

Capital Budgeting Techniques, Project Cash Flows, and Risk

1. Calculate the NPV for the following project. an outflow of \$7,000 followed by inflows of \$3,000, \$2,500 and \$3,500 at one-year intervals at a cost of capital of 7%.

- ☐ a. \$934.60
- ☐ b. \$844.35
- ☐ c. \$816.60
- ☐ d. \$944.35

2. Calculate the NPV for the following project with the following cash flows: an initial outlay of \$35,400 followed by inflows of \$6,500 for three years and then a single inflow in the fourth year of \$18,000 at a cost of capital of 9%. (Recognize the first three inflows as an annuity in your calculations.)

- ☐ a. -\$6,195.35
- ☐ b. \$6,500.13
- ☐ c. -\$6,895.16
- ☐ d. \$7,084.35

3. Calculate the IRR for the following project with the following cash flows: an initial outflow of \$15,220 followed by inflows of \$5,000, \$6,000, and \$6,500 at one year intervals.

- ☐ a. 9%
- ☐ b. 8%
- ☐ c. 7%
- ☐ d. 6%

4. Calculate the IRR for the following project with the following cash flows: An initial outflow of \$47,104 followed by inflows of \$16,000, \$17,000, and 18,000 at one year intervals.

- ☐ a. 9%
- ☐ b. -9%
- ☐ c. 4%
- ☐ d. 2%

5. Calculate the NPV at a cost of capital of 9% and the IRR for a project with an initial outlay of \$69,724 and an inflow of \$15,000 followed by four consecutive inflows of \$17,000 at one-year intervals.

- ☐ a. -\$5,437.29; 6%
- ☐ b. \$5,437.29; 4%
- ☐ c. \$5,437.29; 4.2%
- ☐ d. -\$5,427.29; 3.39%

6. Calculate the NPV at a cost of capital of 9% and the IRR for a project with an initial outlay of \$25,424 followed by two zero cash flow years and then four years of inflows at \$10,500.

- ☐ a. \$3,239.70; 4%
- ☐ b. -\$3,239.70; 6%
- ☐ c. \$3,207.98; 9%
- ☐ d. \$3,207.98; 12%

7. Calculate the NPV at a cost of capital of 9% and the IRR for a project with an initial outlay of \$10,672 followed by another outlay of \$5,000 followed by five inflows of \$5,000 at one-year intervals.

- ☐ a. \$2,583.05; 8.7%
- ☐ b. \$2,583.05; 14%
- ☐ c. -\$2,583.05; 4.2%
- ☐ d. \$2,835.05; -4.2%

8. Calculate the NPV at a cost of capital of 12% and the IRR (to the nearest whole percent) for a project with an initial outflow of \$5,000 followed by inflows of \$1,000, \$2,000, and \$3,000 at one-year intervals.

- ☐ a. 14%
- ☐ b. 12%
- ☐ c. 10%
- ☐ d. 8.6%

9. Calculate the NPV at 12% and the IRR (to the nearest whole percent) for a project with an initial outflow of \$5,000 followed by inflows of \$1,000, \$2,000, and \$3,000. What is the IRR?

- ☐ a. 22%
- ☐ b. 8%
- ☐ c. 7%
- ☐ d. 12%

10. Calculate the NPV at a cost of capital of 12% and the IRR (to the nearest whole percent) for a project with an initial outflow of \$5,000 followed by inflows of \$3,000, \$2,000, and \$1,000 at one-year intervals.

- ☐ a. 15%
- ☐ b. 7.9%
- ☐ c. 12%
- ☐ d. 10%

11. Grand Banks Mining Inc. plans a project to strip mine a wilderness area. Setting up operations and initial digging will cost \$5 million. The first year's operations are expected to be slow and net a positive cash flow of only \$500,000. Then there will be four years of \$2 million cash flows after which the ore will run out. Closing the mine and restoring the environment in the sixth year will cost \$1 million. Calculate the project's NPV at a cost of capital of 12% and the IRR to the nearest whole percent.

