5	3
	223.349	30,000	83.645	1,040,578	252,168	1,202,002		281,143	6	3
	234.517	30,000	87.827	1,092,607	264,776	1,262,102		281,143	7	3
	246.243	30,000	92.219	1,147,237	278,014	1,325,207		281,143	8	3
	258.555	30,000	96.829	1,204,599	291,916	1,391,468		281,143	9	3
	271.482	30,000	101.671	1,264,829	306,511	1,461,041		281,143	10	3

CARD TYPE 4: Sequential run control card. One card only. Maximum of 10 runs.

Data entry: Enter number of sequential runs in columns 9 and 10: 2

Table 2.--Coding instructions and entries for sequential run analyses of sawmill investment venture (example 1)

CFA DATA CODING RECORD--SEQUENTIAL RUN DATA

Date _____

Prototype project Example 1

Estimates prepared by George Harpole

CARD TYPE 5: First year data card. One card for each sequential analysis, up to 10 cards.

Data description	Unit price (F7.3)	Unit sales (F8.0)	Unit manufacturing costs (F10.3)	Other variable costs (F10.0)	Fixed manufacturing costs (F10.0)	Overhead costs (F10.0)	Original cash investment (F10.0)	Short-term rate: Borrow (F5.4)	Short-term rate: Reinvestment (F5.4)	Card
Column numbers	1-7	8-15	16-25	26-35	36-45	46-55	56-65	66-70	71-75	80
Data entry	0	0	0	0	0	0	1,000,000	0	0	5
	165.00	0	45,000	600,000	200,000	1,000,000	0	0	0	5
										5
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										5
										5
										5

Table 3.--Computer printout of composite rate-of-return analysis of sawmill investment venture (example 1)

LUMBER-MANUFACTURING VENTURE ** SUMMERAM/250 DAY YEAR ** LUMBER RECOVERY = .45
(INVESTMENT TAX CREDIT OF $ 276800. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0	EFFECTIVE TAX RATE .5112	ORIGINAL CASH EQUITY	$ 1000000.	VAR. COSTS/SALES = .5998	
FACILITIES COST $ 4614000.	BORROWING RATE .0875	ENDING VALUE OF EQUITY	$ 4684959.	FIXED COSTS/SALES= .2929	
WORKING CAPITAL $ 201873.	REINVESTMENT RATE .0650	FACILITIES SALVAGE VALUE	$ 1071875.	TAX COSTS/SALES = .0506	
TOTAL INVEST. $ 4815873.	COMPOSITE ROR .1670	P.V. OF EQUITY(I=.1200)	$ 1508432.	A.T. PROFIT/SALES= .0567	

FINANCIAL SUMMARY

YEAR-END VALUES . . .	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES	24000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.
UNIT PRICE	$ 175.00	$ 183.77	$ 192.94	$ 202.58	$ 212.71	$ 223.35	$ 234.52	$ 246.24	$ 258.55	$ 271.48
GROSS SALES	$ 4200000.	$ 5513100.	$ 5788140.	$ 6077520.	$ 6381420.	$ 6700470.	$ 7035510.	$ 7387290.	$ 7756649.	$ 8144459.
INTEREST INC-EXP	-333889.	-275426.	-218981.	-163838.	-107332.	-71665.	-10975.	40761.	93314.	149634.
GROSS REVENUES	$ 3866111.	$ 5237674.	$ 5569158.	$ 5913682.	$ 6274088.	$ 6628804.	$ 7024534.	$ 7428051.	$ 7849964.	$ 8294093.
VARIABLE MFG COST	$ 1572912.	$ 2064450.	$ 2167680.	$ 2276040.	$ 2389860.	$ 2509350.	$ 2634810.	$ 2766570.	$ 2904870.	$ 3050130.
SELLING EXPENSE	294000.	385917.	405170.	425426.	446699.	469033.	492486.	517110.	542965.	570112.
OTHER VAR. COST	652256.	856086.	898890.	943835.	991027.	1040578.	1092607.	1147237.	1204599.	1264829.
TOTAL VAR COST	$ 2519168.	$ 3306453.	$ 3471740.	$ 3645301.	$ 3827586.	$ 4018961.	$ 4219902.	$ 4430917.	$ 4652434.	$ 4885071.
UNIT VAR COST	$ 104.97	$ 110.22	$ 115.72	$ 121.51	$ 127.59	$ 133.97	$ 140.66	$ 147.70	$ 155.08	$ 162.84
PROFIT CONTRI	$ 1346943.	$ 1931221.	$ 2097419.	$ 2268381.	$ 2446501.	$ 2609844.	$ 2804632.	$ 2997133.	$ 3197530.	$ 3409023.
FIXED MFG COST	$ 197580.	$ 207459.	$ 217832.	$ 228724.	$ 240160.	$ 252168.	$ 264776.	$ 278014.	$ 291916.	$ 306511.
OVERHEAD COST	941800.	988890.	1038335.	1090251.	1144764.	1202002.	1262102.	1325207.	1391468.	1461041.
TOTAL F.C.	$ 1139380.	$ 1196349.	$ 1256167.	$ 1318975.	$ 1384924.	$ 1454170.	$ 1526878.	$ 1603221.	$ 1683384.	$ 1767552.
FACILITIES COST	$ 0.	$ 0.	$ 0.	$ 0.	$ 263000.	$ 0.	$ 0.	$ 0.	$ 0.	$ -1071875.
WORKING CAPITAL	45140.	12351.	12967.	13616.	14297.	15012.	15764.	16549.	17379.	-364951.
INVESTMENT	$ 45140.	$ 12351.	$ 12967.	$ 13616.	$ 277297.	$ 15012.	$ 15764.	$ 16549.	$ 17379.	$ -1436826.
DEPRECIATION	$ 655383.	$ 583383.	$ 537783.	$ 382102.	$ 324759.	$ 281143.	$ 281143.	$ 281143.	$ 281143.	$ 281143.
AFTER TAX PROFIT	$ 579006.	$ 740848.	$ 849395.	$ 777294.	$ 360157.	$ 427471.	$ 487143.	$ 543922.	$ 602692.	$ 664928.
A.T. EARNINGS	713249.	657431.	$ 643178.	$ 659400.	$ 684916.	$ 708614.	$ 768286.	$ 825065.	$ 883835.	$ 946071.
A.T. NET CASH FLOW	$ 668149.	$ 645980.	$ 630211.	$ 645782.	$ 407619.	$ 693602.	$ 752523.	$ 808515.	$ 866455.	$ 2382897.
ACUM NET CASH FLOW	$ -4147.7M	$ -3502.6M	$ -2872.4M	$ -2226.7M	$ -1819.0M	$ -1125.4M	$ -372.9M	$ 435.6M	$ 1302.1M	$ 3685.0M
BEGINNING-OF-YEAR VALUES FOR MONIES . . .										
BORROWED	$ 3815.9M	$ 3147.7M	$ 2502.6M	$ 1872.4M	$ 1226.7M	$ 819.0M	$ 125.4M	$ .0M	$ .0M	$ .0M
REINVESTED	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ 627.1M	$ 1435.6M	$ 2302.1M

COMPOSITE RATES OF RETURN . . . AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	-.059	.102	.167	.210	.242
UNIT PRICE	*****	.020	.167	.233	.276
UNIT VAR COST	.247	.213	.167	.094	-.102
TOTAL F.C.	.202	.186	.167	.145	.118
FACILITIES COST	.202	.184	.167	.151	.137

Table 4.--Computer printout of unit price break-even computation for a prescribed composite rate-of-return (example 1)

