

Chapter 7: Net Present Value and Capital Budgeting

- 7.1
- a. **Yes**, the reduction in the sales of the company's other products, referred to as **erosion**, should be treated as an incremental cash flow. These lost sales are included because they are a cost (a revenue reduction) that the firm must bear if it chooses to produce the new product.
 - b. **Yes**, expenditures on plant and equipment should be treated as incremental cash flows. These are costs of the new product line. However, if these expenditures have already occurred, they are **sunk costs** and are not included as incremental cash flows.
 - c. **No**, the research and development costs should not be treated as incremental cash flows. The costs of research and development undertaken on the product during the past 3 years are **sunk costs** and should not be included in the evaluation of the project. Decisions made and costs incurred in the past cannot be changed. They should not affect the decision to accept or reject the project.
 - d. **Yes**, the annual depreciation expense should be treated as an incremental cash flow. Depreciation expense must be taken into account when calculating the cash flows related to a given project. While depreciation is not a cash expense that directly affects cash flow, it decreases a firm's net income and hence, lowers its tax bill for the year. Because of this **depreciation tax shield**, the firm has more cash on hand at the end of the year than it would have had without expensing depreciation.
 - e. **No**, dividend payments should not be treated as incremental cash flows. A firm's decision to pay or not pay dividends is independent of the decision to accept or reject any given investment project. For this reason, it is not an incremental cash flow to a given project. Dividend policy is discussed in more detail in later chapters.
 - f. **Yes**, the resale value of plant and equipment at the end of a project's life should be treated as an incremental cash flow. The price at which the firm sells the equipment is a cash inflow, and any difference between the book value of the equipment and its sale price will create gains or losses that result in either a tax credit or liability.
 - g. **Yes**, salary and medical costs for production employees hired for a project should be treated as incremental cash flows. The salaries of all personnel connected to the project must be included as costs of that project.
- 7.2
- Item I is a relevant cost because the opportunity to sell the land is lost if the new golf club is produced. Item II is also relevant because the firm must take into account the erosion of sales of existing products when a new product is introduced. If the firm produces the new club, the earnings from the existing clubs will decrease, effectively creating a cost that must be included in the decision. Item III is not relevant because the costs of Research and Development are sunk costs. Decisions made in the past cannot be changed. They are not relevant to the production of the new clubs. **Choice C is the correct answer.**

7.3 Cash Flow Chart:

	Year 0	Year 1	Year 2	Year 3	Year 4
1. Sales revenue	-	\$7,000	\$7,000	\$7,000	\$7,000
2. Operating costs	-	2,000	2,000	2,000	2,000
3. Depreciation	-	2,500	2,500	2,500	2,500
4. Income before tax [1-(2+3)]	-	2,500	2,500	2,500	2,500
5. Taxes at 34%	-	850	850	850	850
6. Net income [4-5]	0	1,650	1,650	1,650	1,650
7. Cash flow from operation [1-2-5]	0	4,150	4,150	4,150	4,150
8. Initial Investment	-\$10,000	-	-	-	-
9. Changes in net working capital	-200	-50	-50	100	200
10. Total cash flow from investment [9+10]	-10,200	-50	-50	100	200
11. Total cash flow [7+10]	-\$10,200	\$4,100	\$4,100	\$4,250	\$4,350

a. Incremental Net Income [from 6]:

Year 0	Year 1	Year 2	Year 3	Year 4
0	\$1,650	\$1,650	\$1,650	\$1,650

b. Incremental cash flow [from 11]:

Year 0	Year 1	Year 2	Year 3	Year 4
-\$10,200	\$4,100	\$4,100	\$4,250	\$4,350

- c. The present value of each cash flow is simply the amount of that cash flow discounted back from the date of payment to the present. For example, discount the cash flow in Year 1 by 1 period (1.12) , and discount the cash flow that occurs in Year 2 by 2 periods $(1.12)^2$. Note that since the Year 0 cash flow occurs today, its present value does not need to be adjusted.

$$\begin{aligned}
 PV(C_0) &= -\$10,200 \\
 PV(C_1) &= \$4,100 / (1.12) = \$3,661 \\
 PV(C_2) &= \$4,100 / (1.12)^2 = \$3,268 \\
 PV(C_3) &= \$4,250 / (1.12)^3 = \$3,025 \\
 PV(C_4) &= \$4,350 / (1.12)^4 = \$2,765
 \end{aligned}$$

$$NPV = PV(C_0) + PV(C_1) + PV(C_2) + PV(C_3) + PV(C_4) = \mathbf{\$2,519}$$

These calculations could also have been performed in a single step:

$$\begin{aligned}
 NPV &= -\$10,200 + \$4,100 / (1.12) + \$4,100 / (1.12)^2 + \$4,250 / (1.12)^3 + \$4,350 / (1.12)^4 \\
 &= \mathbf{\$2,519}
 \end{aligned}$$

The NPV of the project is \$2,519.