- ☐ a. NPV \$500; IRR 12%
- ☐ b. NPV \$364; IRR 15%
- ☐ c. NPV \$364; IRR 8.93%
- ☐ d. NPV \$500; IRR 15%

12. Calculate the IRR and NPV for a project with the following cash flows: an initial outlay of \$5,000 and inflows of \$1,050 for seven years. Do the NPV calculations at costs of capital of 8% and 12%. Calculate the IRR to the nearest whole percent.

- ☐ a. IRR: 12%; NPV \$467, \$208; PI 1.9, 0.96
- ☐ b. IRR 11%; NPV \$467, -\$208; PI 1.09, 0.96
- ☐ c. IRR 10%; NPV \$467, -\$208; PI 1.19, 0.86
- ☐ d. IRR 9%; NPV \$208, \$477; PI 110%, 0.92

13. Calculate the IRR and NPV for a project with the following cash flow: an initial outlay of \$43,500 and inflows of 14,100 for four years. Do the NPV calculation at costs of capital of 8% and 12%. Calculate the IRR to the nearest whole percent.

- ☐ a. IRR: 11%; NPV \$3,201, \$-674; PI 1.07, 0.98
- ☐ b. IRR 12%; NPV \$674, \$3,211; PI 1.17, 0.98
- ☐ c. IRR 10%; NPV -\$674, \$3,201; PI 1.17, 0.92
- ☐ d. IRR 9%; NPV \$2,374, \$211; PI 1.17, 0.98

14. Calculate the IRR and NPV for a project with the following cash flow: an initial investment of \$78,000 followed by 12 years of \$11,500. Do the NPV calculation at costs of capital of 8% and 12%. Calculate the IRR to the nearest whole percent.

- ☐ a. IRR 11%; NPV \$8,665, -\$3,211; PI 1.17, 0.98
- ☐ b. IRR 12%; NPV \$8,655, \$6,764; PI 1.11, 0.98
- ☐ c. IRR 10%; NPV \$8,665, -\$6,764; PI 1.11, 0.91
- ☐ d. IRR 9%; NPV \$7,665, -\$6,664; PI 1.11, 0.91

15. Calculate the IRR and NPV for a project with the following cash flow: an initial outlay of \$36,423 followed by cash flows of \$8,900 for six years. Do the NPV calculation at costs of capital of 8% and 12%. Calculate the IRR to the nearest whole percent.

- ☐ a. IRR 11%; NPV \$4,721, \$157; PI 1.00, 1.12
- ☐ b. IRR 12%; NPV \$4,721, \$168; PI 1.13, 1.00
- ☐ c. IRR 10%; NPV \$168, \$4,720; PI 1.00, 1.12
- ☐ d. IRR 9%; NPV \$4,721, -\$168; PI 1.00, 1.12

16. The MacCauley Company has sales of \$200 million and total operating expenses (excluding depreciation) of \$130 million. Straight-line depreciation on the company's assets is \$15 million, and the maximum accelerated depreciation allowed by law is \$25 million. Assume that all taxable income is taxed at 40 percent. Assume also that net operating working capital remains constant. Calculate the MacCauley Company's after-tax operating cash flow using both straight-line and accelerated depreciation.

- ☐ a. \$22M; \$48M
- ☐ b. \$38M; \$48M
- ☐ c. \$48M; \$52M
- ☐ d. \$52M; \$37M

17. A new machine costing \$100,000 is expected to save the McKaig Brick Company \$15,000 per year for 12 years before depreciation and taxes. The machine will be depreciated on a straight-line basis for a 12-year period to an estimated salvage value of \$0. The firm's marginal tax rate is 40 percent. What are the annual net cash flows(NCF) associated with the purchase of this machine? Also compute the initial investment outlay for this project.