LUMBER-MANUFACTURING VENTURE ** 30MMFBM/250 DAY YEAR ** LUMBER RECOVERY = .45
(INVESTMENT TAX CREDIT OF $ 276800. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0	EFFECTIVE TAX RATE .5112	ORIGINAL CASH EQUITY	$ 1000000.	VAR. COSTS/SALES = .6253	
FACILITIES COST $ 4614000.	BORROWING RATE .0875	ENDING VALUE OF EQUITY	$ 3105885.	FIXED COSTS/SALES= .3144	
WORKING CAPITAL $ 201873.	REINVESTMENT RATE .0650	FACILITIES SALVAGE VALUE	$ 1071875.	TAX COSTS/SALES = .0264	
TOTAL INVEST. $ 4815873.	COMPOSITE ROR .1200	P.V. OF EQUITY(I=.1200)	$ 1000012.	A.T. PROFIT/SALES= .0340	

FINANCIAL SUMMARY WITH BREAK-EVEN ADJUSTED UNIT PRICES

YEAR-END VALUES . . .	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES	24000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.
UNIT PRICE	$ 166.97	$ 175.34	$ 184.09	$ 193.29	$ 202.96	$ 213.10	$ 223.76	$ 234.95	$ 246.69	$ 259.03
GROSS SALES	$ 4007312.$	5260170.$	5522592.$	5798696.$	6088653.$	6393066.$	6712735.$	7048376.$	7400791.$	7770809.
INTEREST INC-EXP	-333889.	-283090.	-237034.	-193225.	-149067.	-126830.	-80727.	-30703.	17461.	60855.
GROSS REVENUES	$ 3673424.$	4977080.$	5285558.$	5605471.$	5939587.$	6266236.$	6632009.$	7017673.$	7418252.$	7831664.
VARIABLE MFG COST	$ 1572912.$	2064450.$	2167680.$	2276040.$	2389860.$	2509350.$	2634810.$	2766570.$	2904870.$	3050130.
SELLING EXPENSE	280512.	368212.	386581.	405909.	426206.	447515.	469891.	493386.	518055.	543957.
OTHER VAR. COST	652256.	856086.	898890.	943835.	991027.	1040578.	1092607.	1147237.	1204599.	1264829.
TOTAL VAR COST	$ 2505680.$	3288748.$	3453151.$	3625783.$	3807093.$	3997442.$	4197308.$	4407193.$	4627524.$	4858915.
UNIT VAR COST	$ 104.40	$ 109.62	$ 115.11	$ 120.86	$ 126.90	$ 133.25	$ 139.91	$ 146.91	$ 154.25	$ 161.96
PROFIT CONTRI	$ 1167744.$	1688332.$	1832407.$	1979687.$	2132494.$	2268794.$	2434700.$	2610480.$	2790727.$	2972749.
FIXED MFG COST	$ 197580.$	207459.$	217832.$	228724.$	240160.$	252168.$	264776.$	278014.$	291916.$	306511.
OVERHEAD COST	941800.	988890.	1038335.	1090251.	1144764.	1202002.	1262102.	1325207.	1391468.	1461041.
TOTAL F.C.	$ 1139380.$	1196349.$	1256167.$	1318975.$	1384924.$	1454170.$	1526878.$	1603221.$	1683384.$	1767552.
FACILITIES COST	$ 0.$	0.$	0.$	0.$	263000.$	0.$	0.$	0.$	0.$	-1071875.
WORKING CAPITAL	45140.	12351.	12967.	13618.	14297.	15012.	15764.	16549.	17379.	-364951.
INVESTMENT	$ 45140.$	12351.$	12967.$	13618.$	277297.$	15012.$	15764.$	16549.$	17379.$	-1436826.
DEPRECIATION	$ 653383.$	583383.$	453783.$	382102.$	324759.$	281143.$	281143.$	281143.$	281143.$	281143.
AFTER TAX PROFIT	$ -29687.$	-44676.$	59857.$	136185.$	206676.$	260765.$	306321.$	354926.$	403847.$	451677.
A.T. EARNINGS	625696.	538707.	513640.	518287.	531429.	541908.	587484.	636069.	684990.	732820.
A.T. NET CASH FLOW	580556.	526356.	500673.	504669.	254132.	526896.	571700.	619519.	667610.	2109646.
ACUM NET CASH FLOW	$ -4235.3M	$ -3709.0M	$ -3208.3M	$ -2703.6M	$ -2449.5M	$ -1922.6M	$ -1350.9M	$ -731.4M	$ -63.8M	$ 2105.9M
BEGINNING-OF-YEAR VALUES FOR MONIES . . .										
BORROWED	$ 3815.0M	$ 3235.3M	$ 2709.0M	$ 2208.3M	$ 1703.6M	$ 1449.5M	$ 922.6M	$ 350.9M	$ .0M	$ .0M
REINVESTED	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ 208.0M	$ 936.2M

COMPOSITE RATES OF RETURN . . . AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	*****	.017	.120	.175	.213
UNIT PRICE	*****	*****	.120	.204	.254
UNIT VAR COST	.223	.182	.120	-.016	*****
TOTAL F.C.	.169	.147	.120	.086	.037
FACILITIES COST	.158	.138	.120	.103	.086

depreciation, and profits prescribed by the discount rate specified (table 4).

The maximum investment(s) that can be made to obtain a prescribed ROR is again a price-volume-cost break-even calculation *(12,14)*. In the CFA program, total investment is defined as the sum of the investment requirements for facilities and working capital. To obtain the break-even investment(s), overhead, depreciation, investment tax credit and equity, data are adjusted to correspond to facilities costs as fixed percentages (table 5).

PROCEDURES FOR PREPARING CFA DATA INPUTS

The date-coding record of the cash flow analysis and sequential run data are explained as in example 1 (tables 1 and 2).

CARD TYPE 1: Title card. First card only, columns 2 through 79.

The first CFA data card is used to provide an identifying title for each analysis. Any characters may be used.

CARD TYPE 2: Data and program control card. Second card only.

Type 2 card is used to enter two types of CFA data: (1) Costs and investment estimating factors that can be assumed to remain constant over the period of the CFA analysis: and (2) control codes that will be used by the CFA program to select the type of analysis to be run and specify the number of output copies to be printed.

Selling expense.—The factor used for estimating selling expense should represent the ratio of sales cost to gross sales expected to remain constant over the life of an investment. The factor used may account for selling costs such as selling and promotional discount cost, bad debts, and others.

Example 1: The selling expense for the sawmilling venture is expected to include the traditional functional 5-percent selling allowance plus a 2-percent cash discount on the invoiced amount, less transportation cost if paid within 10 days of the invoice date. Consequently, a factor of 0.0700 is used. Bad debt losses and the possibility of foregone 2-percent cash discounts were not considered.

Working capital.—Working capital requirements are part of investment requirement of every manufacturing venture. In the strictest accounting sense, investments are monies required to establish physical and monetary capital resources for future production of revenues *(2)*. Raw material and operating costs tied up in unsold goods-in-process, finished products inventories, and accounts receivable typically represent investment working capital requirements of a manufacturing enterprise.

Example 1: About 15 days of each 250 days of annual production are assumed to represent a typical inventory of unsold materials and products. Therefore, working capital requirements are entered into the CFA analysis as 0.0600, i.e., 15/250 = 0.0600.

Because working capital requirements are essentially a beginning-of-year investment requirement, the CFA program computes working capital requirements as year-ending values for the year preceding the period of requirements. In this manner, the first-year working capital requirement is computed as year 0 investment requirement, then continues numerically through each year of a project's life.

Tax rate.—Because income taxes typically take about 50 percent of taxable corporate income it might seem that investment analyses would not have to consider such a prima facie constant. In short, taxes are important if two projects have equal PVI's or ROR's or both on a before-tax basis but not on an after-tax basis. This situation may occur often because of the impact of income taxes on (1) amounts of cash flows, and (2) timing of cash flows. Income taxes (revenue sharing) are a real cost of manufacturing. As in all areas of cost estimating for cash flow analysis, the most serious errors are likely in omission of cost factors rather than in errors of well-considered estimates.

Example 1: The project's taxable income is assumed subject to a 48-percent Federal tax rate and a 6-percent state tax rate. The effective Federal and state tax rate calculated and used for the CFA analysis is 0.5112, i.e., 0.4800 + 0.0600 - (0.4800 x 0.0600) = 0.5112.