7.4 The initial payment, which occurs today (year 0), does not need to be discounted:

$$PV = \$1,400,000$$

The expected value of his bonus payment is:

$$\begin{aligned}\text{Expected Value} &= C_0(\text{Probability of Occurrence}) + C_1(\text{Probability of Nonoccurrence}) \\ &= \$750,000(0.60) + \$0(0.40) \\ &= \$450,000\end{aligned}$$

The expected value of his salary, including the expected bonus payment, is \$2,950,000 (= \$2,500,000 + \$450,000).

The present value of his three-year salary with bonuses is:

$$\begin{aligned}\text{PV Annuity} &= C_1 A_r^T \\ &= \$2,950,000 A_{0.1236}^3 \\ &= \$7,041,799\end{aligned}$$

Remember that the annuity formula yields the present value of a stream of cash flows one period prior to the initial payment. Therefore, applying the annuity formula to a stream of cash flows that begins four years from today will generate the present value of that annuity as of the end of year three. Discount that result by three years to find the present value.

$$\begin{aligned}\text{PV Delayed Annuity} &= (A_r^T) / (1+r)^{T-1} \\ &= (\$1,250,000 A_{0.1236}^{10}) / (1.1236)^3 \\ &= \$4,906,457\end{aligned}$$

Thus, the total PV of his three-year contract is:

$$\begin{aligned}\text{PV} &= \$1,400,000 + \$2,950,000 A_{0.1236}^3 + (\$1,250,000 A_{0.1236}^{10}) / (1.1236)^3 \\ &= \$1,400,000 + \$7,041,799 + \$4,906,457 \\ &= \mathbf{\$13,348,256}\end{aligned}$$

The present value of the contract is \$13,348,256.

7.5 Compute the NPV of both alternatives. If either of the projects has a positive NPV, that project is more favorable to Benson than simply continuing to rent the building. If both of the projects have positive net present values, recommend the one with the higher NPV. If neither of the projects has a positive NPV, the correct recommendation is to reject both projects and continue renting the building to the current occupants.

Note that the remaining fraction of the value of the building and depreciation are not incremental and should not be included in the analysis of the two alternatives. The \$225,000 purchase price of the building is a sunk cost and should be ignored.

Product A:	t = 0	t = 1 - 14	t = 15
Revenues		\$105,000	\$105,000
-Foregone rent		12,000	12,000
-Expenditures		60,000	63,750 **
-Depreciation*		12,000	12,000
Earnings before taxes		\$21,000	\$17,250
-Taxes (34%)		7,140	5,865
Net income		\$13,860	\$11,385
+Depreciation		12,000	12,000
Capital investment	-\$180,000		
A/T-NCF	-\$180,000	\$25,860	\$23,385

*Since the two assets, equipment and building modifications, are depreciated on a straight-line basis, the depreciation expense will be the same in each year. To compute the annual depreciation expense, determine the total initial cost of the two assets (\$144,000 + \$36,000 = \$180,000) and divide this amount by 15, the economic life of each of the 2 assets. Annual depreciation expense for building modifications and equipment equals \$12,000 (= \$180,000 / 15).

**Cash expenditures (\$60,000) + Restoration costs (\$3,750)

The cash flows in years 1 - 14 ($C_1 - C_{14}$) could have been computed using the following simplification:

$$\begin{aligned}
 \text{After-Tax NCF} &= \text{Revenue} (1 - T_C) - \text{Expenses} (1 - T_C) + \text{Depreciation} (T_C) \\
 &= \$105,000 (0.66) - \$72,000 (0.66) + \$12,000 (0.34) \\
 &= \$25,860
 \end{aligned}$$

The cash flows for year 15 could have been computed by adjusting the annual after-tax net cash flows of the project (computed above) for the after-tax value of the restoration costs.

$$\begin{aligned}
 \text{After-Tax value of restoration costs} &= \text{Restoration Costs} (1 - T_C) \\
 &= -\$3,750 (0.66) \\
 &= -\$2,475
 \end{aligned}$$

$$\begin{aligned}
 \text{After-Tax NCF} &= \$25,860 - \$2,475 \\
 &= \$23,385
 \end{aligned}$$