- ☐ a. NCF \$12,333; NI \$100,000
- ☐ b. NCF \$8,333; NI \$100,000
- ☐ c. NCF \$15,000; NI \$50,000
- ☐ d. NCF \$12,333; NI \$50,000

18. A firm wishes to bid on a contract that is expected to yield the following after-tax net cash flows at the end of each year:

Year	Net Cash Flow
1	\$5,000
2	8,000
3	9,000
4	8,000
5	8,000
6	5,000
7	3,000
8	-1,500

To secure the contract, the firm must spend \$30,000 to retool its plant. This retooling will have no salvage value at the end of the 8 years. Comparable investment alternatives are available to the firm that earn 12 percent compounded annually. The depreciation tax benefit from the retooling is reflected in the net cash flows in the table. Compute the project's net present value. Should the project be adopted? What is the meaning of the computed net present value figure?

- ☐ a. \$200; yes.
- ☐ b. \$158; yes.
- ☐ c. \$158; no.
- ☐ d. \$175; yes.

19. A machine that costs \$8,000 is expected to operate for 10 years. The estimated salvage value at the end of 10 years is \$0. The machine is expected to save the company \$1,554 per year before taxes and depreciation. The company depreciates its assets on a straight-line basis and has a marginal tax rate of 40 percent. What is the internal rate of return on this investment?

- ☐ a. 9%
- ☐ b. 12.1%
- ☐ c. 12.14%
- ☐ d. 9.11%

20. A junior executive is fed up with the operating policies of his boss. Before leaving the office of his angered superior, the young man suggests that a well-trained monkey could handle the trivia assigned to him. Pausing a moment to consider the import of this closing statement, the boss is seized by the thought that this must have been in the back of her own mind ever since she hired the junior executive. She decides to seriously consider replacing the executive with a bright young baboon. She figures that she could argue strongly to the board that such "capital deepening" is necessary for the cost-conscious firm. Two days later, a feasibility study is completed, and the following data are presented to the president:

- It would cost \$12,000 to purchase and train a reasonably alert baboon with a life expectancy of 20 years.
- Annual expenses of feeding and housing the baboon would be \$4,000.
- The junior executive's annual salary is \$7,000 (a potential saving if the baboon is hired).
- The baboon will be depreciated on a straight-line basis over 20 years to a zero salvage value.
- The firm's marginal tax rate is 40 percent.
- The firm's current cost of capital is estimated to be 11 percent.

On the basis of the net present value criterion, should the monkey be hired (and the junior executive fired)?

- ☐ a. Buy and hire the monkey.
- ☐ b. Do not buy/hire the monkey.

21. Valley Products, Inc. is considering two independent investments having the following cash flow streams:

Year	Project A	Project B
0	-\$50,000	-\$40,000
1	+20,000	+20,000
2	+20,000	+10,000
3	+10,000	+5,000
4	+5,000	+40,000
5	+5,000	+40,000

Valley uses a combination of the net present value approach and the payback approach to evaluate investment alternatives. It requires that all projects have a positive net present value when cash flows are discounted at 10 percent and that all projects have a payback period no longer than 3 years. Which project or projects should the firm accept? Why?

- ☐ a. Accept both.
- ☐ b. Accept A, reject B.
- ☐ c. Reject A, accept B.
- ☐ d. Reject both.

22. Find the IRR of the following investments and determine which should be accepted, given a required rate of return of 10%:

Investment A: An investment costing \$31,140 promising a cash flow of \$3,000 per year for 15 years.

Investment B: An investment costing \$46,000 promising a cash flow of \$6,000 per year for 20 years.

- ☐ a. Accept A.
- ☐ b. Accept B.
- ☐ c. Accept both A and B.
- ☐ d. Reject both A and B.

23. Due to construction time, the initial outlay of a project spreads over a 2 year period and amounts to \$10,000 per year in year 0 and year 1. After completion, the investment project will produce annual cash flows of \$15,000 in year 2 and in year 3. The required rate of return is 14%. Calculate the NPV and the IRR.