Table 5.--Computer printout of facilities, depreciation, and overhead costs break-even computations for a prescribed composite rate-of-return (example 1)

LUMBER-MANUFACTURING VENTURE ** 30MMFBM/250 DAY YEAR ** LUMBER RECOVERY = .45
(INVESTMENT TAX CREDIT OF $ 314134. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0		EFFECTIVE TAX RATE	.5112	ORIGINAL CASH EQUITY	$ 1134878.	VAR. COSTS/SALES =	.5998
FACILITIES COST	$ 5236327.	BORROWING RATE	.0875	ENDING VALUE OF EQUITY	$ 3524758.	FIXED COSTS/SALES=	.3349
WORKING CAPITAL	$ 209495.	REINVESTMENT RATE	.0650	FACILITIES SALVAGE VALUE	$ 1216447.	TAX COSTS/SALES =	.0286
TOTAL INVEST.	$ 5445822.	COMPOSITE ROR	.1200	P.V. OF EQUITY(I=.1200)	$ 1134878.	A.T. PROFIT/SALES=	.0368

FINANCIAL SUMMARY WITH BREAK-EVEN ADJUSTED FACILITIES COST(S), DEPRECIATION AND OVERHEAD

YEAR-END VALUES . . .	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES	24000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.
UNIT PRICE	$ 175.00	$ 183.77	$ 192.94	$ 202.58	$ 212.71	$ 223.35	$ 234.52	$ 246.24	$ 258.55	$ 271.48
GROSS SALES	$ 4200000.$	5513099.$	5788140.$	6077520.$	6381420.$	6700469.$	7035509.$	7387289.$	7756649.$	8144459.
INTEREST INC-EXP	-377208.	-318843.	-266475.	-216652.	-166428.	-141078.	-88637.	-31742.	22216.	71538.
GROSS REVENUES	$ 3822792.$	5194257.$	5521664.$	5860867.$	6214992.$	6559392.$	6946873.$	7355548.$	7778866.$	8215997.
VARIABLE MFG COST	$ 1572912.$	2064450.$	2167680.$	2276040.$	2389860.$	2509350.$	2634810.$	2766570.$	2904870.$	3050130.
SELLING EXPENSE	294000.	385917.	405170.	425426.	446699.	469033.	492486.	517110.	542965.	570112.
OTHER VAR. COST	652256.	856086.	898890.	943835.	991027.	1040578.	1092607.	1147237.	1204599.	1264829.
TOTAL VAR COST	$ 2519168.$	3306453.$	3471740.$	3645301.$	3827586.$	4018961.$	4219902.$	4430917.$	4652434.$	4885071.
UNIT VAR COST	$ 104.97	$ 110.22	$ 115.72	$ 121.51	$ 127.59	$ 133.97	$ 140.66	$ 147.70	$ 155.08	$ 162.84
PROFIT CONTRI	$ 1303624.$	1887804.$	2049925.$	2215566.$	2387406.$	2540431.$	2726970.$	2924631.$	3126432.$	3330926.
FIXED MFG COST	$ 197580.$	207459.$	217832.$	228724.$	240160.$	252168.$	264776.$	278014.$	291916.$	306511.
OVERHEAD COST	1068828.	1122269.	1178384.	1237302.	1299167.	1364126.	1432332.	1503948.	1579146.	1658103.
TOTAL F.C.	$ 1266408.$	1329728.$	1396216.$	1466026.$	1539327.$	1616294.$	1697108.$	1781962.$	1871062.$	1964614.
FACILITIES COST	$ 0.$	0.$	0.$	0.$	298473.$	0.$	0.$	0.$	0.$	-1216447.
WORKING CAPITAL	45521.	12751.	13387.	14059.	14760.	15498.	16275.	17086.	17943.	-376774.
INVESTMENT	$ 45521.$	12751.$	13387.$	14059.$	313233.$	15498.$	16275.$	17086.$	17943.$	-1593222.
DEPRECIATION	$ 743780.$	662069.$	514986.$	433639.$	368562.$	319063.$	319063.$	319063.$	319063.$	319063.
AFTER TAX PROFIT	$ -31234.$	-50832.$	67807.$	154413.$	230388.$	295760.$	347439.$	402578.$	457666.$	511895.
A.T. EARNINGS	712546.	611237.	582795.	588052.	602949.	614823.	666502.	721641.	776729.	830958.
A.T. NET CASH FLOW	667024.	598405.	569408.	573993.	289716.	599325.	650227.	704556.	758787.	2424180.
ACUM NET CASH FLOW	$ -4778.8M	$ -4180.3M	$ -3610.9M	$ -3036.9M	$ -2747.2M	$ -2147.9M	$ -1497.6M	$ -793.1M	$ -34.3M	$ 2389.9M
BEGINING-OF-YEAR VALUES FOR MONIES . . .										
BORROWED	$ 4310.9M	$ 3643.9M	$ 3045.4M	$ 2476.0M	$ 1902.0M	$ 1612.3M	$ 1013.0M	$ 362.8M	$ .0M	$ .0M
REINVESTED	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ .0M	$ 341.8M	$ 1100.6M

COMPOSITE RATES OF RETURN * * * AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	*****	.024	.120	.172	.210
UNIT PRICE	*****	-.330	.120	.199	.247
UNIT VAR COST	.215	.176	.120	.010	*****
TOTAL F.C.	.168	.146	.120	.087	.039
FACILITIES COST	.158	.138	.120	.103	.086

Discount rate.—As mentioned, the discount rate entered into the CFA anaylsis will determine the PVI and the amount of profit to be included in any break-even analysis. This discount rate may be used to represent opportunity cost and to establish a basis for comparing the PVI of one project with that of one or more alternative projects with similar risk *(1,3-5,13)*. If the risk of a project is considered different from alternative investment opportunities, an appropriate increase or decrease may be made in the discount rate used for analysis *(3)*.

Example 1: A discount rate of 12 percent is used to represent the ROR expected from similar projects with comparable risk.

Years considered.—In the CFA program the number of years considered determines the number of type 3 cards read, the number of years for which CFA calculations will be performed, and the number of years for which cash flow results will be printed. The program allows for analyses to be specified to time frames of from 2 to 20 years, beginning from the time-point ending "Year 0."

The CFA program offers two possibilities for using "years considered." The first possibility is to provide an investment time period appropriate solely for the life of the project considered. The second is to provide a standardized time frame that may exceed the useful life of a project for analyzing different ventures that may have different "useful," or economic, lives.

The useful life that may be specified for project evaluation should not be confused with the prospective physical life of a facility *(2)*. The guidelines of the Federal Class Life Asset Depreciation Range (ADR), established by the 1971 Revenue Act, indicate sawmills, plywood plants, and particleboard mills have commercially useful lives that usually range from 8 to 12 years (table 6). These useful life expectancies are based on the assumption that these facilities will be supported by a sufficient amount of maintenance and repair service to maintain original productive efficienty. Modifications, additions, or repairs that might increase the useful life of a facility or increase productive capacities are new investment costs *(2)*.

To compute investment analyses in the context of standarized time frames, each analysis should use a standard number, up to 20, for the years considered. This standarization procedure can be used if computing either an IRR or a CRR. Using this analytic method will also require that a blank type 3 data card be added for each year beyond a project's terminal year for each of the remaining years in the standarized time frame. The CFA program will use the discount rate specified to compute before and after-tax interest income to be derived from the post-terminal investment of equity capital.

Example 1: The useful life of the sawmill venture is considered 10 years, which can be used in conjunction with 10-year time frames for the standarized evaluation of other investment opportunities.

Output copies.—As mentioned, three different types of CFA program analysis may be selected for computation: (1) Financial: (2) price/cost break-even; and (3) investment break-even. The number entered, 1 through 9, to specify the type of analysis will affect CFA program analysis options and determines the number of output copies that will be printed.

The *financial analysis* computed by the CFA program is based solely on the input data (table 1). Cash flows and their associated economic criteria are computed and printed as program output. The *price/cost break-even* analysis computes total unit cost of production in terms of unit price required to generate revenues equal to associated investment, operating costs, taxes and profits prescribed by the data inputs *(12,14)*.