The present value of the initial outlay is simply the cost of the outlay since it occurs today (year 0).

$$PV(C_0) = -\$180,000$$

Since the cash flows in years 1-14 are identical, their present value can be found by determining the value of a 14-year annuity with payments of \$25,860, discounted at 12 percent.

$$PV(C_{1-14}) = \$25,860 A_{0,12}^{14} = \$171,404$$

Because the last cash flow occurs 15 years from today, discount the amount of the cash flow back 15 years at 12 percent to determine its present value.

$$\begin{aligned}
 PV(C_{15}) &= \$23,385 / (1.12)^{15} \\
 &= \$4,272
 \end{aligned}$$

$$\begin{aligned}
 NPV_A &= PV(C_0) + PV(C_{1-14}) + PV(C_{15}) \\
 &= -\$4,324
 \end{aligned}$$

These calculations could also have been performed in a single step:

$$\begin{aligned} NPV_A &= -\$180,000 + \$25,860 A_{0,12}^{14} + \$23,385 / (1.12)^{15} \\ &= -\$180,000 + \$171,404 + \$4,272 \\ &= -\$4,324 \end{aligned}$$

Since the net present value of Project A is negative, Benson would rather rent the building to its current occupants than implement Project A.

Product B	t = 0	t = 1 - 14	t = 15
Revenues		\$127,500	\$127,500
-Foregone rent		12,000	12,000
-Expenditures		75,000	103,125 **
-Depreciation*		14,400	14,400
Earnings before taxes		\$26,100	-\$2,025
-Taxes (34%)		8,874	-689
Net income		\$17,226	-\$1,336
+Depreciation		14,400	14,400
Capital investment	-\$216,000		
A/T-NCF	-\$216,000	\$31,626	\$13,064

* Since the two assets, equipment and building modifications, are depreciated on a straight-line basis, the depreciation expense will be the same in each year. To compute the annual depreciation expense, determine the total initial cost of the two assets (\$162,000 + \$54,000 = \$216,000) and divide this amount by 15, the economic life of each of the two assets. Annual depreciation expense for building modifications and equipment is \$14,400 (= \$216,000/ 15).

**Cash expenditures (\$75,000) + Restoration costs (\$28,125)

The cash flows in years 1 - 14 ($C_1 - C_{14}$) could have been computed using the following simplification:

$$\begin{aligned} \text{After-Tax NCF} &= \text{Revenue (1 - T)} - \text{Expenses (1 - T)} + \text{Depreciation (T)} \\ &= \$127,500 (0.66) - \$87,000 (0.66) + \$14,400 (0.34) \\ &= \$31,626 \end{aligned}$$

The cash flows for year 15 could have been computed by adjusting the annual after-tax net cash flows of the project (computed above) for the after-tax value of the restoration costs.

$$\begin{aligned} \text{After-tax value of restoration costs} &= \text{Restoration Costs (1 - } T_C) \\ &= -\$28,125(0.66) \\ &= -\$18,562 \end{aligned}$$

$$\begin{aligned} \text{After-Tax NCF} &= \$31,626 - \$18,562 \\ &= \$13,064 \end{aligned}$$

The present value of the initial outlay is simply the cost of the outlay since it occurs today (year 0).

$$PV(C_0) = -\$216,000$$

Because the cash flows in years 1-14 are identical, their present value can be found by determining the value of a 14-year annuity with payments of \$31,626, discounted at 12 percent.

$$\begin{aligned} PV(C_{1-14}) &= \$31,626 A_{0,12}^{14} \\ &= \$209,622 \end{aligned}$$

Since the last cash flow occurs 15 years from today, discount the amount of the cash flow back 15 years at 12 percent to determine its present value.

$$\begin{aligned}PV(C_{15}) &= \$13,064 / (1.12)^{15} \\ &= \$2,387\end{aligned}$$

$$\begin{aligned}NPV_B &= PV(C_0) + PV(C_{1-14}) + PV(C_{15}) \\ &= -\$216,000 + \$209,622 + \$2,387 \\ &= \mathbf{-\$3,991}\end{aligned}$$

These calculations could also have been performed in a single step:

$$\begin{aligned}NPV_B &= -\$216,000 + \$31,626 A_{0.12}^{14} + \$13,064 / (1.12)^{15} \\ &= -\$216,000 + \$209,622 + \$2,387 \\ &= \mathbf{-\$3,991}\end{aligned}$$

Since the net present value of Project B is negative, Benson would rather rent the building to its current occupants than implement Project B.

Since the net present values of both Project A and Project B are negative, Benson should continue to rent the building to its current occupants.