- ☐ a. NPV \$2,890; IRR 24.4%
- ☐ b. NPV \$8,770; IRR 22%
- ☐ c. NPV \$2,890; IRR 22.5%
- ☐ d. NPV \$7,860; IRR 52.4%

24. A firm has a choice between two mutually exclusive investment alternatives, each requiring an initial outlay of \$25,000. Investment A promises cash flows of \$2,000 the first year; \$2,000 the second year; and \$35,000 the third year. Investment B offers \$21,000 the first year; \$10,000 the second year; and \$2,000 the third year. The required rate of return is 8%. Calculate the NPV and the IRR of each. Which of these two mutually exclusive investments should be accepted?

- ☐ a. NPV_A , \$6,356; IRR_A ~17%; NPV_B \$4,604; IRR_B 22.15%
- ☐ b. NPV_A , \$5,604; IRR_A ~22%; NPV_B \$4,840; IRR_B 22.15%
- ☐ c. NPV_A , \$6,356; IRR_A ~17%; NPV_B \$1,710; IRR_B 21.15%
- ☐ d. NPV_A , \$8,220; IRR_A 22.15%; NPV_B \$4,604; IRR_B 23.0%

25. An investment will generate \$30,000,000 in sales revenues each year. Annual expenses will equal \$10 million for labor, \$8 million for materials, and \$6 million for other cash expenses. Annual depreciation will equal \$2 million. The marginal tax rate is 40%. Calculate the annual after-tax cash flow of the investment by converting each item into its after-tax equivalent.

- ☐ a. \$3.6M
- ☐ b. \$4.4M
- ☐ c. \$4.8M
- ☐ d. \$6.1M

26. Nethers Plastics has purchased a light truck for \$30,000. The depreciation method is straight-line for 5 years (with the half-year convention). Given a 40% tax rate, find the after-tax proceeds from the sale of the truck if it is sold for \$10,000 after 3 years.

- ☐ a. \$12,000
- ☐ b. \$8,000
- ☐ c. \$10,000
- ☐ d. \$11,800

27. Springfield Manufacturing is considering building a new plant that will add significantly to its capacity. After taking into account all tax effects, it has determined that the cash outflow in the initial period will be \$4,900,000 and the annual after tax cash inflow will be \$750,000 for the first five years of the project's life and \$500,000 for the remaining five years. It also calculates that the after-tax termination cash flow in the tenth year is \$800,000. Should Springfield build the new plant?

- ☐ a. Yes.
- ☐ b. No.

THE PROBLEM BANK - SOLUTIONS

Part 4 - Capital Budgeting

Section 1 - Basic

1. Calculate the NPV for the following project. an outflow of \$7,000 followed by inflows of \$3,000, \$2,500 and \$3,500 at one-year intervals at a cost of capital of 7%.

- a. \$934.60
- b. **\$844.35**
- c. \$816.60
- d. \$944.35

ANSWER: **b**

SOLUTION:

$$\begin{aligned}\text{NPV} &= -\$7,000 + \$3,000 [\text{PVIF}_{7\%,1}] + \$2,500 [\text{PVIF}_{7\%,2}] + \$3,500 [\text{PVIF}_{7\%,3}] \\ \text{NPV} &= -\$7,000 + \$3,000 (.9346) + \$2,500 (.8734) + \$3,500 (.8163) \\ \text{NPV} &= \$844.35\end{aligned}$$

KEYSTROKES:

HP

7,000 [+/-] [CFj]
3,000 [CFj]
2,500 [CFj]
3,500 [CFj]
7 [I/YR]
['] [NPV]

Solution: 844.38

TI

[CF]
7,000 [+/-] [ENTER] [↓]
3,000 [ENTER] [↓]
1 [ENTER] [↓]
2,500 [ENTER] [↓]
1 [ENTER] [↓]
3,500 [ENTER] [↓]
1 [ENTER] [↓] [NPV]
7 [ENTER] [↓] [CPT]

Solution: 844.38

2. Calculate the NPV for the following project with the following cash flows: an initial outlay of \$35,400 followed by inflows of \$6,500 for three years and then a single inflow in the fourth year of \$18,000 at a cost of capital of 9%. (Recognize the first three inflows as an annuity in your calculations.)