The *investment break-even* analysis computes facilities investment costs and associated levels of overhead costs, depreciation, and working capital requirements that will break even in the context of other values of price-volume-cost data input *(6,7)*. Overhead costs and depreciation are adjusted by the program as a constant percentage of facilities costs. Working capital requirements are recomputed on a basis of adjusted overhead costs.

Example 1: One output copy is specified

Table 6.--Guidelines for Federal class life asset depreciation range for sawmill venture[1/]

Depreciable assets	Allowable depreciation range		
	Lower limit	Standard period	Upper limit
	------	-Years-	------
Land improvements	--	20	--
Buildings:			
Factory, shop, office	--	45	--
Warehouse and storage	--	60	--
Process equipment:			
Timber harvesting	5	6	7
Primary and secondary manufacturing of lumber plywood and particleboard	8	10	12
Sawmills with temporary foundations	5	6	7
Pulp and wood fiber manufacturing	13	16	19
Paper and paper board manufacturing	9.5	12	14.5
Mobile equipment:			
General purpose, less than 13,000 pounds unloaded	3	4	5
General purpose, 13,000 pounds or more unloaded	5	6	7
Over-the-road truck and tractor units	3	4	5
Trailers and van trailers	5	6	7
Miscellaneous:			
Office furniture, fixtures, and equipment	8	10	12
Computers and peripheral information systems equipment	5	6	7

1/ Guidelines established by 1971 Revenue Act (2).

for each type of analysis to provide the printed outputs illustrated by tables 3, 4, and 5.

Original cash investment.—The CFA program assumes that the amount entered as original cash investment is an initial, or "Year 0" ending, value. If an amount is entered as an original cash investment, the program will compute a CRR, interest income and expense cash flows, and annual money capital deficit and money surplus position of the project. If no value is entered as an original cash investment, the program will compute an internal ROR.

Example 1: An original cash investment of $1,000,000 is assumed to represent the proprietary cash equity that will be used to initiate the sawmill's venture (table 2).

By leaving the original cash investment amount blank on the type 2 data card, CRR and IRR analyses may be run from a single set of type 2 and 3 data cards by using the sequential analysis option. This can be accomplished as illustrated by the CFA program data entries used for example 1 (tables 1 and 2).

Borrowing rate.—Amount, time for repayment, method of repayment, and security provided, as well as anticipated conditions of different money markets will typically influence the amount of interest that may be estimated as an appropriate short term rental rate for borrowed money. The CFA program provides for specification of a borrowing rate of interest that may be different from short term reinvestment and long term borrowing or investment rates that may be used for the program analyses. However, borrowing and short term reinvestment rates of interest should be specified only if computing a CRR. Likewise, interest costs should be excluded from all other CFA data inputs if computing either an IRR or a CRR. If other interest costs are added to a cash flow analysis, techniques for computing the CFA program will affect a double counting of interest and yield incorrect results.

Example 1: A short term borrowing rate of 0.0875 was assumed for cost of funds that would have to be borrowed to finance the saw mill project.

Reinvestment rate.—The CFA program provides for specifying a short term reinvestment rate-of-earning interest if computing a CRR. This rate will be used by the program to compute any interest income that may be derived from reinvestment of a project's cash surpluses during the useful life of a project.

Example 1: A reinvestment rate of 0.0650 was assumed appropriate to represent earnings that might be realized from short term investments of any of the sawmill project's cash surpluses.

As mentioned, when a project's terminal year occurs prior to the year used to end a standardized time frame, the CFA program will use the discount rate specified to determine before- and after-tax interest income to be derived from post-terminal after-tax rate of interest earned by the terminal value of a project if computing either an IRR or a CRR.

CARD TYPE 3: Annual price-volume-cost date. One card for each year, up to 21 cards

The CFA program assumes that all values entered on the type 3 cards are year-ending values. The data typically used to hypothesize cash flow characteristics of an investment project are either data projections or a forecast derived from fairly firm present-value estimates. In either situation, the type 3 card data should be prepared as year-ending values.

Example 1: All prices and cost data prepared for the sawmill projects' type 3 data cards are estimated as real values, increasing at a rate of 0.05 each year.

Unit price.—The unit prices entered in the CFA program will usually represent a weighted average of prices of the product mixture. The projection or the forecast of product prices should reflect the assumptions made for the marketing strategy in developing a venture *(10)*.

Example 1: A price of $175.00 per unit is assumed to appropriately represent the average unit value of the sawmill project's first year of production. This amount was increased by 0.05 for each succeeding year.

Unit Sales.—The unit sales, the sales volume data, entered into the CFA program

must be expressed in the same units as the unit prices for the program to compute annual gross sales correctly. Most facilities that manufacture wood products operate at less than their rated capacity. The difference between rated capacities and operating outputs are typically caused by interruptions for repairs, maintenance, bad weather, and other nonpredictables.

Example 1: The estimated annual output for the sawmill venture is expected to average 30 million board feet (Mfbm, lumber tally) per year. Due to the first year startup time losses that can be expected, the first year's annual output estimate was adjusted to 24 million board feet.

Variable manufacturing costs.—Variable manufacturing cost data must be prepared as unit cost data on the same unit basis as unit prices and unit sales. The CFA program will calculate total annual costs from the unit cost estimates.

Example 1: Log costs are the only costs considered to vary directly with the volume of product output and have been converted to a cost per unit of finished product output, less the revenues expected to be realized from the sale of residues, that is, log cost of $150 per thousand board feet, log scale (200 ft^3/Mfbm), less the value of residues at $30 per unit (72 ft^3 of solid/wood unit), yields a net unit log cost of $65.538 per thousand board feet, lumber tally (56.6 ft^3 of solid wood/Mfbm).

Other variable costs.—Promotional costs, opportunity costs, and any other costs that may be identified as variable costs but are more readily prepared as annual cost estimates should be entered in the CFA analysis as "other variable cost." For most wood products manufacturers, labor, energy, and utilities costs may be partly variable and partly fixed.

Example 1: As indicated by table 7, the first year-ending's estimate of other variable cost is $815,320. Due to the first year's estimated startup loss of production output, the first year estimate was adjusted to $652,256. The $815,320 estimate was increased by 0.05 each year to calculate the estimates used for each subsequent year.

Fixed manufacturing costs.—Fixed manufacturing costs are those costs predominately dependent on the rated capacity or other fixed characteristics of a facility. Again, as for other variable costs, labor, power, fuel, and utilities costs may be partly fixed and partly variable.

Example 1: As indicated by table 7, the first year-ending's estimate of fixed manufacturing cost is $197,580. This was the amount entered in the CFA analysis, and increased by 0.05 each year to calculate the estimates used for each subsequent year.

Overhead costs.—Overhead costs should include only those costs that can be expected to vary as a constant percentage of facilities cost, such as property taxes, insurance, supplies, maintenance, and repair costs.

Example 1: As indicated by table 7, the first year-ending's estimate of overhead cost is $941,800. The first year estimate of overhead cost was increased by 0.05 to calculate the estimates used for subsequent years.

Facilities costs.—As mentioned, the CFA program considers two main categories of manufacturing investments—facilities and working capital. These are the monies required to establish the physical and the money capital resources necessary for future production of revenues (2,5,9,13,14). Costs for land, site preparation, buildings, process machinery, mobile equipment, engineering, consultation, and other costs incurred for establishing a production facility are investment costs for the facility. Additionally, any costs for replacements, additions, modifications, or repairs that may be incurred to increase a facility's efficiency, operating capacity, or to extend its useful life are also facilities' investment costs (2).

All values entered into the CFA program are computationally treated as year-ending values as has been mentioned. For this reason, the "year 0" is provided for entry of the facilities costs estimated to be required for initiating a project. All facilities costs should be entered as year-ending "book cost" estimates, beginning with the initial facilities investment entered for year 0.

