CHAPTER 9

Capital Budgeting

9.1 CAPITAL BUDGETING DECISIONS DEFINED

Capital budgeting is the process of making long-term planning decisions for investments. There are typically two types of investment decisions:

1. Selection decisions in terms of obtaining new facilities or expanding existing facilities. Examples include:
   (*a*) Investments in long-term assets such as property, plant, and equipment
   (*b*) Resource commitments in the form of new product development, market research, refunding of long-term debt, introduction of a computer, etc.
2. Replacement decisions in terms of replacing existing facilities with new facilities. Examples include replacing a manual bookkeeping system with a computerized system and replacing an inefficient lathe with one that is numerically controlled.

9.2 CAPITAL BUDGETING TECHNIQUES

There are several methods of evaluating investment projects. They are:

1. Payback period
2. Accounting rate of return (ARR) (also called *simple rate of return*)
3. Net present value (NPV)
4. Internal rate of return (IRR) (also called *time-adjusted rate of return*)
5. Profitability index (also called the *excess present value index*)

The NPV method and the IRR method are called *discounted cash flow* (*DCF*) methods, since they both recognize the time value of money and thus discount future cash flows. Each of the methods presented above is discussed below.

PAYBACK PERIOD

Payback period measures the length of time required to recover the amount of initial investment. The payback period is determined by dividing the amount of initial investment by the cash inflow through increased revenues or cost savings.

EXAMPLE 9.1 Assume:

Cost of investment	$18,000
Annual cash savings	$ 3,000

Then, the payback period is:

$$\frac{\$18,000}{\$3,000} = 6 \text{ years}$$

When cash inflows are not even, the payback period is determined by trial and error. When two or more projects are considered, the rule for making a selection decision is as follows:

Decision rule: Choose the project with the shorter payback period. The rationale behind this is: The shorter the payback period, the less risky the project, and the greater the liquidity.

EXAMPLE 9.2 Consider two projects whose cash inflows are not even. Assume that each project costs $1,000.

Year	A	B
1	$100	$500
2	200	400
3	300	300
4	400	100
5	500	—
6	600	—

Based on trial and error, the payback period of project A is four years ($100 + $200 + $300 + $400 = $1,000 in four years). The payback period of project B is

$$2 \text{ years} + \frac{\$100}{\$300} = 2\tfrac{1}{3} \text{ years}$$

Therefore, according to this method, choose project B over project A.

Advantages of the payback period method:

1. It is simple to compute and easy to understand.
2. It handles investment risk effectively.

Shortcomings of the payback period method:

1. It does not recognize the time value of money.
2. It ignores the impact of cash inflows after the payback period. It is essentially cash flows after the payback period which determine profitability of an investment.

ACCOUNTING (SIMPLE) RATE OF RETURN

Accounting rate of return (ARR) measures profitability from the conventional accounting standpoint by relating the required investment to the future annual net income. Sometimes the former is the average investment.

Decision rule: Under the ARR method, choose the project with the higher rate of return.

EXAMPLE 9.3 Consider the investment:

Initial investment	\$6,500
Estimated life	20 years
Cash inflows per year	\$1,000
Depreciation by straight line	\$ 325

Then,

$$ARR = \frac{\$1,000 - \$325}{\$6,500} = 10.4\%$$

Using the *average* investment, which is usually assumed to be one-half of the original investment, the resulting rate of return will be doubled:

$$ARR = \frac{\$1,000 - \$325}{\frac{1}{2}(\$6,500)} = \frac{\$675}{\$3,250} = 20.8\%$$

The justification for using the average investment is that each year the investment amount is decreased by \$325 through depreciation, and therefore the average is computed as one-half of the original cost.

Advantages: The method is easily understandable and simple to compute, and recognizes the profitability factor.

Shortcomings:

1. It fails to recognize the time value of money.
2. It uses accounting data instead of cash flow data.

NET PRESENT VALUE

Net present value (NPV) is the excess of the present value (PV) of cash inflows generated by the project over the amount of initial investment (I). Simply, $NPV = PV - I$. The present value of future cash flows is computed using the so-called cost of capital (or minimum required rate of return) as the discount rate.

Decision rule: If NPV is positive, accept the project. Otherwise, reject.

EXAMPLE 9.4

Initial investment	\$12,950
Estimated life	10 years
Annual cash inflows	\$ 3,000
Cost of capital (minimum required rate of return)	12%

Present value of cash inflows (PV):	
\$3,000 × PV of annuity of \$1 for 10 years and 12% [=\$3,000 (5.65)]	\$16,950
Initial investment (I)	12,950
Net present value ($NPV = PV - I$)	\$ 4,000

Since the investment's NPV is positive, the investment should be accepted.

Advantages: The NPV method obviously recognizes the time value of money and is easy to compute whether the cash flows form an annuity or vary from period to period.

Disadvantage: It requires detailed long-term forecasts of incremental cash flow data.

For the purpose of computing present value of future cash flows, two tables are provided below.

Table 9-1—Present Value of $1

Table 9-2—Present Value of an Annuity of $1

INTERNAL RATE OF RETURN (OR TIME-ADJUSTED RATE OF RETURN)

Internal rate of return (IRR) is defined as the rate of interest that equates I with the PV of future cash inflows. In other words, at IRR, $I = PV$, or $NPV = 0$.

Decision rule: Accept if IRR exceeds the cost of capital; otherwise, reject.

EXAMPLE 9.5 Assume the same data given in Example 9.4. We will set up the following equality ($I = PV$):

$$\$12{,}950 = \$3{,}000 \times \text{PV factor}$$

$$\text{PV factor} = \frac{\$12{,}950}{\$3{,}000} = 4.317$$

which stands somewhere between 18 percent and 20 percent in the 10-year line of Table 9-2. Using the interpolation as follows:

	PV Factor	
18%	4.494	4.494
IRR		4.317
20%	4.192	
Difference	0.302	0.177

Therefore, $$IRR = 18\% + \frac{0.177}{0.302}(20\% - 18\%) = 18\% + 0.586(2\%) = 18\% + 1.17\% = 19.17\%$$

Since the investment's IRR is greater than the cost of capital (12 percent), the investment should be accepted.

Advantages: It does consider the time value of money and is therefore more exact and realistic than ARR.

Shortcomings:

1. It is difficult to compute, especially when the cash inflows are not even.
2. It fails to recognize the varying size of investment in competing projects and their respective dollar profitabilities.

The trial-and-error method for computing IRR when cash inflows are not even is summarized, step by step, as follows:

1. Compute NPV at the cost of capital, denoted here as r_1,
2. See if NPV is positive or negative.
3. If NPV is positive, then pick another rate (r_2) much higher than r_1. If NPV is negative, then pick another rate (r_2) much smaller than r_1. The true IRR at which $NPV = 0$ must be somewhere in between these two rates.
4. Compute NPV using r_2.
5. Use interpolation for the exact rate.

Table 9-1 Present Value of $1

Periods	4%	5%	6%	8%	10%	12%	14%	16%	18%	20%	22%	24%	26%	28%	30%	40%
1	0.962	0.952	0.943	0.926	0.909	0.893	0.877	0.862	0.847	0.833	0.820	0.806	0.794	0.781	0.769	0.714
2	0.925	0.907	0.890	0.857	0.826	0.797	0.769	0.743	0.718	0.694	0.672	0.650	0.630	0.610	0.592	0.510
3	0.889	0.864	0.840	0.794	0.751	0.712	0.675	0.641	0.609	0.579	0.551	0.524	0.500	0.477	0.455	0.364
4	0.855	0.823	0.792	0.735	0.683	0.636	0.592	0.552	0.516	0.482	0.451	0.423	0.397	0.373	0.350	0.260
5	0.822	0.784	0.747	0.681	0.621	0.567	0.519	0.476	0.437	0.402	0.370	0.341	0.315	0.291	0.269	0.186
6	0.790	0.746	0.705	0.630	0.564	0.507	0.456	0.410	0.370	0.335	0.303	0.275	0.250	0.227	0.207	0.133
7	0.760	0.711	0.665	0.583	0.513	0.452	0.400	0.354	0.314	0.279	0.249	0.222	0.198	0.178	0.159	0.095
8	0.731	0.677	0.627	0.540	0.467	0.404	0.351	0.305	0.266	0.233	0.204	0.179	0.157	0.139	0.123	0.068
9	0.703	0.645	0.592	0.500	0.424	0.361	0.308	0.263	0.225	0.194	0.167	0.144	0.125	0.108	0.094	0.048
10	0.676	0.614	0.558	0.463	0.386	0.322	0.270	0.227	0.191	0.162	0.137	0.116	0.099	0.085	0.073	0.035
11	0.650	0.585	0.527	0.429	0.350	0.287	0.237	0.195	0.162	0.135	0.112	0.094	0.079	0.066	0.056	0.025
12	0.625	0.557	0.497	0.397	0.319	0.257	0.208	0.168	0.137	0.112	0.092	0.076	0.062	0.052	0.043	0.018
13	0.601	0.530	0.469	0.368	0.290	0.229	0.182	0.145	0.116	0.093	0.075	0.061	0.050	0.040	0.033	0.013
14	0.577	0.505	0.442	0.340	0.263	0.205	0.160	0.125	0.099	0.078	0.062	0.049	0.039	0.032	0.025	0.009
15	0.555	0.481	0.417	0.315	0.239	0.183	0.140	0.108	0.084	0.065	0.051	0.040	0.031	0.025	0.020	0.006
16	0.534	0.458	0.394	0.292	0.218	0.163	0.123	0.093	0.071	0.054	0.042	0.032	0.025	0.019	0.015	0.005
17	0.513	0.436	0.371	0.270	0.198	0.146	0.108	0.080	0.060	0.045	0.034	0.026	0.020	0.015	0.012	0.003
18	0.494	0.416	0.350	0.250	0.180	0.130	0.095	0.069	0.051	0.038	0.028	0.021	0.016	0.012	0.009	0.002
19	0.475	0.396	0.331	0.232	0.164	0.116	0.083	0.060	0.043	0.031	0.023	0.017	0.012	0.009	0.007	0.002
20	0.456	0.377	0.312	0.215	0.149	0.104	0.073	0.051	0.037	0.026	0.019	0.014	0.010	0.007	0.005	0.001
21	0.439	0.359	0.294	0.199	0.135	0.093	0.064	0.044	0.031	0.022	0.015	0.011	0.008	0.006	0.004	0.001
22	0.422	0.342	0.278	0.184	0.123	0.083	0.056	0.038	0.026	0.018	0.013	0.009	0.006	0.004	0.003	0.001
23	0.406	0.326	0.262	0.170	0.112	0.074	0.049	0.033	0.022	0.015	0.010	0.007	0.005	0.003	0.002	
24	0.390	0.310	0.247	0.158	0.102	0.066	0.043	0.028	0.019	0.013	0.008	0.006	0.004	0.003	0.002	
25	0.375	0.295	0.233	0.146	0.092	0.059	0.038	0.024	0.016	0.010	0.007	0.005	0.003	0.002	0.001	
26	0.361	0.281	0.220	0.135	0.084	0.053	0.033	0.021	0.014	0.009	0.006	0.004	0.002	0.002	0.001	
27	0.347	0.268	0.207	0.125	0.076	0.047	0.029	0.018	0.011	0.007	0.005	0.003	0.002	0.001	0.001	
28	0.333	0.255	0.196	0.116	0.069	0.042	0.026	0.016	0.010	0.006	0.004	0.002	0.002	0.001	0.001	
29	0.321	0.243	0.185	0.107	0.063	0.037	0.022	0.014	0.008	0.005	0.003	0.002	0.001	0.001	0.001	
30	0.308	0.231	0.174	0.099	0.057	0.033	0.020	0.012	0.007	0.004	0.003	0.002	0.001	0.001		
40	0.208	0.142	0.097	0.046	0.022	0.011	0.005	0.003	0.001	0.001						