- a. **-\$6,195.35**
- b. \$6,500.13
- c. -\$6,895.16
- d. \$7,084.35

ANSWER: **a**

SOLUTION:

$$\text{NPV} = -\$35,400 + \$6,500 [\text{PVIFA}_{9\%,3}] + \$18,000 [\text{PVIF}_{9\%,4}]$$

$$\begin{aligned}\text{NPV} &= -\$35,400 + \$6,500 (2.5313) + \$18,000 (.7084) \\ \text{NPV} &= \$6,195.35\end{aligned}$$

3. Calculate the IRR for the following project with the following cash flows: an initial outflow of \$15,220 followed by inflows of \$5,000, \$6,000, and \$6,500 at one year intervals.

- a. 9%
- b. 8%
- c. **7%**
- d. 6%

ANSWER: **c**

SOLUTION:

$$\begin{aligned}\text{NPV} &= 0 = C_0 + C_1 [\text{PVIF}_{\text{IRR},1}] + C_2 \text{PVIF}_{\text{IRR},2} + C_3 [\text{PVIF}_{\text{IRR},3}] \\ \text{IRR is approximately 7\%:} \\ \text{NPV} &= -\$15,220 + \$5,000 (.9346) + \$6,000 (.8734) + \$6,500 (.8163) \\ &= \$0.65, \text{ or } \$0.70\end{aligned}$$

KEYSTROKES:

HP

15,220 [+/-] [CFj]
5,000 [CFj]
6,000 [CFj]
6,500 [CFj]
['] [IRR/YR]

Solution: 7.00

TI

[CF]
15,220 [+/-] [ENTER] [↓]
5,000 [ENTER] [↓]
1 [ENTER] [↓]
6,000 [ENTER] [↓]
1 [ENTER] [↓]
6,500 [ENTER] [↓]
1 [ENTER] [↓]
[IRR] [CPT]

Solution: 7.00

4. Calculate the IRR for the following project with the following cash flows: An initial outflow of \$47,104 followed by inflows of \$16,000, \$17,000, and 18,000 at one year intervals.

- a. 9%
- b. -9%
- c. **4%**
- d. 2%

ANSWER: **c**

SOLUTION:

$$\begin{aligned}\text{IRR is approximately 4\%:} \\ \text{NPV} &= -\$47,104 + \$16,000 (.9615) + \$17,000 (.9246) + \$18,000 (.8890) \\ &= \$0.20\end{aligned}$$

5. Calculate the NPV at a cost of capital of 9% and the IRR for a project with an initial outlay of \$69,724 and an inflow of \$15,000 followed by four consecutive inflows of \$17,000 at one-year intervals.

- a. **-\$5,437.29; 6%**
- b. \$5,437.29; 4%
- c. \$5,437.29; 4.2%
- d. -\$5,427.29; 3.39%

ANSWER: **a**

SOLUTION:

$$\begin{aligned}\text{NPV} &= -\$69,724 + \$15,000 [\text{PVIF}_{9\%,1}] + [\text{PVIF}_{9\%,1}] (\$17,000 [\text{PVIFA}_{9\%,4}]) \\ &= -\$69,724 + \$15,000 (0.9174) + (0.9174) \{ \$17,000 (3.2397) \} \\ &= -\$5,437.29 \\ \text{IRR is approximately } 6\%: \\ \text{NPV} &= -\$69,724 + \$15,000 (0.9434) + (0.9434) (\$17,000 (3.4651)) \\ &= -\$0.42\end{aligned}$$

6. Calculate the NPV at a cost of capital of 9% and the IRR for a project with an initial outlay of \$25,424 followed by two zero cash flow years and then four years of inflows at \$10,500.

- a. \$3,239.70; 4%
- b. -\$3,239.70; 6%
- c. \$3,207.98; 9%
- d. **\$3,207.98; 12%**

ANSWER: **d**

SOLUTION:

$$\begin{aligned}\text{NPV} &= -\$25,424 + [\text{PVIF}_{9\%,2}] (\$10,500 [\text{PVIFA}_{9\%,4}]) \\ &= -\$25,424 + (0.8417) \{ \$10,500 (3.2397) \} \\ &= \$3,207.98 \\ \text{IRR is approximately } 12\%: \\ \text{NPV} &= -\$25,424 + (0.7972) \{ \$10,500 (3.0373) \} \\ &= \$0.02\end{aligned}$$

7. Calculate the NPV at a cost of capital of 9% and the IRR for a project with an initial outlay of \$10,672 followed by another outlay of \$5,000 followed by five inflows of \$5,000 at one-year intervals.