Example 1: As indicated by table 8, the initial year 0 and the fifth year facilities costs

Table 7.--First year-ending annual operating cost estimates for a sawmill venture (example 1)

Type of cost	Costs for--		
	Other variables	Fixed manufacturing	Overhead
	- - - - - - - - Dollars - - - - - - - -		
Labor	762,320	190,580	--
Power and fuel	45,000	5,000	--
Utilities	8,000	2,000	--
Taxes and insurance	--	--	500,000
Supplies	--	--	60,000
Maintenance and repairs	--	--	266,800
General overhead	--	--	115,000
Totals	815,320	197,580	941,800

were estimated as $4,614,000 and $263,000, respectively. The fifth year investment estimate assumed that all of the mobile equipment would have to be replaced by the end of the fifth year.

Investment tax credit.—A credit of 10 percent of the investment value of manufacturing equipment (not including buildings) having a useful life of 3 years or more may generally be applied against current tax liabilities or may be carried over to other years as a credit or both can be done. The investment tax credit, however, may not exceed any given year's tax liability *(2)*. Federal tax laws detail the rules for investment tax credit; the laws have varied as to amount applicability over the last several years. For this reason, either the Federal Internal Revenue Service or a tax specialist should be consulted for any accurate application of investment tax credit.

Example 1: An investment tax credit of $276,800 is entered as 10 percent of the installed cost of processing equipment (table 1).

Depreciation.—To calculate taxable income, Federal and most state tax laws permit the deduction of a depreciation allowance from revenues *(2,14)*. This special provision provides for the nontaxable recovery of monies invested in assets used to produce income. Depreciation allowances are not out-of-pocket operating costs, but do affect the amounts and the timing of income tax costs. For this reason, annual depreciation allowances are added to after-tax profits to determine after-tax earnings. Investment costs are then deducted from after-tax earnings to determine after-tax annual net cash flows (tables 3-5, and 9).

The salvage value of an asset generally does not have to be taken into account if calculating a schedule of allowances for annual depreciation. But, by Federal tax rules, depreciable assets should not be depreciated below their reasonable salvage value *(2)*. If salvage value of an asset is greater than undepreciated balance, the gain becomes sub-

Table 8.--Costs and depreciation for sawmilling manufacturing (example 1)

Capital assets	Year-end facilities costs, and depreciation allowance ($1,000)[1/]										
	0	1st	2d	3d	4th	5th	6th	7th	8th	9th	10th
Land[2/]	(60)	--	--	--	--	--	--	--	--	--	--
Site preparation	(65)	3.250	3.250	3.250	3.250	3.250	3.250	3.250	3.250	3.250	3.250
Buildings	(744)	16.533	16.533	16.533	16.533	16.533	16.533	16.533	16.533	16.533	16.533
Process machinery	[3/](3,111)	560.000	488.000	358.400	286.720	229.376	175.500	175.5	175.5	175.5	175.5
Mobile equipment	(206)	37.080	37.080	37.080	37.080	37.080					
Mobile equipment replacement							47.340	47.340	47.340	47.340	47.340
Miscellaneous	(428)	38.520	38.520	38.520	(263) 38.520	38.520	38.520	38.520	38.520	38.520	38.520
Total	(4,614)	655.383	583.393	453.783	382.103	324.759	281.143	281.143	281.143	281.143	281.143

1/ Values in parentheses represent real costs, or "book value," of capital assets.
2/ Nondepreciable.
3/ Includes installation cost.

ject to tax rules on capital gains. To be consistent with the basic concept of depreciation tax rules, the CFA program does not recognize the prospects for capital gains and treats salvage value as a nontaxable recovery of undepreciated investment.

Depreciation allowances for realty are limited to the straight line, the 150-percent declining-balance depreciation method, or any other method that does not give greater allowances in the first two-thirds of useful life of the realty than does the 150-percent declining-balance method *(2,14)*.

Depreciation for assets other than for realty may be computed under the straight-line method, the double-declining-balance method, the sum of the years digits method, or one of the two accelerated-depreciation methods that may be converted to the straight-line method at any time during the depreciation life of the asset *(2,14)*.

Example 1: As indicated by table 8, land was not considered a depreciable asset. The cost of site preparation was depreciated over a 20-year useful life estimate using the straight-line method. The cost of buildings was depreciated over a 45-year useful life estimate using the straight-line method. The cost of process machinery was depreciated over a 10-year useful life estimate, assuming a fair salvage value equal to 10 percent of the initial cost. A depreciation schedule was calculated using the double-declining method for the first 5 years, then converting to straight-line for the last 5 years. The costs for mobile equipment were depreciated over a 5-year useful life estimate using the straight-line method.

CARD TYPE 4: Sequential run control card. One card only.

A sequential run control card must follow the last type 3 card used in the data deck. The number entered on this card determines the number of type 5 cards read and the number of sequential CFA analyses that will be computed. The CFA sequential run option is to simplify the preparation of data if type 3 card data is used as a prototype.

If the type 4 card is left blank, analyses will be computed and printed on the basis of the data entered on the type 2 and 3 cards, and no type 5 cards have to be added to the data deck. If a number 1 through 10 is entered on the type 4 card, an unaltered analysis of type 2 and 3 card data will be omitted unless one or more of the following type 5 cards submitted is entirely blank.

Example 1: The number 2 has been entered on the type 4 card to allow for two sequential CFA runs of analyses.

CARD TYPE 5: First-year data card. One card for each sequential analysis up to 10 cards

By using the sequential CFA analysis option, a series of analyses may be made on the basis of adjusted type 2 and 3 card data. These analyses include original cash investment, borrowing rate, lending rate, unit price, unit sales, unit manufacturing costs, other variable costs, fixed manufacturing costs, and overhead costs. The price-volume-cost data entered on type 5 cards should represent only first-year values. The CFA program will compute the annual sequence of values as a percentage of type 3 data established by the ratio of card 5 to card 3 first-year values.

Example 1: Two type 5 cards are included in the data deck to correspond to the number entered into the CFA program by the type 4 card. The first type 5 card is left blank except for the entry of the original cash investment to allow for a CRR analysis of card 2 and 3 data (tables 3-5). The second type 5 card enters new data (table 2) solely to illustrate the process of using prototype data to produce sequential and IRR analyses (table 9).

INTERPRETATION OF CFA PROGRAM OUTPUT

Interpretations of cash flow analyses are usually intended to assist a decisionmaker by providing certain types of comparative investment criteria. For this reason, the interpretation of cash flow analyses starts with the preparation of the input data for CFA program analysis (tables 3-5). The more the procedures for preparing data and computing results are standardized, the more valid the comparative interpretations of economic criteria will become. The possible consequences, and pitfalls, of comparing nonstandarized analyses should be given careful consideration in the

Table 9.--Computer printout of internal rate-of-return analysis of sawmill investment venture (example 1)

LUMBER-MANUFACTURING VENTURE ** 30MMFBM/250 DAY YEAR ** LUMBER RECOVERY = .45
(INVESTMENT TAX CREDIT OF $ 276800. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0	EFFECTIVE TAX RATE .5112	ORIGINAL CASH EQUITY	$ 0.	VAR. COSTS/SALES = .4942	
FACILITIES COST $ 4614000.	BORROWING RATE .0000	ENDING VALUE OF EQUITY	$ 6186393.	FIXED COSTS/SALES= .3084	
WORKING CAPITAL $ 172800.	REINVESTMENT RATE .0000	FACILITIES SALVAGE VALUE	$ 1071875.	TAX COSTS/SALES = .0964	
TOTAL INVEST. $ 4786800.	INTERNAL ROR .1630	P.V. OF INVST.(I=.1200)	$ 994741.	A.T. PROFIT/SALES= .1010	