Table 9-2 Present Value of Annuity of $1

Periods	4%	5%	6%	8%	10%	12%	14%	16%	18%	20%	22%	24%	26%	28%	30%	40%
1	0.962	0.952	0.943	0.926	0.909	0.893	0.877	0.862	0.847	0.833	0.820	0.806	0.794	0.781	0.769	0.714
2	1.886	1.859	1.833	1.783	1.736	1.690	1.647	1.605	1.566	1.528	1.492	1.457	1.424	1.392	1.361	1.224
3	2.775	2.723	2.673	2.577	2.487	2.240	2.322	2.246	2.174	2.106	2.042	1.981	1.868	1.816	1.816	1.589
4	3.630	3.546	3.465	3.312	3.170	3.037	2.914	2.798	2.690	2.589	2.494	2.404	2.320	2.241	2.166	1.879
5	4.452	4.330	4.212	3.993	3.791	3.605	3.433	3.274	3.127	2.991	2.864	2.745	2.635	2.532	2.436	2.035
6	5.242	5.076	4.917	4.623	4.355	4.111	3.889	3.685	3.498	3.326	3.167	3.020	2.885	2.759	2.643	2.168
7	6.002	5.786	5.582	5.206	4.868	4.564	4.288	4.039	3.812	3.605	3.416	3.242	3.083	2.937	2.802	2.263
8	6.733	6.463	6.210	5.747	5.335	4.968	4.639	4.344	4.078	3.837	3.619	3.421	3.241	3.076	2.925	2.331
9	7.435	7.108	6.802	6.247	5.759	5.328	4.946	4.607	4.303	4.031	3.786	3.566	3.366	3.184	3.019	2.379
10	8.111	7.722	7.360	6.710	6.145	5.650	5.216	4.833	4.494	4.192	3.923	3.682	3.465	3.269	3.092	2.414
11	8.760	8.306	7.887	7.139	6.495	5.988	5.453	5.029	4.656	4.327	4.035	3.776	3.544	3.335	3.147	2.438
12	9.385	8.863	8.384	7.536	6.814	6.194	5.660	5.197	4.793	4.439	4.127	3.851	3.606	3.387	3.190	2.456
13	9.986	9.394	8.853	7.904	7.103	6.424	5.842	5.342	4.910	4.533	4.203	3.912	3.656	3.427	3.223	2.468
14	10.563	9.899	9.295	8.244	7.367	6.628	6.002	5.468	5.008	4.611	4.265	3.962	3.695	3.459	3.249	2.477
15	11.118	10.380	9.712	8.559	7.606	6.811	6.142	5.575	5.092	4.675	4.315	4.001	3.726	3.483	3.268	2.484
16	11.652	10.838	10.106	8.851	7.824	6.974	6.265	5.669	5.162	4.730	4.357	4.033	3.751	3.503	3.283	2.489
17	12.166	11.274	10.477	9.122	8.022	7.120	6.373	5.749	5.222	4.775	4.391	4.059	3.771	3.518	3.295	2.492
18	12.659	11.690	10.828	9.372	8.201	7.250	6.467	5.818	5.273	4.812	4.419	4.080	3.786	3.529	3.304	2.494
19	13.134	12.085	11.158	9.604	8.365	7.366	6.550	5.877	5.316	4.844	4.442	4.097	3.799	3.539	3.311	2.496
20	13.590	12.462	11.470	9.818	8.514	7.469	6.623	5.929	5.353	4.870	4.460	4.110	3.808	3.546	3.316	2.497
21	14.029	12.821	11.764	10.017	8.649	7.562	6.687	5.973	5.384	4.891	4.476	4.121	3.816	3.551	3.320	2.498
22	14.451	13.163	12.042	10.201	8.772	7.645	6.743	6.011	5.410	4.909	4.488	4.130	3.822	3.556	3.323	2.498
23	14.857	13.489	12.303	10.371	8.883	7.718	6.792	6.044	5.432	4.925	4.499	4.137	3.827	3.559	3.325	2.499
24	15.247	13.799	12.550	10.529	8.985	7.784	6.835	6.073	5.451	4.937	4.507	4.143	3.831	3.562	3.327	2.499
25	15.622	14.094	12.783	10.675	9.077	7.843	6.873	6.097	5.467	4.948	4.514	4.147	3.834	3.564	3.329	2.499
26	15.983	14.375	13.003	10.810	9.161	7.896	6.906	6.118	5.480	4.956	4.520	4.151	3.837	3.566	3.330	2.500
27	16.330	14.643	13.211	10.935	9.237	7.943	6.935	6.136	5.492	4.964	4.525	4.154	3.839	3.567	3.331	2.500
28	16.663	14.898	13.406	11.051	9.307	7.984	6.961	6.152	5.502	4.970	4.528	4.157	3.840	3.568	3.331	2.500
29	16.984	15.141	13.591	11.158	9.370	8.022	6.983	6.166	5.510	4.975	4.531	4.159	3.841	3.569	3.332	2.500
30	17.292	15.373	13.765	11.258	9.427	8.055	7.003	6.177	5.517	4.979	4.534	4.160	3.842	3.569	3.332	2.500
40	19.793	17.159	15.046	11.925	9.779	8.244	7.105	6.234	5.548	4.997	4.544	4.166	3.846	3.571	3.333	2.500

EXAMPLE 9.6 Consider the following investment whose cash flows are different from year to year:

Year	Cash Inflows
1	$1,000
2	2,500
3	1,500

Assume that the amount of initial investment is $3,000 and the cost of capital is 14 percent.

Step 1 NPV at 14 percent:

Year	Cash Inflows	PV Factor at 14%	Total PV
1	$1,000	0.877	$ 877
2	2,500	0.769	1,923
3	1,500	0.675	1,013
			$3,813

Thus,

$$NPV = \$3{,}813 - \$3{,}000 = \$813$$

Step 2 We see that $NPV = \$813$ is positive at $r_1 = 14$ percent.

Step 3 Pick, say, 30 percent as r_2 to play safe.

Step 4 Computing NPV at $r_2 = 30$ percent:

Year	Cash Inflows	PV Factor at 30%	Total PV
1	$1,000	0.769	$ 769
2	2,500	0.592	1,480
3	1,500	0.455	683
			$2,932

Thus,

$$NPV = \$2{,}932 - \$3{,}000 = \$(68)$$

Step 5 Interpolating:

	NPV	
14%	$813	$813
IRR		0
30%	−68	
Difference	$881	$813

Therefore,

$$IRR = 14\% + \frac{\$813}{\$881}(30\% - 14\%) = 14\% + 0.923(16\%) = 14\% + 14.76\% = 28.76\%$$

SUMMARY OF DECISION RULES USING NPV AND IRR METHODS

Net present value (NPV):

1. Calculate the NPV, using the cost of capital as the discount rate.
2. If the NPV is positive, accept the project; otherwise, reject the project.

Internal rate of return (IRR):

1. Using present value tables, compute the IRR by trial-and-error interpolation.
2. If this rate of return exceeds the cost of capital, accept the project; if not, reject the project.

PROFITABILITY INDEX (OR EXCESS PRESENT VALUE INDEX)

The profitability index is the ratio of the total PV of future cash inflows to the initial investment, that is, PV/I. This index is used as a means of ranking projects in descending order of attractiveness. If the profitability index is greater than 1, then accept.