- a. \$2,583.05; 8.7%
- b. **\$2,583.05; 14%**
- c. -\$2,583.05; 4.2%
- d. \$2,835.05; -4.2%

ANSWER: **b**

SOLUTION:

$$\text{NPV} = -\$10,672 - \$5,000 [\text{PVIF}_{9\%,1}] + [\text{PVIF}_{9\%,1}] \{ \$5,000 [\text{PVIFA}_{9\%,5}] \}$$

$$\begin{aligned}
&= -\$10,672 - \$5,000 (0.9174) + (0.9174) (\$5,000 (3.8897)) \\
&= \$2,583.05 \\
&\text{IRR is approximately 14\%:} \\
&\text{NPV} = -\$10,672 - \$5,000 (0.8772) + (0.8772) (\$5,000 (3.4331)) \\
&= -\$0.42
\end{aligned}$$

8. Calculate the NPV at a cost of capital of 12% and the IRR (to the nearest whole percent) for a project with an initial outflow of \$5,000 followed by three inflows of \$2,000 at one-year intervals.

- a. 14%
- b. 12%
- c. **10%**
- d. 8.6%

ANSWER: **c**

SOLUTION:

$$\begin{aligned}
&\text{NPV} = C_0 + C [\text{PVIFA}_{i,n}] \\
&\text{NPV} = -\$5,000 + \$2,000 [\text{PVIFA}_{12\%,3}] \\
&= -\$5,000 + \$2,000 (2.4018) \\
&= -\$5,000 + \$4,803.60 \\
&= -\$196.40 \\
&0 = -\$5,000 + \$2,000 [\text{PVIFA}_{\text{IRR},3}] \\
&\text{PVIFA}_{\text{IRR},3} = 2.5000 \\
&\text{IRR} = 10\%
\end{aligned}$$

9. Calculate the NPV at a cost of capital of 12% and the IRR (to the nearest whole percent) for a project with an initial outflow of \$5,000 followed by inflows of \$1,000, \$2,000, and \$3,000 at one-year intervals.

- a. 22%
- b. **8%**
- c. 7%
- d. 12%

ANSWER: **b**

SOLUTION:

$$\begin{aligned}
&\text{NPV} = C_0 + C [\text{PVIFA}_{i,n}] \\
&\text{NPV} = -\$5,000 + \$1,000 [\text{PVIF}_{12\%,1}] + \$2,000 [\text{PVIF}_{12\%,2}] + \$3,000 [\text{PVIF}_{12\%,3}] \\
&= -\$5,000 + \$1,000 (0.8929) + \$2,000 (0.7972) + \$3,000 (0.7118) \\
&= -\$5,000 + \$4,622.70 = -\$377.30 \\
&\text{IRR is approximately 8\% (NPV} = \$22\text{).}
\end{aligned}$$

10. Calculate the NPV at a cost of capital of 12% and the IRR (to the nearest whole percent) for a project with an initial outflow of \$5,000 followed by inflows of \$3,000, \$2,000, and \$1,000 at one-year intervals.

- a. 15%
- b. 7.9%

- c. **12%**
- d. 10%

ANSWER: **c**

SOLUTION:

$$\begin{aligned}
 \text{NPV} &= C_0 + C [\text{PVIFA}_{i,n}] \\
 \text{NPV} &= -\$5,000 + \$3,000 [\text{PVIF}_{12\%,1}] + \$2,000 [\text{PVIF}_{12\%,2}] + \$1,000 [\text{PVIF}_{12\%,3}] \\
 &= -\$5,000 + \$3,000 (.8929) + \$2,000 (.7972) + \$1,000 (.7118) \\
 &= -\$5,000 + \$4,984.90 \\
 &= -\$15.10
 \end{aligned}$$

Hence, IRR is approximately 12%.