FINANCIAL SUMMARY

YEAR-END VALUES . . .	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES	24000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.
UNIT PRICE	$ 165.00	$ 173.27	$ 181.91	$ 191.01	$ 200.56	$ 210.59	$ 221.12	$ 232.17	$ 243.78	$ 255.97
GROSS SALES	$ 3960000.	$ 5198065.	$ 5457389.	$ 5730233.	$ 6016767.	$ 6317586.	$ 6633480.	$ 6965159.	$ 7313412.	$ 7679062.
INTEREST INC-EXP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROSS REVENUES	$ 3960000.	$ 5198065.	$ 5457389.	$ 5730233.	$ 6016767.	$ 6317586.	$ 6633480.	$ 6965159.	$ 7313412.	$ 7679062.
VARIABLE MFG COST	$ 1080000.	$ 1417502.	$ 1488382.	$ 1562785.	$ 1640936.	$ 1722981.	$ 1809125.	$ 1899595.	$ 1994555.	$ 2094294.
SELLING EXPENSE	277200.	363865.	382017.	401116.	421174.	442231.	464344.	487561.	511939.	537534.
OTHER VAR. COST	600000.	787500.	826875.	868219.	911630.	957211.	1005072.	1055325.	1108092.	1163496.
TOTAL VAR COST	$ 1957200.	$ 2568867.	$ 2697274.	$ 2832120.	$ 2973740.	$ 3122423.	$ 3278541.	$ 3442481.	$ 3614585.	$ 3795325.
UNIT VAR COST	$ 81.55	$ 85.63	$ 89.91	$ 94.40	$ 99.12	$ 104.08	$ 109.28	$ 114.75	$ 120.49	$ 126.51
PROFIT CONTRI	$ 2002800.	$ 2629199.	$ 2760115.	$ 2898113.	$ 3043027.	$ 3195162.	$ 3354940.	$ 3522678.	$ 3698827.	$ 3883737.
FIXED MFG COST	$ 200000.	$ 210000.	$ 220500.	$ 231525.	$ 243102.	$ 255257.	$ 268019.	$ 281419.	$ 295491.	$ 310265.
OVERHEAD COST	1000000.	1050000.	1102501.	1157625.	1215506.	1276282.	1340096.	1407100.	1477456.	1551328.
TOTAL F.C.	$ 1200000.	$ 1260000.	$ 1323001.	$ 1389150.	$ 1458608.	$ 1531538.	$ 1608115.	$ 1688519.	$ 1772947.	$ 1861593.
FACILITIES COST	$ 0.	$ 0.	$ 0.	$ 0.	$ 263000.	$ 0.	$ 0.	$ 0.	$ 0.	$ -1071875.
WORKING CAPITAL	35100.	10395.	10914.	11461.	12033.	12635.	13268.	13929.	14627.	-307163.
INVESTMENT	$ 35100.	$ 10395.	$ 10914.	$ 11461.	$ 275033.	$ 12635.	$ 13268.	$ 13929.	$ 14627.	$ -1379038.
DEPRECIATION	$ 655383.	$ 583383.	$ 537783.	$ 382102.	$ 324759.	$ 281143.	$ 281143.	$ 281143.	$ 281143.	$ 281143.
AFTER TAX PROFIT	$ 348857.	$ 384107.	$ 420652.	$ 550809.	$ 615722.	$ 675757.	$ 736426.	$ 759114.	$ 803947.	$ 851001.
A.T. EARNINGS	1004240.	967490.	944435.	932911.	940481.	956900.	997568.	1040257.	1085090.	1132144.
A.T. NET CASH FLOW	969140.	957095.	923522.	921450.	665447.	944265.	984301.	1026328.	1070463.	25111A2.
ACUM NET CASH FLOW	$ -3817.7M	$ -2860.6M	$ -1937.0M	$ -1015.6M	$ -350.1M	$ 594.1M	$ 1578.4M	$ 2604.7M	$ 3675.2M	$ 6186.4M

INTERNAL RATES OF RETURN * * * AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	.067	.115	.163	.206	.247
UNIT PRICE	.020	.097	.163	.224	.280
UNIT VAR COST	.229	.197	.163	.128	.092
TOTAL F.C.	.198	.181	.163	.146	.128
FACILITIES COST	.203	.181	.163	.148	.135

final presentation and interpretations of cash flow analyses.

To have summaries of cash flow analyses follow a standard format whereby the same elements of every cash flow analysis may be readily compared to other project evaluations is usually helpful. The CFA program output is itself a standarized format addressed to this objective. An economic summary of the CFA program output (fig. 1) can be of additional value. Recommendations or qualitative evaluations of the impounderable aspects of the investment evaluation should be handled separately from presentation of well-specified economic criteria.

Example 1: The CRR estimated for a sawmill investment opportunity is greater than the alternative ROR for investments with similar risk. Therefore, the sawmill project should warrant consideration as a new investment venture subject to a capability of satisfying the capital budgeting requirements assumed for analysis.

Additional graphic and statistical interpretations of CFA program outputs may be useful as illustrated by figure 2. The figure was based on the ratio computations displayed in the upper right of the printed CFA program output. Each of these ratios is derived directly from the nondiscounted sum of the corresponding cash flows except for the ratio of fixed costs to gross sales. In the computation of this ratio, annual depreciation allowances are added to annual total fixed costs as a capital recovery cost.

ANALYSIS OF INCREMENTAL INVESTMENT

The sawmill facility, example 1, could have included a computer-sawing control system as a part of the example but was deferred from consideration to serve as an example to illustrate the concept and uses of incremental investment analysis *(1,5-7,9)*. The basic requisite for incremental investment opportunities is they must represent investment, the cost and revenue cash flows that can be considered as an adjunctive investment venture (examples 1 and 2). Our evaluation of the sawmill project indicated that the ROR for the project was greater than alternative investment opportunities with similar risk. The same question then has to be answered for the additional investment that would be required to include a computerized sawing control system in the sawmill facility (example 2).

Many different types of investment and cost-increasing changes generally may increase the revenue potentials of manufacturing facilities. The difficult part of evaluating incremental investments is usually in estimating additional increments of revenue and cost cash flows that may be attributed to the additional investment. This task frequently can be simplified, however, by estimating the before-tax profit contribution cash flow of the incremental investment *(6,7)*. The profit contribution from incremental sawmill investments will often be the net difference between the expected changes in revenues and variable cost. Once estimated, the expected profit contribution of an incremental investment may be used to compute the revenue cash flows that will be required for CFA program analysis.

Variable costs, sometimes called direct costs, typically include selling, raw material, and other costs that change as production volume changes. For sawmills operating at a normal level, labor, energy, maintenance, and repair costs are typically "fixed" although at varying operating levels these costs may become variable costs, dependent on production volume. For this reason, the profit contribution for a sawmill is typically equal to the simple difference between total revenues and total selling and log-input costs. As indicated, the profit contribution of an incremental investment is important because the net revenue value of the incremental investment can be estimated as the anticipated change (increase or decrease) in total profit contributions due to the additional investment.

The key variables that sawmill incremental investments are most likely to affect are the lumber recovery factor (board feet of lumber recovered per cubic foot of log input), value of the lumber product mix, and the volume of logs processed. A change in the total profit contribution (ΔTPC) can be quickly calculated for these three variables and for the variable cost of production:

ECONOMIC SUMMARY

Date _____
Analyst _____

Project Lumber Manufacturing Venture (Example 1/)

Project life	10 yrs.
CFA time frame	10 yrs.
Effective tax rate	0.5118
Borrowing rate	0.0875
Lending rate	0.0650
Alternative ROR[1/]	0.12
Composite ROR	0.1670
Internal ROR	0.1630
Payout time (i=0)	8 yrs.

	Estimated	For break even
	$1,000	
Initial investment (n=0)		
Facilities	4,614	5,236
Working capital	202	210
sub-total	4,816	5,446
Equity capital	1,000	1,135
Borrowing requirement	3,816	4,311
Facilities salvage value (n=10)	1,072	1,217
Present value of the investment (n=10, i=.12)	1,509	1,135

1/ Rate of return.