EXAMPLE 9.7 Using the data in Example 9.4, the profitability index PV/I is \$16,950/\$12,950 = 1.31. Since this project generates \$1.31 for each dollar invested (or its profitability index is greater than 1), the project should be accepted.

9.3 MUTUALLY EXCLUSIVE INVESTMENTS

Projects are said to be *mutually exclusive* if the acceptance of one project automatically excludes the acceptance of the other. In the case where one must choose between mutually exclusive investments, the NPV and IRR methods may give decision results that contradict each other. The conditions under which contradictory rankings can occur are:

1. Projects have different expected lives.
2. Projects have different size of investment.
3. The timing of the projects' cash flows differs. For example, the cash flows of one project increase over time, while those of the other decrease.

The contradiction results from different assumptions with respect to the reinvestment rate on cash flows released from the projects.

(*a*) The NPV method discounts all cash flows at the cost of capital, thus implicitly assuming that these cash flows can be reinvested at this rate.

(*b*) The IRR method implies a reinvestment rate at IRR. Thus, the implied reinvestment rate will differ from project to project.

The NPV method generally gives correct ranking, since the cost of capital is a more realistic reinvestment rate.

EXAMPLE 9.8 Assume the following:

	Cash Flows					
	0	1	2	3	4	5
A	\$(100)	\$120	—	—	—	—
B	(100)	—	—	—	—	\$201.14

Computing IRR and NPV at 10 percent gives the different rankings as follows:

	IRR	NPV at 10%
A	*20%**	9.09
B	15%	*24.90**

*Highest profit.

The general rule is to go by NPV ranking. Thus project B would be chosen over project A.

9.4 CAPITAL RATIONING

Many firms specify a limit on the overall budget for capital spending. *Capital rationing* is concerned with the problem of selecting the mix of acceptable projects that provides the *highest overall NPV* in such a case. The profitability index is used widely in ranking projects competing for limited funds.

EXAMPLE 9.9

Projects	I	PV	Profitability Index	Ranking
A	\$ 70,000	\$112,000	1.6	1
B	100,000	145,000	1.45	2
C	110,000	126,500	1.15	5
D	60,000	79,000	1.32	3
E	40,000	38,000	0.95	6
F	80,000	95,000	1.19	4

Assume that the company's fixed budget is \$250,000. Using the profitability index, we select projects A, B, and D:

	I	PV
A	\$ 70,000	\$112,000
B	100,000	145,000
D	60,000	79,000
	\$230,000	\$336,000

where NPV = \$336,000 − \$230,000 = \$106,000.

9.5 INCOME TAX FACTORS

Income taxes make a difference in many capital budgeting decisions. In other words, the project which is attractive on a pretax basis may have to be rejected on an after-tax basis. Income taxes typically affect both the amount and the timing of cash flows. Since net income, not cash inflows, is subject to tax, after-tax cash inflows are not usually the same as after-tax net income.

Let us define:

S = Sales
E = Cash operating expenses
d = Depreciation
t = Tax rate

Then, before-tax cash inflows = $S - E$ and net income = $S - E - d$.

By definition,

$$\text{After-tax cash inflow} = \text{Before-tax cash inflow} - \text{Taxes}$$
$$\text{After-tax cash inflow} = (S - E) - (S - E - d)(t)$$

Rearranging gives the *short-cut formula*:

$$\text{After-tax cash inflow} = (S - E)(1 - t) + (d)(t)$$

As can be seen, the deductibility of depreciation from sales in arriving at net income subject to taxes *reduces* income tax payments and thus serves as a *tax shield*.

$$\text{Tax shield} = \text{Tax savings on depreciation} = (d)(t)$$

EXAMPLE 9.10 Assume:

$$S = \$12{,}000$$
$$E = \$10{,}000$$
$$d = \$500\text{/year by straight-line}$$
$$t = 40\%$$

Then,

$$\text{After-tax cash inflow} = (\$12{,}000 - \$10{,}000)(1 - 0.4) + (\$500)(0.4)$$
$$= \$1{,}200 + \$200 = \$1{,}400$$

Note that a Tax shield = Tax savings on depreciation = $(d)(t)$ = (\$500)(0.4) = \$200.

After-tax cash *outflow* would be similarly computed by simply dropping S in the previous formula. Therefore,

$$\text{After-tax cash } \textit{outflow} = (-E)(1-t) + (d)(t)$$

EXAMPLE 9.11 Assume:

$$E = \$6{,}000$$
$$d = \$800\text{/year by straight-line}$$
$$t = 40\%$$

Then,

$$\text{After-tax cash } \textit{outflow} = (-\$6{,}000)(1 - 0.4) + (\$800)(0.4) = -\$3{,}600 + \$320 = -\$3{,}280 = \$3{,}280$$

Since the tax shield is $d \times t$, the higher the depreciation deduction, the higher the tax savings on depreciation. Therefore, the accelerated depreciation methods such as the double-declining-balance method and the sum-of-the-years'-digits methods produce higher tax savings than the straight-line method. They will produce higher present values for the tax savings, which greatly affect investment decisions.

EXAMPLE 9.12 We will now look at the present values of tax shield effects of alternative depreciation methods. Assume:

Initial investment	\$100,000
Estimated life	4 years
Salvage value	0
Cost of capital after taxes	15%
Tax rate	40%

(*a*) *Straight-line depreciation:*

		15% PV Factor	PV of Tax Savings
Annual depreciation (\$100,000 ÷ 4 = \$25,000):			
Depreciation deduction	\$25,000		
Multiply by 40%	× 40%		
Income tax savings, years 1–4	\$10,000	2.855	\$28,550

(*b*) *Sum-of-the-years'-digits depreciation:*

Year	Multiplier*	Depreciation Deduction	Tax Shield: Income Tax Savings at 40%	15% PV Factor	PV of Tax Savings
1	4/10	$40,000	$16,000	0.870	$13,920
2	3/10	30,000	12,000	0.756	9,072
3	2/10	20,000	8,000	0.658	5,264
4	1/10	10,000	4,000	0.572	2,288
					$30,544

*The denominator for the sum-of-the-years'-digits method is 1 + 2 + 3 + 4 = 10 or

$$S = \frac{n(n+1)}{2} = \frac{4(4+1)}{2} = 10$$

where: S = sum of the years
n = life of the asset

(*c*) *Double-declining-balance depreciation:*

Year	Book Value	Rate* (%)	Depreciation Deduction	Tax Shield: Income Tax Savings at 40%	15% PV Factor	PV of Tax Savings
1	$100,000	50	$50,000	$20,000	0.870	$17,400
2	50,000	50	25,000	10,000	0.756	7,560
3	25,000	50	12,500	5,000	0.658	3,290
4	12,500	50	12,500†	5,000	0.572	2,860
						$31,110

*The percentage rate for the double-declining-balance method is 2 × straight-line rate = 2 × 25% = 50%.
†The asset is depreciated to zero salvage value in the fourth year.

9.6 CAPITAL BUDGETING DECISIONS AND THE MODIFIED ACCELERATED COST RECOVERY SYSTEM (MACRS)

Although the traditional depreciation methods still can be used for computing depreciation for book purposes, 1981 saw a new way of computing depreciation deductions for tax purposes. The current rule is called the *Modified Accelerated Cost Recovery System* (MACRS) rule, as enacted by Congress in 1981 and then modified somewhat in 1986 under the Tax Reform Act of 1986. This rule is characterized as follows:

1. It abandons the concept of useful life and accelerates depreciation deductions by placing all depreciable assets into one of eight property age classes. It calculates deductions based on an allowable percentage of the asset's original cost (see Tables 9-3 and 9-4).

   With a shorter asset tax life than useful life, the company can deduct depreciation more quickly and save more in income taxes in the earlier years, thereby making an investment more attractive. The rationale behind the system is that this way the government encourages companies to invest in facilities and increase productive capacity and efficiency. [Remember that the higher d is, the larger the tax shield $(d)(t)$ is.]

Table 9-3 Modified Accelerated Cost Recovery System Classification of Assets

	Property class					
Year	3-year	5-year	7-year	10-year	15-year	20-year
1	33.3%	20.0%	14.3%	10.0%	5.0%	3.8%
2	44.5	32.0	24.5	18.0	9.5	7.2
3	14.8*	19.2	17.5	14.4	8.6	6.7
4	7.4	11.5*	12.5	11.5	7.7	6.2
5		11.5	8.9*	9.2	6.9	5.7
6		5.8	8.9	7.4	6.2	5.3
7			8.9	6.6*	5.9*	4.9
8			4.5	6.6	5.9	4.5*
9				6.5	5.9	4.5
10				6.5	5.9	4.5
11				3.3	5.9	4.5
12					5.9	4.5
13					5.9	4.5
14					5.9	4.5
15					5.9	4.5
16					3.0	4.4
17						4.4
18						4.4
19						4.4
20						4.4
21						2.2
Total	100%	100%	100%	100%	100%	100%

*Denotes the year of changeover to straight-line depreciation.

2. Since the allowable percentages in Table 9-3 add up to 100%, there is no need to consider the salvage value of an asset in computing depreciation.
3. A company may elect to use the straight-line method. The straight-line convention must follow what is called the *half-year convention*. This means that the company can deduct only half of the regular straight-line depreciation amount in the first year. The reason for electing to use the MACRS optional straight-line method is that some firms may prefer to stretch out depreciation deductions using the straight-line method rather than to accelerate them. Those firms are usually ones that are just starting out or have little or no income and wish to show more income on their income statements.