11. Grand Banks Mining Inc. plans a project to strip mine a wilderness area. Setting up operations and initial digging will cost \$5 million. The first year's operations are expected to be slow and net a positive cash flow of only \$500,000. Then there will be four years of \$2 million cash flows after which the ore will run out. Closing the mine and restoring the environment in the sixth year will cost \$1 million. Calculate the project's NPV at a cost of capital of 12% and the IRR to the nearest whole percent.

- a. NPV \$500; IRR 12%
- b. **NPV \$364; IRR 15%**
- c. NPV \$364; IRR 8.93%
- d. NPV \$500; IRR 15%

ANSWER: **b**

SOLUTION:

$$\begin{aligned}
 &(\$000) \\
 \text{NPV} &= -\$5,000 + \$500 [\text{PVIF}_{12\%,1}] + [\text{PVIF}_{12\%,1}] \{ \$2,000 [\text{PVIFA}_{12\%,4}] \} - \$1,000 [\text{PVIFA}_{12\%,6}] \\
 &= -\$5,000 + \$500 (.8929) + (.8929) \{ \$2,000 (3.0373) \} - \$1,000 (.5066) \\
 &= \$364 \\
 &\text{IRR is approximately 15\% (NPV = -\$32).}
 \end{aligned}$$

12. Calculate the IRR and NPV for a project with the following cash flows: an initial outlay of \$5,000 and inflows of \$1,050 for seven years. Do the NPV calculations at costs of capital of 8% and 12%. Calculate the IRR to the nearest whole percent.

- a. IRR: 12%; NPV \$467, \$208
- b. **IRR 11%; NPV \$467, -\$208**
- c. IRR 10%; NPV \$467, -\$208
- d. IRR 9%; NPV \$208, \$477

ANSWER: **b**

SOLUTION:

$$\text{IRR: } 0 = C_0 + C [\text{PVIFA}_{\text{IRR},n}]$$

$$[\text{PVIFA}_{\text{IRR},n}] = -C_0/C$$

$$[\text{PVIFA}_{\text{IRR},7}] = \$5,000/\$1,050 = 4.7619$$

$$\text{IRR} = 11\%$$

$$\text{NPV } 8\%: = -\$5,000 + \$1,050 [\text{PVIFA}_{8\%,7}] = -\$5,000 + \$1,050 (5.2064)$$

$$= -\$5,000 + \$5,467 = \$467$$

$$12\% = -5,000 + \$1,050 [\text{PVIFA}_{12\%,7}] = -\$5,000 + \$1,050 (4.5638)$$

$$= -\$5,000 + \$4,792 = =\$208$$

KEYSTROKES:

HP

5,000 [+/-] [CFj]

1,050 [CFj]

7 ['] [Nj]

['] [IRR/YR]

Solution: 10.68 \approx 11%

8 [I/YR]

['] [NPV]

Solution: 466.69

[+] 5,000

[÷] 5,000

[=]

Solution: 1.09

12 [I/YR]

['] [NPV]

Solution: -208.06

[+] 5,000

[÷] 5,000

[=]

Solution: .96

Solution 9%:

IRR: 10.68 \approx 11%

NPV: 466.69

PI: 1.09

Solution 12%:

NPV: -208.6

PI: .96

TI

[CF]

5,000 [+/-] [ENTER] [↓]

1,050 [ENTER] [↓]

7 [ENTER] [↓] [IRR] [CPT]

Solution: 10.68 \approx 11%

[NPV]

8 [ENTER] [↓] [CPT]

Solution: 466.69

[+] 5,000

[÷] 5,000

[=]

Solution: 1.09

12 [I/Y]

[CPT] [NPV]

Solution: -208.06

[+] 5,000

[÷] 5,000

[=]

Solution: .96

Solution 9%:

IRR: 10.68 \approx 11%

NPV: 466.69

PI: 1.09

Solution 12%:

NPV: -208.6

PI: .96

13. Calculate the IRR and NPV for a project with the following cash flow: an initial outlay of \$43,500 and inflows of 14,100 for four years. Do the NPV calculation at costs of capital of 8% and 12%. Calculate the IRR to the nearest whole percent.