Composite Rate of return sensitivities

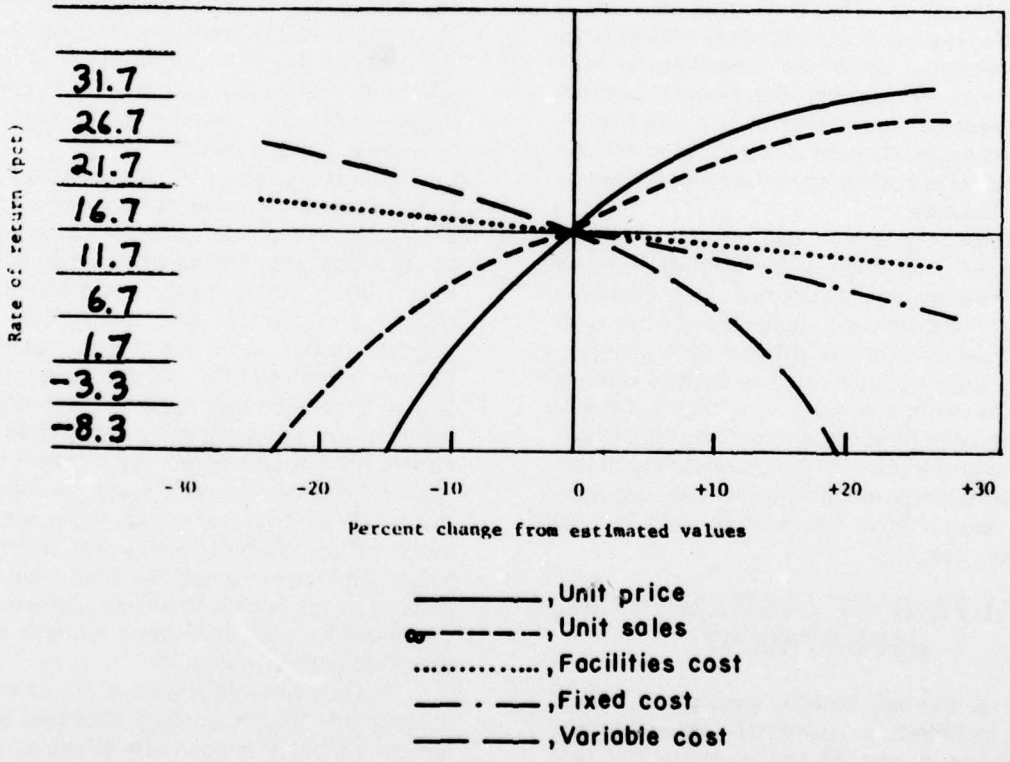


Figure 1.--Economic summary of CFA analysis (example 1).

(M 146 208)

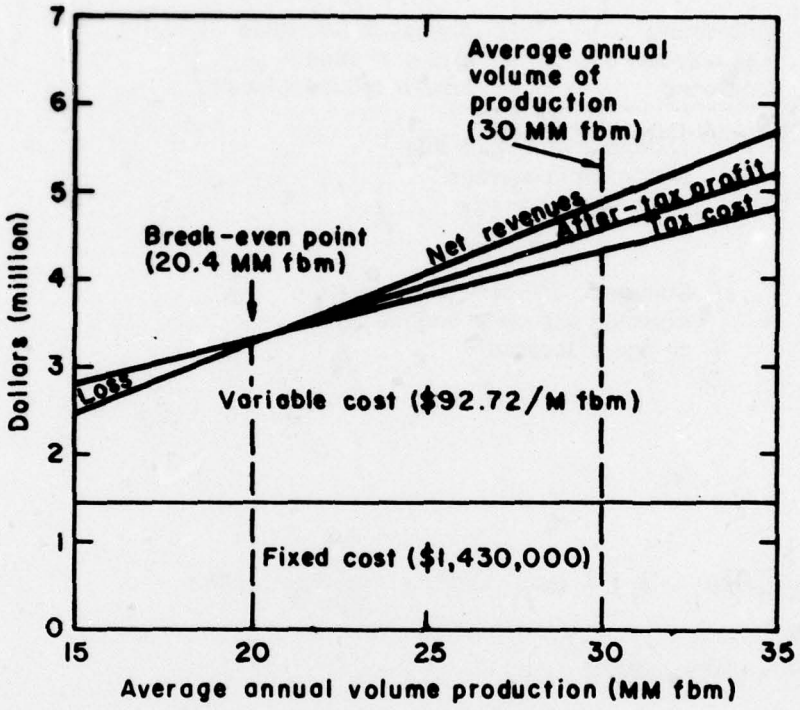


Figure 2.--Relationship of cost to volume and profit for a sawmill venture (example 1).

(M 146 209)

$$\Delta\overline{TPC} = \left(\begin{array}{c}\text{Volume of}\\ \text{logs normally}\\ \text{processed}\end{array}\right) \times \left[\left(\begin{array}{c}\text{change in unit value}\\ \text{due to change in}\\ \text{lumber recovery factor}\end{array}\right) + \left(\begin{array}{c}\text{change in unit value due}\\ \text{to change in average}\\ \text{value of lumber mix}\end{array}\right) + \left(\begin{array}{c}\text{Change in unit cost due to}\\ \text{expected change in volume}\\ \text{of logs processed}\end{array}\right)\right]$$

or,

$$\Delta\overline{TPC} = Q[(\Delta\overline{LRF}(P_l - P_r) + (\Delta\overline{P}_l \cdot LRF') + (\frac{\Delta\overline{Q\%}}{100}(P_l' \cdot LRF') + P_r(BFE - LRF') - AVC)]$$

where,

$\Delta\overline{TPC}$ = Total expected change in the profit contribution

Q = Average volume of logs normally processed each month expressed in thousands of cubic feet

$\Delta\overline{LRF}$ = Expected change in lumber recovery factor

P_l = Average value of lumber expressed in dollars per 1,000 board feet

P_r = Value of 1,000 board feet of lumber converted to mill residues (residue value/Mfbm)

$\Delta\overline{P}_l$ = Expected change in value of lumber products expressed in dollars per 1,000-board-foot measure

LRF' = LRF (lumber recovery factor) + $\Delta\overline{LRF}$

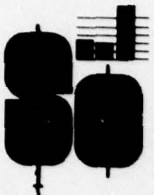
$\Delta\overline{Q\%}$ = Expected percentage increase or decrease in volume of logs processed

P' = $P_l + \Delta\overline{P}_l$

BFE = Number of nominal board feet of lumber containing 1 net cubic foot of solid wood

AVC = Average variable cost expressed in dollars per 1,000 cubic feet of log volume

Example 2: The computer-controlled sawing system is estimated to have the following effects on the three key variables of production:



Estimated effects

$\Delta\overline{LRF}$: Estimated increase in the lumber recovery factor = 0.80

ΔP_l: Expected change in the average value of the lumber = $1.00

$\Delta\overline{Q\%}$: Expected percentage increase or decrease in volume of logs processed = -6%

Using equation (1) the change in average annual profit contributions ($\Delta\overline{TPC}$) that may be expected from the incremental investment can be calculated as follows, assuming:

1 Mfbm, log scale = 200 cubic feet solid wood
1 Mfbm, lumber tally = 56.625 cubic feet solid wood
1 unit of residues = 72 cubic feet solid wood
BFE = 17.66 board feet measure per cubic foot solid wood where the initial mill conditions are:

LRF = 7.95
Q = 18,875 Mfbm, log scale = 3,775 M ft^3
P_l = $175.00/Mfbm
P_r = $30.00/unit = $23.59/Mfbm
AVC = $150.00/Mfbm, log scale = $750.00/M ft^3

and the resulting mill conditions are

LRF' = 8.75
Q' = 18,120 Mfbm, log scale
P'_l = $176.00/Mfbm
P_r = $30.00/unit = $23.59/Mfbm
AVC = $150.00/Mfbm, log scale = $750.00/M ft^3

then,

$$\Delta\overline{TPC} = Q[(0.80(\$175.00 - \$23.59)) + (\$1.00 \cdot 8.75) + (-0.06((\$176.00 \cdot 8.75) + (\$23.59 \cdot 8.91) - (\$750.00))] = Q[\$121.13 + 8.75 - \$60.01] = Q[\$69.87] = \$263,759.25$$

$\Delta\overline{TPC}$ /annual average volume of lumber produced = $263,759/30,000 Mfbm = $8.792/Mfbm

On the basis of these hypothetical estimates, an operable computer-controlled sawing system will be expected to contribute $8.792/Mfbm to profits during the first year. This estimate will then be used to compute the revenue cash flows required for the CFA program analysis of the incremental investment (table 10).