EXAMPLE 9.13 Assume that a machine falls under a 3-year property class and costs $3,000 initially. The straight-line option under MACRS differs from the traditional straight-line method in that under this method the company can deduct only $500 depreciation in the first year and the fourth year ($3,000/3 years = $1,000; $1,000/2 = $500). The following table compares the straight line with half-year convention with the MACRS.

Table 9-4 MACRS by Property Class

MACRS Property Class and Depreciation Method	Useful Life (ADR Midpoint Life)*	Examples of Assets
3-year property, 200% declining balance	4 years or less	Most small tools are included; the law specifically excludes autos and light trucks from this property class.
5-year property, 200% declining balance	More than 4 years to less than 10 years	Autos and light trucks, computers, typewriters, copiers, duplicating equipment, heavy general-purpose trucks, and research and experimentation equipment are included.
7-year property, 200% declining balance	10 years or more to less than 16 years	Office furniture and fixtures and most items of machinery and equipment used in production are included.
10-year property, 200% declining balance	16 years or more to less than 20 years	Various machinery and equipment, such as that used in petroleum distilling and refining and in the milling of grain, are included.
15-year property, 150% declining balance	20 years or more to less than 25 years	Sewage treatment plants, telephone and electrical distribution facilities, and land improvements are included.
20-year property, 150% declining balance	25 years or more	Service stations and other real property with an ADR midpoint life of less than 27.5 years are included.
27.5-year property, straight-line	Not applicable	All residential rental property is included.
31.5-year property, straight-line	Not applicable	All nonresidential real property is included.

*"ADR midpoint life" means the "useful life" of an asset in a business sense; the appropriate ADR midpoint lives for assets are designated in the Internal Revenue Service Code.

Year	Straight-Line (Half-Year) Depreciation	Cost		MACRS %	MACRS Deduction
1	$ 500	$3,000	×	33.3%	$ 999
2	1,000	3,000	×	44.5	1,335
3	1,000	3,000	×	14.8	444
4	500	3,000	×	7.4	222
	$3,000				$3,000

EXAMPLE 9.14 A machine costs $10,000. Annual cash inflows are expected to be $5,000. The machine will be depreciated using the MACRS rule and will fall into the 3-year property class. The cost of capital after taxes is 10 percent. The estimated life of the machine is four years. The salvage value of the machine at the end of the fourth year is expected to be $1,200. The tax rate is 30 percent.

The formula for computation of after-tax cash inflows $(S - E)(1 - t) + (d)(t)$ needs to be computed separately. The NPV analysis can be performed as follows.

						Present Value Factor @ 10%	Present Value
Initial investment: $10,000						1.000	$(10,000.00)
$(S - E)(1 - t)$:							
$5,000(1 − 0.3) = $3,500 for 4 years						3.170*	$ 11,095.00
$(d)(t)$:							
Year	Cost		MACRS %	d	$(d)(t)$		
1	$10,000	×	33.3%	$3,330	$ 999	0.909†	908.09
2	$10,000	×	44.5	4,450	1,335	0.826†	1,102.71
3	$10,000	×	14.8	1,480	444	0.751†	333.44
4	$10,000	×	7.4	740	222	0.683†	151.63
Salvage value:							
$1,200 in year 4: $1,200 (1 − 0.3) = 840‡†						0.683†	573.72
Net present value (NPV)							$4,164.59

*From Table 9-4.
†From Table 9-3.
‡Any salvage value received under the MACRS rules is a *taxable gain* (the excess of the selling price over book value, $1,200 in this example), since the book value will be zero at the end of the life of the machine.

Since $NPV = PV - I =$ $4,164.59 is positive, the machine should be bought.

Summary

(1) The NPV method and the IRR method are called ____________ methods.

(2) ____________ is the process of making ____________ decisions.

(3) ____________ divides ____________ by the cash inflow through increased revenues or cash savings in operating expenses.

(4) The shorter the ____________, the less risky the project and the greater the ____________.

(5) Accounting rate of return does not recognize the ____________.

(6) Internal rate of return is the rate at which ____________ equals ____________.

(7) Accept the investment if its IRR exceeds ____________.

(8) IRR is especially difficult to compute when the cash flows are ____________.

(9) In ____________, the NPV and the IRR methods may produce ____________.

(10) ____________ is used widely in ranking the investments competing for limited funds.

(11) The ____________ method discounts all cash flows at the ____________, thus implicitly assuming that these cash flows can be reinvested at this rate.

(12) Income taxes affect both ____________ and ____________ of cash flow.

(13) ____________ is obtained by multiplying the depreciation deduction by the income tax rate.

(14) The traditional accelerated depreciation methods such as ____________ and ____________ produce higher tax savings on depreciation than the straight-line method does.

(15) MACRS rules abandon the concept of ____________.

(16) The straight-line method with ____________ allows the company to deduct only the half of the regular straight-line deduction amount in the ____________ year.

(17) Immediate disposal of the old machine usually results in ____________ that is fully deductible from current income for tax purposes.

Answers: (1) discounted cash flow (DCF); (2) capital budgeting, long-term investment; (3) payback period, the initial amount of investment; (4) payback period, liquidity; (5) time value of money; (6) present value of cash inflows, the initial investment; (7) the cost of capital; (8) not even; (9) mutually exclusive investments, conflicting rankings; (10) profitability index (or excess present value index); (11) NPV, cost of capital; (12) the amount, the timing; (13) tax shield; (14) the double-declining-balance method, the sum-of-the-years'-digits method; (15) useful life; (16) the half-year convention, first; (17) a loss.

Solved Problems

9.1 The following data are given for Alright Aluminum Company:

Initial cost of proposed equipment	\$75,000
Estimated useful life	7 years
Estimated annual savings in cash operating expenses	\$18,000
Predicted residual value at the end of the useful life	\$ 3,000
Cost of capital	12%

Compute the following:

(*a*) Payback period

(*b*) Present value of estimated annual savings

(*c*) Present value of estimated residual value

(*d*) Total present value of estimated cash inflows

(*e*) Net present value (NPV)

(*f*) Internal rate of return (IRR)

SOLUTION

(*a*) $$\text{Payback period} = \frac{\text{Initial investment}}{\text{Annual savings}} = \frac{\$75{,}000}{\$18{,}000} = 4.167 \text{ years}$$

(*b*) $12,000 × PV factor of an annuity of $1 at 12% for 7 years = $18,000 × 4.564 = $82,152

(*c*) $$\$3{,}000 \times \text{PV factor of } \$1 = \$3{,}000 \times 0.452 = \$1{,}356$$

(*d*) $$\text{Total PV} = \$82{,}152 + \$1{,}356 = \$83{,}508$$

(*e*) $$NPV = PV - I = \$83{,}508 - \$75{,}000 = \$8{,}508$$

(*f*) At IRR, $I = PV$. Thus,

$$\$75{,}000 = \$18{,}000 \times \text{PV factor}$$

$$\text{PV factor} = \frac{\$75{,}000}{\$18{,}000} = 4.167$$

which is, in the seven-year line, somewhere between 14 percent and 16 percent.

Using the interpolation,

	PV factor	
14%	4.288	4.288
True rate		4.167
16%	4.039	
Difference	0.249	0.121

$$IRR = 14\% + \frac{4.288 - 4.167}{4.288 - 4.039}(16\% - 14\%)$$

$$= 14\% + \frac{0.121}{0.249}(2\%) = 14\% + 0.97\% = 14.97\%$$

9.2 The John-in-the-Box Store is a fast-food restaurant chain. Potential franchisees are given the following revenue and cost information:

Building and equipment	$490,000
Annual revenue	520,000
Annual cash operating costs	380,000

The building and equipment have a useful life of 20 years. The straight-line method for depreciation is used. Ignore income taxes.

(*a*) What is the payback period?

(*b*) What is the accounting (simple) rate of return?

SOLUTION

(*a*) $$\text{Payback period} = \frac{\$490{,}000}{\$520{,}000 - \$380{,}000} = \frac{\$490{,}000}{\$140{,}000} = 3.5 \text{ years}$$

(*b*) $$\text{Annual depreciation} = \frac{\$490{,}000}{20 \text{ years}} = \$24{,}500$$

$$\text{Accounting (simple) rate of return} = \frac{\$140{,}000 - \$24{,}500}{\$490{,}000} = 23.57\%$$

9.3 The Rango Company is considering a capital investment for which the initial outlay is \$20,000. Net annual cash inflows (before taxes) are predicted to be \$4,000 for 10 years. Straight-line depreciation is to be used, with an estimated salvage value of zero. Ignoring income taxes, compute the items listed below.

1. Payback period
2. Accounting rate of return (ARR)
3. Net present value (NPV), assuming a cost of capital (before tax) of 12 percent
4. Internal rate of return (IRR)

SOLUTION

1.
$$\text{Payback period} = \frac{\text{Initial investment}}{\text{Annual cash flow}} = \frac{\$20{,}000}{\$4{,}000/\text{year}} = 5 \text{ years}$$

2.
$$\text{Accounting rate of return (ARR)} = \frac{\text{Average annual net income}}{\text{Initial investment}}$$

$$\text{Depreciation} = \frac{\$20{,}000}{10 \text{ years}} = \$2{,}000/\text{year}$$

$$\text{Accounting rate of return} = \frac{(\$4{,}000 - \$2{,}000)/\text{year}}{\$20{,}000} = 0.10 = 10\%$$

3.
$$\begin{aligned}\text{Net present value (NPV)} &= \text{PV of cash inflows [discounted at the cost of capital (12\%)]} \\ &\quad - \text{Initial investment} \\ &= \$4{,}000 \times (\text{PV Factor}) - \$20{,}000 = \$4{,}000(5.650) - \$20{,}000 = \$2{,}600\end{aligned}$$

4. Internal rate of return (IRR) = Rate which equates the amount invested with the present value of cash inflows generated by the project

Therefore, we set the following equation:

$$\$20{,}000 = \$4{,}000 \text{ (PV Factor)}$$

$$\text{PV Factor} = \frac{\$20{,}000}{\$4{,}000} = 5$$

which stands between 14 percent and 16 percent.

	Table Value	
14%	5.216	5.216
True rate		5.000
16%	4.833	
Difference	0.383	0.216

Using interpolation,

$$\begin{aligned} IRR &= 14\% + \left(\frac{5.216 - 5.000}{5.216 - 4.833}\right)(16\% - 14\%) = 14\% + \frac{0.216}{0.383}(2\%) \\ &= 14\% + (0.564)(2\%) = 14\% + 1.13\% = 15.13\% \end{aligned}$$

9.4 Consider an investment which has the following cash flows:

Year	Cash Flows
0	$(31,000)
1	10,000
2	20,000
3	10,000
4	10,000
5	5,000

1. Compute the following:
   (*a*) Payback period
   (*b*) Net present value (NPV) at 14 percent cost of capital
   (*c*) Internal rate of return (IRR)
2. Based on (*b*) and (*c*) in part 1, make a decision.

SOLUTION

1. (*a*) Payback period:

Year	Cash Flow	Recovery of Initial Outlay: Needed	Recovery of Initial Outlay: Balance	Payback Period in Years
1	$10,000	$31,000	$21,000	1.00
2	20,000	21,000	1,000	1.00
3	10,000	1,000	—	0.10
				2.1

(*b*) NPV:

Year	Cash Flow	PV Factor at 14%	PV
0	$(31,000)	1.000	$(31,000)
1	10,000	0.877	8,770
2	20,000	0.769	15,380
3	10,000	0.675	6,750
4	10,000	0.592	5,920
5	5,000	0.519	2,595
	Net present value (NPV)		$ 8,415

(*c*) By definition, IRR is the rate at which $PV = I$ or $NPV = 0$. We know from part (*b*) that NPV at 14 percent = $8,415. We will try 30 percent and see what happens to NPV.

Year	Cash Flow	PV Factor at 30%	PV
0	$(31,000)	1.000	$(31,000)
1	10,000	0.769	7,690
2	20,000	0.592	11,840
3	10,000	0.455	4,550
4	10,000	0.350	3,500
5	5,000	0.269	1,345
			$ (2,075)

Now we are sure that the true IRR is somewhere between 14 percent and 30 percent.
Using interpolation:

	NPV	
14%	$ 8,415	$8,415
True rate		0
30%	−2,075	
Difference	$10,490	$8,415

Therefore, $IRR = 14\% + \frac{\$8{,}415}{\$8{,}415 - (-\$2{,}075)}(30\% - 14\%)$

$$= 14\% + \frac{\$8{,}415}{\$10{,}490}(16\%) = 14\% + 12.835\% = 26.835\%$$

2. Under the NPV method, accept, since the NPV is a positive $8,415. Under the IRR method, accept, since the IRR of 26.835 percent exceeds the cost of capital of 14 percent.

9.5 Fill in the blanks for each of the following independent cases. Assume in all cases that the investment has a useful life of 10 years.

	Annual Cash Inflow	Investment	Cost of Capital	IRR	NPV
1.	$100,000	$449,400	14%	(*a*)	(*b*)
2.	$ 70,000	(*c*)	14%	20%	(*d*)
3.	(*e*)	$200,000	(*f*)	14%	$35,624
4.	(*g*)	$300,000	12%	(*h*)	$39,000

SOLUTION

1. (*a*) 18%; ($449,400/$100,000 = 4.494, the present value factor for 18% and 10 years)
   (*b*) $72,200; ($\$100{,}000 \times 5.216 = \$521{,}600$, so $NPV = \$521{,}600 - \$449{,}400 = \$72{,}200$)
2. (*c*) $293,440; ($\$70{,}000 \times 4.192$, the present value factor for 20% and 10 years; at IRR, $PV = I$)
   (*d*) $71,680; ($\$70{,}000 \times 5.216 = \$365{,}120$, so $NPV = \$365{,}120 - \$293{,}440 = \$71{,}680$)
3. (*e*) $38,344; ($200,000/5.216 factor for 14% and 10 years)
   (*f*) 10%; ($NPV = PV - I$; $PV = NPV + I$; Total $PV = \$35{,}624 + \$200{,}000$; $\$235{,}624/\$38{,}344 = 6.145$, the present value factor for 10%)
4. (*g*) $60,000; (Total $PV = \$39{,}000 + \$300{,}000$; $339,000/5.650 factor for 12% = $60,000)
   (*h*) About 15%; ($300,000/$60,000 = 5, which stands halfway between 14% and 16%)

9.6 Horn Corp. invested in a four-year project. Horn's cost of capital is 8 percent. Additional information on the project is as follows:

Year	Cash Inflow from Operations, Net of Income Taxes	Present Value of $1 at 8%
1	$2,000	0.926
2	2,200	0.857
3	2,400	0.794
4	2,600	0.735

Assuming a positive net present value of $500, what was the amount of the original investment?

(AICPA, adapted)

SOLUTION

Since $NPV = PV - I$, $I = PV - NPV$:

Year	Cash Inflow	Present Value of $1	Total PV
1	$2,000	0.926	$1,852
2	2,200	0.857	1,885
3	2,400	0.794	1,906
4	2,600	0.735	1,911
Present value of future *inflows* (PV)			$7,554
Net present value (NPV)			500
Initial outlay (I)			$7,054

9.7 Gene, Inc., invested in a machine with a useful life of six years and no salvage value. The machine was depreciated using the straight-line method and it was expected to produce annual cash inflow from operations, net of income taxes, of $2,000. The present value of an ordinary annuity of $1 for six periods at 10 percent is 4.355. The present value of $1 for six periods at 10 percent is 0.564. Assuming that Gene used an internal rate of return of 10 percent, what was the amount of the original investment?

(AICPA, adapted)

SOLUTION

By definition, at IRR, $PV = I$ or $NPV = 0$. To obtain the amount of initial investment, all you have to do is to find the present value of $2,000 a year for six periods.

$$PV = \$2{,}000 \times 4.355 = \$8{,}710$$

9.8 Mercury Transit, Inc., has decided to inaugurate express bus service between its headquarters city and a nearby suburb (one-way fare, $0.50), and is considering the purchase of either 32- or 52-passenger buses, on which pertinent estimates are as follows:

	32-Passenger Bus	52-Passenger Bus
Number of each to be purchased	6	4
Useful life	8 years	8 years
Purchase price of each bus (paid on delivery)	$80,000	$110,000
Mileage per gallon	10	$7\frac{1}{2}$
Salvage value per bus	$ 6,000	$ 7,000
Drivers' hourly wage	$ 3.50	$ 4.20
Price per gallon of gasoline	$ 0.60	$ 0.60
Other annual cash expenses	$ 4,000	$ 3,000

During the four daily rush hours, all buses will be in service and are expected to operate at full capacity (state law prohibits standees) in both directions of the route, each bus covering the route 12 times (six round trips) during the four-hour period. During the remainder of the 16-hour day, 500 passengers would be carried and Mercury Transit would operate only four buses on the route. Part-time drivers would be employed to drive the extra hours during the rush hours. A bus traveling the route all day would go 480 miles, and one traveling only during rush hours would go 120 miles a day during the 260-day year.

Ignoring income taxes, answer the following:

1. Prepare a schedule showing the computation of the estimated annual gross revenues from the new route for each alternative.
2. Prepare a schedule showing the computation of the estimated annual drivers' wages for each alternative.
3. Prepare a schedule showing the computation of the estimated annual cost of gasoline for each alternative.
4. Assume that your computations in 1, 2, and 3 are as follows:

	32-Passenger Bus	52-Passenger Bus
Estimated annual revenues	$365,000	$390,000
Estimated annual drivers' wages	67,000	68,000
Estimated annual cost of gasoline	32,000	36,000

Assuming that a minimum rate of return of 12 percent before income taxes is desired and that all annual cash flows occur at the end of the year, determine whether the 32- or the 52-passenger buses should be purchased. Use the NPV method.

(AICPA, adapted)

SOLUTION

1.

	32-Passenger Bus	52-Passenger Bus
Capacity per trip	32	52
Trips by each bus during rush hours	× 12	× 12
Rush-hour passengers carried by each bus	384	624
Number of buses	× 6	× 4
Total rush-hour passengers carried daily	2,304	2,496
Total other passengers daily	500	500
Total daily passengers	2,804	2,996
Days per year	× 260	× 260
Total passengers carried annually	729,040	778,960
Fare per passenger	× $0.50	× $0.50
Total annual revenue	$364,520	$389,480

Note that the 500 passengers represent 500 one-way fares.