The remaining data that must be entered into the CFA program for analysis of example 2

Table 10.--Coding instructions and entries for incremental investment venture (example 2)

CFA DATA CODING RECORD

Date _____

Estimates prepared by _____

Data confidence level _____

Project Example 2

Comments _____

CARD TYPE 1: Title card. First card only, columns 2 through 79.

Data entry: Incremental Investment * * * Computer Sawing Control

CARD TYPE 2: Data and program control card. Second card only.

Data description	Selling expense (F6.4)	Working capital (F6.4)	Tax rate (F6.4)	Discount rate (F6.4)	Years considered (12)	Output copies (Max. 9@) Financial analysis	Price/cost break-even	Facilities break-even	Original cash investment (F9.0)	Short-term rate Borrow (F4.4)	Reinvestment (F4.4)	Card
Cols.	1-6	7-12	13-18	19-24	29-30	34	38	42	46-54	58-61	65-68	80
Data entry	0	0	.5112	.12	10	1	0	0	200,000	.0875	.0650	2

CARD TYPE 3: Annual price-volume-cost data. One card for each year, up to 21 cards.

Data description	Unit price (F7.3)	Unit sales (F8.0)	Unit manufacturing costs (F10.3)	Other variable costs (F10.0)	Fixed manufacturing costs (F10.0)	Overhead costs (F10.0)	Facilities costs (F10.0)	Investment tax credit Depreciation (F10.0)	Year No.	Card
Cols.	1-7	8-15	16-25	26-35	36-45	46-55	56-65	66-75	79	80
Data entries										
							500,000	50,000	0	3
	8.792	24,000				33,333		90,000	1	3
	9.232	30,000				35,000		90,000	2	3
	9.693	30,000				36,750		90,000	3	3
	10.178	30,000				38,588		90,000	4	3
	10.687	30,000				40,517	300,000	90,000	5	3
	11.221	30,000				42,543		60,000	6	3
	11.782	30,000				44,670		60,000	7	3
	12.371	30,000				46,903		60,000	8	3
	12.990	30,000				49,249		60,000	9	3
	13.639	30,000				51,711		60,000	10	3

CARD TYPE 4: Sequential run control card. One card only. Maximum of 10 runs.

Data entry: Enter number of sequential runs in columns 9 and 10: 0

should be prepared following the same procedures and considerations illustrated for analysis of example 1.

Example 2: The CRR estimated for the incremental investment for a computer-sawing control system is greater than the alternative ROR for investments with similar risk (table 11). Therefore, this additional investment possibility should warrant consideration as a joint investment venture with the sawmill proposal, subject to the ability to satisfy the capital budgeting requirements assumed for analysis.

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Table 11.--Computer printout of composite rate-of-return analysis of sawmill incremental investment (example 2)

INCREMENTAL INVESTMENT ANALYSIS OF A COMPUTER SAWING CONTROL SYSTEM
(INVESTMENT TAX CREDIT OF $ 50000. CONSIDERED.)

INITIAL INVESTMENT--YEAR 0		EFFECTIVE TAX RATE	.5112	ORIGINAL CASH EQUITY	$ 200000.	VAR. COSTS/SALES =	.0000
FACILITIES COST	$ 500000.	BORROWING RATE	.0875	ENDING VALUE OF EQUITY	$ 1381911.	FIXED COSTS/SALES=	.2907
WORKING CAPITAL	$ 0.	REINVESTMENT RATE	.0650	FACILITIES SALVAGE VALUE	$ 50000.	TAX COSTS/SALES =	.3475
TOTAL INVEST.	$ 500000.	COMPOSITE ROR	.2132	P.V. OF EQUITY(I=.1200)	$ 444938.	A.T. PROFIT/SALES=	.3620

FINANCIAL SUMMARY

YEAR-END VALUES . . .		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
UNIT SALES		24000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.	30000.
UNIT PRICE	$	8.79 $	9.23 $	9.69 $	10.18 $	10.69 $	11.22 $	11.78 $	12.37 $	12.99 $	13.64
GROSS SALES	$	211008.$	276960.$	290790.$	305340.$	320610.$	336630.$	353460.$	371130.$	389700.$	409170.
INTEREST INC-EXP		-26250.	-11373.	1868.	12990.	24868.	18048.	29959.	42715.	56367.	70969.
GROSS REVENUES	$	184758.$	265587.$	292658.$	318330.$	345478.$	354678.$	383419.$	413845.$	446067.$	480139.
VARIABLE MFG COST	$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.
SELLING EXPENSE		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OTHER VAR. COST		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL VAR COST	$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.
UNIT VAR COST	$	.00 $	.00 $	.00 $	.00 $	.00 $	.00 $	.00 $	.00 $	.00 $	.00
PROFIT CONTRI	$	184758.$	265587.$	292658.$	318330.$	345478.$	354678.$	383419.$	413845.$	446067.$	480139.
FIXED MFG COST	$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.$	0.
OVERHEAD COST		33333.	35000.	36750.	38588.	40517.	42543.	44670.	46903.	49249.	51711.
TOTAL F.C.	$	33333.$	35000.$	36750.$	38588.$	40517.$	42543.$	44670.$	46903.$	49249.$	51711.
FACILITIES COST	$	0.$	0.$	0.$	0.$	300000.$	0.$	0.$	0.$	0.$	-50000.
WORKING CAPITAL		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INVESTMENT	$	0.$	0.$	0.$	0.$	300000.$	0.$	0.$	0.$	0.$	-50000.
DEPRECIATION	$	90000.$	90000.$	90000.$	90000.$	90000.$	60000.$	60000.$	60000.$	60000.$	60000.
AFTER TAX PROFIT	$	80025.$	68719.$	81096.$	92746.$	105073.$	123243.$	136252.$	150033.$	164637.$	180087.
A.T. EARNINGS		170025.	158719.	171096.	182746.	195073.	183243.	196252.	210033.	224637.	240087.
A.T. NET CASH FLOW		170025.	158719.	171096.	182746.	-104927.	183243.	196252.	210033.	224637.	290087.
ACUM NET CASH FLOW	$	-330.0M $	-171.3M $	-.2M $	182.6M $	77.7M $	260.9M $	457.2M $	667.2M $	891.8M $	1181.9M
BEGINING-OF-YEAR VALUES FOR MONIES . . .											
BORROWED	$	300.0M $	130.0M $	.0M $	.0M $	.0M $	.0M $	.0M $	.0M $	.0M $	.0M
REINVESTED	$	.0M $	.0M $	28.7M $	199.8M $	382.6M $	277.7M $	460.9M $	657.2M $	867.2M $	1091.8M

COMPOSITE RATES OF RETURN * * * AT ADJUSTED INPUT VALUES

	80 PCT	90 PCT	100 PCT	110 PCT	120 PCT
UNIT SALES	.177	.196	.213	.228	.242
UNIT PRICE	.177	.196	.213	.228	.242
UNIT VAR COST	.213	.213	.213	.213	.213
TOTAL F.C.	.217	.215	.213	.211	.209
FACILITIES COST	.244	.228	.213	.200	.188

U.S. Forest Products Laboratory.

A cash flow computer program to analyze investment opportunities in wood products manufacturing, by George B. Harpole, Madison, Wis., FPL 1978.

25 p. (USDA Forest Serv. Res. Pap. FPL 305)

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KEYWORDS: Investment opportunities, wood products manufacturing, computer program, rate-of-return, cash flow analysis, sawmill venture, profit.

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