2. Estimated annual drivers' wages:

	32-Passenger Bus	52-Passenger Bus
Buses operating daily during rush hours	6	4
Rush hours	× 4	× 4
Rush-hour time for all drivers	24	16
Buses operating remainder of day	4	4
Remaining hours	× 12	× 12
Regular driving time, excluding rush hours	48	48
Total daily driver hours	72	64
Days per year	× 260	× 260
Total annual driver hours	18,720	16,640
Hourly wage rate	× $3.50	× $4.20
Total annual drivers' wages	$65,520	$69,888

3. Estimated annual cost of gasoline:

	32-Passenger Bus	52-Passenger Bus
Buses operating during rush hours	6	4
Rush-hour mileage per bus	× 120	× 120
Total rush-hour mileage	720	480
Buses operating during remainder of day	4	4
Mileage per bus, remainder of day	× 360	× 360
Total mileage for remainder of day	1,440	1,440
Total daily mileage	2,160	1,920
Days per year	× 260	× 260
Total annual mileage	561,600	499,200
Miles per gallon	÷ 10	÷ $7\frac{1}{2}$
Annual gallons of gasoline consumption	56,160	66,560
Price per gallon	× \$0.60	× \$0.60
Total annual cost of gasoline	\$33,696	\$39,936

4. Computations of net annual cash inflows:

	32-Passenger Bus	52-Passenger Bus
Annual revenues	\$365,000	\$390,000
Less: Cash disbursements		
Drivers' wages	\$ 67,000	\$ 68,000
Gasoline	32,000	36,000
Other expenses	4,000	3,000
Total	\$103,000	\$107,000
Net annual cash inflow	\$262,000	\$283,000

Item	Year(s) Having Cash Flows	Amount of Cash Flows	12 Percent Factor	Present Value of Cash Flows
Purchase 32-passenger buses:				
Cost of the buses	Now	\$(480,000)	1.000	\$ (480,000)
Net annual cash inflows	1–8	262,000	4.968	1,301,616
Salvage value	8	36,000	0.404	14,544
Net present value				\$ 836,160
Purchase 52-passenger buses:				
Cost of the buses	Now	\$(440,000)	1.000	\$ (440,000)
Net annual cash inflows	1–8	283,000	4.968	1,405,944
Salvage value	8	28,000	0.404	11,312
Net present value				\$ 977,256
Net present value in favor of purchasing the 52-passenger buses				\$ 141,096

9.9 Data relating to three investments are given below:

	A	B	C
Investment (I)	$30,000	$20,000	$50,000
Useful life	10	4	20
Annual cash savings	$ 6,207	$ 7,725	$ 9,341

Rank the projects according to their attractiveness using the following:

(*a*) Payback period

(*b*) IRR

(*c*) NPV at 14 percent cost of capital

SOLUTION

(*a*) Payback period:

Project	Payback Period	Rank
A	$30,000/$6,207 = 4.833 years	2
B	$20,000/$7,725 = 2.588 years	1
C	$50,000/$9,341 = 5.353 years	3

(*b*) IRR ranking:

Project	Closest Rate	Rank
A	16%	3
B	20%	1
C	18%	2

(*c*) NPV at 14%:

Project	Annual Savings	PV Factor	Total PV	I	NPV	Rank
A	$6,207	5.216	$32,376	$30,000	$ 2,376	3
B	7,725	2.914	22,511	20,000	2,511	2
C	9,341	6.623	61,865	50,000	11,865	1

9.10 Rand Corporation is considering five different investment opportunities. The company's cost of capital is 12 percent. Data on these opportunities under consideration are given below.

Project	Investment	PV at 12%	NPV	IRR	Profitability Index (rounded)
(*a*)	$35,000	$39,325	$4,325	16%	1.12
(*b*)	20,000	22,930	2,930	15	1.15
(*c*)	25,000	27,453	2,453	14	1.10
(*d*)	10,000	10,854	854	18	1.09
(*e*)	9,000	8,749	(251)	11	0.97

1. Rank these five projects in descending order of preference, according to
   - NPV
   - IRR
   - Profitability index

2. Which ranking would you prefer?
3. Based on your answer in part 2, which projects would you select if $55,000 is the limit to be spent?

SOLUTION

1.

	Order of Preference		
	NPV	IRR	Profitability Index
(*a*)	1	2	2
(*b*)	2	3	1
(*c*)	3	4	3
(*d*)	4	1	4
(*e*)	5	5	5

2. The profitability index approach is generally considered the most dependable method of ranking projects competing for limited funds. It is an index of relative attractiveness, measured in terms of how much you get out for each dollar invested.
3. Based on the answer in part 2, projects (*a*) and (*b*) should be selected, where combined NPV would be $7,255 ($2,930 + $4,325) with the limited budget of $55,000.

9.11 A medium-sized manufacturing company is considering the purchase of a small computer in order to reduce the cost of its data processing operations. At the present time, the manual bookkeeping system in use involves the following direct cash expenses per month:

Salaries	$7,500
Payroll taxes and fringe benefits	1,700
Forms and supplies	600
	$9,800

Existing furniture and equipment are fully depreciated in the accounts and have no salvage value. The cost of the computer, including alterations, installation, and accessory equipment, is $100,000. This entire amount is depreciable for income tax purposes on a double-declining basis at the rate of 20 percent per annum.

Estimated annual costs of computerized data processing are as follows:

Supervisory salaries	$15,000
Other salaries	24,000
Payroll taxes and fringe benefits	7,400
Forms and supplies	7,200
	$53,600

The computer is expected to be obsolete in three years, at which time its salvage value is expected to be $20,000. The company follows the practice of treating salvage value as inflow at the time that it is likely to be received.

1. Compute the savings in annual cash expenses after taxes. Assume a 50 percent tax rate.
2. Decide whether or not to purchase the computer, using the net present value method. Assume a minimum rate of return of 10 percent after taxes.

(SMA, adapted)

SOLUTION

1.

Annual cash expenses of the manual bookkeeping machine system, $9,800 × 12	$117,600
Annual cash expenses of computerized data processing	53,600
Annual cash savings	$ 64,000

	Year 1	Year 2	Year 3
Annual cash savings (*a*)	$64,000	$64,000	$ 64,000
Depreciation	20,000	16,000	12,800
Inflow before tax	$44,000	$48,000	$ 51,000
Income tax (50%) (*b*)	22,000	24,000	25,600
Cash inflow after tax ($a - b$)	$42,000	$40,000	$ 38,400

2.

	After-Tax Cash Inflow		PV Factor	PV
Year 1	$42,000	×	0.909	$ 38,178
Year 2	40,000	×	0.826	33,040
Year 3	38,400	×	0.750	28,800
Year 3 Salvage	20,000	×	0.750	15,000
Year 3 Tax loss	15,600*	×	0.750	11,700
				$126,718
Investment (I)				100,000
Net present value (NPV)				$ 26,718

*The $15,600 tax benefit of the loss on the disposal of the computer at the end of year 3 is computed as follows:

Estimated salvage value		$ 20,000
Estimated book value:		
Historical cost	$100,000	
Accumulated depreciation	48,800	51,200
Estimated loss		$(31,200)
Tax rate		50%
Tax effect of estimated loss		$(15,600)

Since the net present value is positive, the computer should be purchased to replace the manual bookkeeping system.

9.12 The Michener Company purchased a special machine one year ago at a cost of $12,500. At that time, the machine was estimated to have a useful life of six years and a $500 disposal value. The annual cash operating cost is approximately $20,000.

A new machine that has just come on the market will do the same job but with an annual cash operating cost of only $17,000. This new machine costs $16,000 and has an estimated life of five years with a $1,000 disposal value. The old machine could be used as a trade-in at an allowance of $5,000. Straight-line depreciation is used, and the company's income tax rate is 50 percent. Compute the internal rate of return on the new investment.

(CGA, adapted)

SOLUTION

Cash outflow:			
Cost of new machine		$16,000	
Trade-in allowance for old machine		5,000	
Net cash outflow (*I*)		$11,000	
Cash savings (annual):			
Cash operating costs:			
Old machine	$20,000		
New machine	17,000	$ 3,000	$3,000
Depreciation expense (annual):			
Old machine [($12,500 − $500) ÷ 6 years]	$ 2,000		
New machine [($11,000 cash outflow + $10,500 old machine's book value); ($21,500 − $1,000) ÷ 5 years]	4,100		
Additional annual depreciation		2,100	
Taxable savings		$ 900	
Income tax on savings ($900 × 0.50)			450
Annual cash savings after income tax			$2,550

Internal rate of return factor: $11,000 ÷ $2,550 = 4.314

By interpolation:

	Present Value Factor		Present Value Factor
4%	4.452	4%	4.452
6%	4.212	IRR	4.314
	0.240		0.138

$$IRR = \left(\frac{0.138}{0.240} \times 2\%\right) + 4\% = 1.15\% + 4\% = 5.15\%$$

9.13 Two new machines are being evaluated for possible purchase. Forecasts relating to the two machines are:

	Machine 1	Machine 2
Purchase price	$50,000	$60,000
Estimated life (straight-line depreciation)	4 years	4 years
Estimated scrap value	None	None
Annual cash benefits before income tax:		
Year 1	$25,000	$45,000
Year 2	25,000	19,000
Year 3	25,000	25,000
Year 4	25,000	25,000
Income tax rate	40%	40%

Compute the net present value of each machine.

(CGA, adapted)

SOLUTION

After-tax cash benefit:

Year	Cash Benefit (a)	Depreciation	Taxable Income	Income Tax (b)	Net After-Tax Cash Inflow (a) − (b)
			Machine 1		
1	$25,000	$12,500	$12,500	$5,000	$20,000
2	25,000	12,500	12,500	5,000	20,000
3	25,000	12,500	12,500	5,000	20,000
4	25,000	12,500	12,500	5,000	20,000
			Machine 2		
1	$45,000	$15,000	$30,000	$12,000	$33,000
2	19,000	15,000	4,000	1,600	17,400
3	25,000	15,000	10,000	4,000	21,000
4	25,000	15,000	10,000	4,000	21,000

Net present value:

Year	Cash (Outflow) Inflow	Present Value of $1 8 Percent	Net Present Value of Cash Flow
		Machine 1	
0	$(50,000)	1.000	$(50,000)
1–4	20,000	3.312	66,240
		Net present value	$ 16,240
		Machine 2	
0	$(60,000)	1.000	$(60,000)
1	33,000	0.926	30.558
2	17,400	0.857	14,912
3	21,000	0.794	16,674
4	21,000	0.735	15,435
		Net present value	$ 17,579

9.14 The Lon-Ki Manufacturing Company must decide between two investments, A and B, which are mutually exclusive. The data on these projects are as follows (in thousands of dollars):

Project	Year 0	1	2	3	4
A	$(100)	$120.00	—	—	—
B	(100)	—	—	—	$193.80

1. For each project, compute:
   (*a*) NPV at 12 percent cost of capital
   (*b*) IRR
2. Why the conflicting ranking? Make a recommendation on which project should be chosen.

SOLUTION

1. (*a*) NPV at 12 percent:

Project	Cash Inflow	PV at $1	PV	NPV
A	$120.00	0.893	$107.16	$ 7.16
B	$193.80	0.636	123.26	23.26

(*b*) IRR:

Project		IRR
A	$100/$120 = 0.833	20%
B	$100/$193.80 = 0.516	18%

2. The conflicting ranking results from different assumptions regarding the reinvestment rate on the cash inflows released by the project. The NPV method assumes the cost of capital (12 percent in this problem) as the rate for reinvestment, whereas the IRR method assumes that the cash inflows are reinvested at their own internal rate of return (20 percent in the case of project A). We recommend the use of NPV for ranking mutually exclusive investments, because we think the cost of capital is a more realistic reinvestment rate.

9.15 After-tax cash flows for two mutually exclusive projects (with economic lives of four years each) are:

Year	Project X	Project Y
0	$(12,000)	$(12,000)
1	5,000	0
2	5,000	0
3	5,000	0
4	5,000	25,000

The company's cost of capital is 10 percent. Compute the following:

1. The internal rate of return for each project.
2. The net present value for each project.
3. Which project should be selected? Why?

(CGA, adapted)

SOLUTION

1. Project X:

$$\text{IRR factor} = \frac{\$12{,}000}{\$5{,}000} = 2.4$$

	Present Value Factor		Present Value Factor
24%	2.404	24%	2.404
25%	2.362	IRR factor	2.400
	0.042		0.004

$$\text{Internal rate of return} = 24\% + \left(\frac{0.004}{0.042} \times 1\%\right) = 24\% + 0.1\% = 24.1\%$$

Project Y:

Year	Cash (Outflow) Inflow	Present Value of $1 20%	Net Present Value of Cash Flow	Present Value of $1 22%	Net Present Value of Cash Flow
0	$(12,000)	1.000	$(12,000)	1.000	$(12,000)
4	25,000	0.482	12,050	0.451	11,275
			$ 50		$ (725)

$$\text{Internal rate of return} = 20\% + \left(2\% \times \frac{\$50}{\$775}\right) = 20\% + 0.13\% = 20.13\%$$

2. Project X:

Year	Cash (Outflow) Inflow	Present Value of $1 10%	Net Present Value of Cash Flow
0	$(12,000)	1.000	$(12,000)
1–4	5,000	3.170	15,850
		Net present value	$ 3,850

Project Y:

Year	Cash (Outflow) Inflow	Present Value of $1 10%	Net Present Value of Cash Flow
0	$(12,000)	1.000	$(12,000)
4	25,000	0.683	17,075
		Net present value	$ 5,075

In summary,

Project	IRR	NPV
X	24.1%	$3,850
Y	20.13%	5,075

3. Using the IRR method, project X is superior to project Y; using the NPV method, project Y is more attractive than X. The decision hinges on the assumption made about reinvestment of cash inflow. Theory suggests resorting to the NPV method because the cost of capital reinvestment assumption implicit in this method is considered to be a more realistic assumption than the IRR, where a reinvestment at the IRR is assumed.

9.16 A machine costs $1,000 initially. Annual cash inflows are expected to be $300. The machine will be depreciated using the MACRS rule and will fall into the three-year property class. No salvage value is anticipated. The cost of capital is 16 percent. The estimated life of the machine is five years. The tax rate is 40 percent. Make a decision using NPV.

SOLUTION

	Year(s) Having Cash Flows	Amount of Cash Flows	16% PV Factor	PV
Initial investment	Now	$1,000	1.000	$(1,000)
Annual cash inflows:				
$300				
×60%				
$180	1–5	180	3.274	589

Depreciation deductions:

Year	Cost	MACRS %	Depreciation	Tax Shield				
1	$1,000	33.3%	$333	$133.20	1	$133.20	0.862	$114.82
2	1,000	44.5	445	178.00	2	178.00	0.743	132.25
3	1,000	14.8	148	59.20	3	59.20	0.641	37.95
4	1,000	7.4	74	29.60	4	29.60	0.552	16.34
Net present value								$ (109.32)

The machine should not be bought, because the NPV of −$109.32 is negative.

9.17 A firm is considering the purchase of an automatic machine for $6,200. The machine has an installation cost of $800 and zero salvage value at the end of its expected life of five years. Depreciation is by the straight-line method with the *half-year convention*. The machine is considered a five-year property. Expected cash savings before tax is $1,800 per year over the five years. The firm is in the 40 percent tax bracket. The firm has determined the cost of capital (or minimum required rate of return) as 10 percent after taxes. Should the firm purchase the machine? Use the NPV method.

SOLUTION

	Year(s) Having Cash Flows	Amount of Cash Flows	10% PV Factor	PV
Initial investment	Now	$(7,000)	1.000	$(7,000)
Annual cash inflows:				
$1,800				
×60%				
$1,080	1–5	1,080	3.791	4,094

Depreciation deductions:

Year	Depreciation	Tax shield at 40%				
1	$ 700	$280	1	$ 280	0.909	$ 255
2	1,400	560	2	560	0.826	463
3	1,400	560	3	560	0.751	421
4	1,400	560	4	560	0.683	382
5	1,400	560	5	560	0.621	348
6	700	280	6	280	0.564	158
Net present value						$ (879)

The firm should not buy the automatic machine, since its NPV is negative.

9.18 The Wessels Corporation is considering installing a new conveyor for materials handling in a warehouse. The conveyor will have an initial cost of $75,000 and an installation cost of $5,000. Expected benefits of the conveyor are: (*a*) Annual labor cost will be reduced by $16,500, and (*b*) breakage and other damages from handling will be reduced by $400 per month. Some of the firm's costs are expected to increase as follows: (*a*) Electricity cost will rise by $100 per month, and (*b*) annual repair and maintenance of the conveyor will amount to $900.

Assume that the firm uses the MACRS rules for depreciation in the five-year property class. No salvage value will be recognized for tax purposes. The conveyor has an expected useful life of eight years and a projected salvage value of $5,000. The tax rate is 40 percent.

1. Estimate future cash inflows for the proposed project.
2. Determine the project's NPV at 10 percent. Should the firm buy the conveyor?

SOLUTION

1. Annual cash inflow:

$16,500	Reduction in labor cost
4,800	Reduction in breakage
−1,200	Increase in electricity costs
−900	Increase in repair and maintenance cost
$19,200	

2. Initial amount of investment is:

$75,000 + $5,000 = $80,000

					Year(s) Having Cash Flows	Amount of Cash Flows	10% PV Factor	PV
Initial investment					Now	$(80,000)	1.000	$(80,000)
Annual cash inflow:	$19,200							
	×60%							
After-tax cash inflow:	$11,520				1–8	11,520	5.335	61,459.20

Depreciation deduction:

Year	Cost	MACRS	Depreciation	Tax Shield				
1	$80,000	20%	$16,000	$ 6,400	1	$ 6,400	0.909	$ 5,817.60
2	80,000	32	25,600	10,240	2	10,240	0.826	8,458.24
3	80,000	19.2	15,360	6,144	3	6,144	0.751	4,614.14
4	80,000	11.5	9,200	3,680	4	3,680	0.683	2,513.44
5	80,000	11.5	9,200	3,680	5	3,680	0.621	2,285.28
6	80,000	5.8	4,640	1,856	6	1,856	0.564	1,046.78
								$ 24,735.48

Salvage value, fully taxable since book value will be zero:

$5,000				
×60%				
$3,000	8	$ 3,000	0.467	$ 1,401.00
				$ 7,595.68

The Wessels Corporation should buy and install the conveyor, since it brings a positive NPV.

9.19 Wisconsin Products Company manufactures several different products. One of the firm's principal products sells for $20 per unit. The sales manager of Wisconsin Products has stated repeatedly that he could sell more units of this product if they were available. In an attempt to substantiate his claim, the sales manager conducted a market research study last year at a cost of $44,000 to determine potential demand for this product. The study indicated that Wisconsin Products could sell 18,000 units of this product annually for the next five years.

The equipment currently in use has the capacity to produce 11,000 units annually. The variable production costs are $9 per unit. The equipment has a book value of $60,000 and a remaining useful life of five years. The salvage value of the equipment is negligible now and will be zero in five years.

A maximum of 20,000 units could be produced annually on the new machinery which can be purchased. The new equipment costs $300,000 and has an estimated useful life of five years with no salvage value at the end of five years. Wisconsin Products' production manager has estimated that the new equipment would provide increased production efficiencies that would reduce the variable production costs to $7 per unit.

Wisconsin Products Company uses straight-line depreciation on all of its equipment for tax purposes. The firm is subject to a 40 percent tax rate, and its after-tax cost of capital is 15 percent.

The sales manager felt so strongly about the need for additional capacity that he attempted to prepare an economic justification for the equipment, although this was not one of his responsibilities. His analysis, presented below, disappointed him because it did not justify acquiring the equipment.

Required Investment		
Purchase price of new equipment		$300,000
Disposal of existing equipment:		
Loss of disposal	$60,000	
Less: Tax benefit (40%)	24,000	36,000
Cost of market research study		44,000
Total investment		$380,000

Annual Returns	
Contribution margin from product:	
Using the new equipment [18,000 × ($20 − $7)]	$234,000
Using the existing equipment [11,000 × ($20 − $9)]	121,000
Increase in contribution margin	$113,000
Less: Depreciation	60,000
Increase in before-tax income	$ 53,000
Income tax (40%)	21,200
Increase in income	$ 31,800
Less: 15% cost of capital on the additional investment required (0.15 × $380,000)	57,000
Net annual return of proposed investment in new equipment	$ (25,200)

1. The controller of Wisconsin Products Company plans to prepare a discounted cash flow analysis for this investment proposal. The controller has asked you to prepare corrected calculations of

   (*a*) The required investment in the new equipment

   (*b*) The recurring annual cash flows

Explain the treatment of each item of your corrected calculations that is treated differently from the original analysis prepared by the sales manager.

2. Calculate the net present value of the proposed investment in the new equipment.

SOLUTION

1. (*a*)	Purchase price of new equipment		$(300,000)
	Disposal of existing equipment:		
	Selling price	$ 0	
	Book value	60,000	
	Loss on disposal	$60,000	
	Tax rate	0.4	
	Tax benefit of loss on disposal		24,000
	Required investment (*I*)		$(276,000)
(*b*)	Increased cash flows resulting from change in contribution margin:		
	Using new equipment [18,000 ($20 − $7)]*		$ 234,000
	Using existing equipment [11,000 ($20 − $9)]		121,000
	Increased cash flows		$ 113,000
	Less: Taxes (0.40 × $113,000)		45,200
	Increased cash flows after taxes		$ 67,800
	Depreciation tax shield:		
	Depreciation on new equipment ($300,000 ÷ 5)	$60,000	
	Depreciation on existing equipment ($60,000 ÷ 5)	12,000	
	Increased depreciation charge	$48,000	
	Tax rate	0.4	
	Depreciation tax shield		19,200
	Recurring annual cash flows		$ 87,000

*The new equipment is capable of producing 20,000 units, but Wisconsin Products can sell only 18,000 units annually.

The sales manager made several errors in his calculations of required investment and annual cash flows. The errors are as follows:

Required investment:

- The cost of the market research study ($44,000) is a sunk cost because it was incurred last year and will not change regardless of whether the investment is made or not.
- The loss on the disposal of the existing equipment does not result in an actual cash cost as shown by the sales manager. The loss on disposal results in a reduction of taxes, which reduces the cost of the new equipment.

Annual cash flows:

- The sales manager considered only the depreciation on the new equipment rather than just the additional depreciation which would result from the acquisition of the new equipment.
- The sales manager also failed to consider that the depreciation is a noncash expenditure which provides a tax shield.
- The sales manager's use of the discount rate (i.e., cost of capital) was incorrect. The discount rate should be used to reduce the value of future cash flows to their current equivalent at time period zero.

2.

Present value of future cash flows ($87,000 × 3.36)	$292,320
Required investment (I)	276,000
Net present value	$ 16,320

9.20 The Baxter Company manufactures toys and other short-lived-fad–type items. The research and development department came up with an item that would make a good promotional gift for office equipment dealers. Aggressive and effective effort by Baxter's sales personnel has resulted in almost firm commitments for this product for the next three years. It is expected that the product's value will be exhausted by that time.

In order to produce the quantity demanded, Baxter will need to buy additional machinery and rent some additional space. It appears that about 25,000 square feet will be needed; 12,500 square feet of presently unused, but leased, space is available now. (Baxter's present lease with 10 years to run costs $3.00 a foot.) There is another 12,500 square feet adjoining the Baxter facility which Baxter will rent for three years at $4.00 per square foot per year if it decides to make this product.

The equipment will be purchased for about $900,000. It will require $30,000 in modifications, $60,000 for installation, and $90,000 for testing; all of these activities will be done by a firm of engineers hired by Baxter. All of the expenditures will be paid for on January 1, 19X1.

The equipment should have a salvage value of about $180,000 at the end of the third year. No additional general overhead costs are expected to be incurred.

The following estimates of revenues and expenses for this product for the three years have been developed.

	19X1	19X2	19X3
Sales	$1,000,000	$1,600,000	$800,000
Material, labor, and incurred overhead	$ 400,000	$ 750,000	$350,000
Assigned general overhead	40,000	75,000	35,000
Rent	87,500	87,500	87,500
Depreciation	450,000	300,000	150,000
	$ 977,500	$1,212,500	$622,500
Income before tax	$ 22,500	$ 387,500	$177,500
Income tax (40%)	9,000	155,000	71,000
	$ 13,500	$ 232,500	$106,500

1. Prepare a schedule which shows the incremental after-tax cash flows for this project.

2. If the company requires a two-year payback period for its investment, would it undertake this project? Show your supporting calculations clearly.

3. Calculate the after-tax accounting rate of return for the project.

4. A newly hired business-school graduate recommends that the company consider the use of net present value analysis to study this project. If the company sets a required rate of return of 20 percent after taxes, will this project be accepted? Show your supporting calculations clearly. (Assume all operating revenues and expenses occur at the end of the year.)

(CMA, adapted)

SOLUTION

1.

Incremental After-Tax Cash Flow (000 omitted)	19X1	19X2	19X3
Sales	$1,000	$1,600	$800
Material, labor, overhead	$ 400	$ 750	$350
Added rent	50	50	50
Depreciation	450	300	150
Incremental costs	$ 900	$1,100	$550
Incremental income	$ 100	$ 500	$250
Incremental taxes	40	200	100
Incremental income after taxes	$ 60	$ 300	$150
Add back depreciation	450	300	150
Incremental operation cash flow	$ 510	$ 600	$300
Salvage value			180
Net incremental after-tax cash flow	$ 510	$ 600	$480

Initial investment for project:

Purchase price	$ 900
Modification	30
Installation	60
Testing	90
Total	$1,080

2. The project should be undertaken if the criterion is a two-year payback.

19X1	$ 510,000
19X2	600,000
	$1,110,000

Payback is in two years, which is greater than cost of $1,080,000.
The payback period is:

$$\frac{510}{510} + \frac{570}{600} = 1.95 \text{ years}$$

3.

19X1 income	$ 13,500
19X2 income	232,500
19X3 income	106,500
	$352,500

Average income: $117,500 ($352,500/3)

$$\text{Accounting rate of return} = \frac{\$117{,}500}{\$1{,}080{,}000} = 10.88\%$$

4. The project should be adopted if a 20 percent after-tax rate of return is required.

Present Value of Cash Flows at 20%		
19X1	$0.83 \times 510{,}000 =$	$ 423,300
19X2	$0.69 \times 600{,}000 =$	414,000
19X3	$0.58 \times 480{,}000 =$	278,400
Present value		$1,115,700

The present value of $1,115,700 is greater than the initial outlay of $1,080,000; therefore, the project more than satisfies the 20 percent requirement.

9.21 R. Oliver and J. Rand have formed a corporation to franchise a quick food system for shopping malls. They have just completed experiments with the prototype machine which will serve as the basis of the operation. Because the system is new and untried, they have decided to conduct a pilot operation in a nearby mall. If it proves successful, they will aggressively market the franchises.

The income statements below represent Oliver and Rand's best estimates of income from the mall operation for the next four years. At the end of the four-year period they intend to sell the operation and concentrate on the sale of and supervision of franchises. Based on the income stream projected, they believe the operation can be sold for $190,000; the income tax liability from the sale will be $40,000.

1. Calculate the cash flow for the mall operation for the four-year period beginning January 1, 19X6, ignoring income tax implications.

2. Adjust the cash flows for the tax consequences as appropriate.

Projected Income
For Years Ending December 31

	19X6	19X7	19X8	19X9
Sales	$120,000	$150,000	$200,000	$230,000
Less: Cost of goods sold	$ 60,000	$ 75,000	$100,000	$110,000
Wages	24,000	30,000	40,000	44,000
Supplies	2,000	2,300	2,400	3,200
Personal property taxes	1,000	1,200	1,600	1,800
Annual rental charge*	12,000	12,000	12,000	12,000
Depreciation†	11,000	11,000	11,000	11,000
Development costs‡	20,000	20,000	20,000	20,000
Total expenses	$130,000	$151,500	$187,000	$202,000
Net income before taxes	$(10,000)	$ (1,500)	$ 13,000	$ 28,000
Less: Income taxes @ 40%	—§	—§	600§	11,200
Net income after taxes	$(10,000)	$ (1,500)	$ 12,400	$ 16,800

*The shopping mall requires tenants to sign a 10-year lease. Three years' rental is payable at the beginning of the lease period, with annual payments at the end of each of the next seven years.

†Construction of an operational machine is estimated to be completed on January 1, 19X7. The $130,000 purchase price will be paid at that time. The salvage value at the end of its 10-year life is estimated at $20,000. Straight-line depreciation is to be used for statement purposes and sum-of-the-years'-digits for tax purposes.

‡The prototype machine cost $200,000 to develop and build in 19X6. It is not suitable for commercial use. However, since it was the basis of the system, it is to be amortized at $20,000 per year. The same amount will be deducted for tax purposes.

§The losses of the first two years are offset against the $13,000 income in 19X8 before income tax charges are calculated.

(CMA, adapted)