- IRR: 11%; NPV \$3,201, \$-674**
- IRR 12%; NPV \$674, \$3,211
- IRR 10%; NPV -\$674, \$3,201
- IRR 9%; NPV \$2,374, \$211

ANSWER: **a**

SOLUTION:

$$\text{IRR: } [\text{PVIFA}_{\text{IRR},4}] = \$43,500 / \$14,100 = 3.0851$$

$$\text{IRR} = 11\%$$

$$\text{NPV } 8\%: \text{NPV} = -\$43,500 + \$14,100 [\text{PVIFA}_{8\%,4}] = -\$43,500 + \$14,100 (3.3121) \\ = -\$43,500 + \$46,701 = \$3,210$$

$$12\% \text{ NPV} = -\$43,500 + \$14,100 [\text{PVIFA}_{12\%,4}] = -\$43,500 + \$14,100 (3.0373) \\ = -\$43,500 + \$42,826 = -\$674$$

14. Calculate the IRR and NPV for a project with the following cash flow: an initial investment of \$78,000 followed by 12 years of \$11,500. Do the NPV calculation at costs of capital of 8% and 12%. Calculate the IRR to the nearest whole percent.

- a. IRR 11%; NPV \$8,665, -\$3,211
- b. IRR 12%; NPV \$8,655, \$6,764
- c. **IRR 10%; NPV \$8,665, -\$6,764**
- d. IRR 9%; NPV \$7,665, -\$6,664

ANSWER: **c**

SOLUTION:

$$\text{IRR: } [\text{PVIFA}_{\text{IRR},12}] = \$78,000 / \$11,500 = 6.7826$$

$$\text{IRR} = 10\%$$

$$\text{NPV } 8\%: = -\$78,000 + \$11,500 [\text{PVIFA}_{8\%,12}] = -\$78,000 + \$11,500 (7.5361) \\ = -\$78,000 + \$86,665 = \$8,665$$

$$12\% = -\$78,000 + \$11,500 [\text{PVIFA}_{12\%,12}] = -\$78,000 + \$11,500 (6.1944) \\ = -\$78,000 + \$71,236 = -\$6,764$$

15. Calculate the IRR and NPV for a project with the following cash flow: an initial outlay of \$36,423 followed by cash flows of \$8,900 for six years. Do the NPV calculation at costs of capital of 8% and 12%. Calculate the IRR to the nearest whole percent.

- a. IRR 11%; NPV \$4,721, \$157
- b. **IRR 12%; NPV \$4,721, \$168**
- c. IRR 10%; NPV \$168, \$4,720
- d. IRR 9%; NPV \$4,721, -\$168

ANSWER: **b**

SOLUTION:

$$\text{IRR: } [\text{PVIFA}_{\text{IRR},6}] = \$36,423 / \$8,900 = 4.0925$$

$$\text{IRR} = 12\%$$

$$\text{NPV } 8\%: \text{NPV} = -\$36,423 + \$8,900 [\text{PVIFA}_{8\%,6}] = -\$36,423 + \$8,900 (4.6229) \\ = -\$36,423 + \$41,144 = \$4,721$$

$$12\% = -\$36,423 + \$8,900 [\text{PVIFA}_{12\%,6}] = -\$36,423 + \$8,900 (4.1114) \\ = -\$36,423 + \$36,591 = \$168$$

16. The MacCauley Company has sales of \$200 million and total operating expenses (excluding depreciation) of \$130 million. Straight-line depreciation on the company's assets is \$15 million, and the maximum accelerated depreciation allowed by law is \$25 million. Assume that all taxable income

is taxed at 40 percent. Assume also that net operating working capital remains constant. Calculate the MacCauley Company's after-tax operating cash flow using both straight-line and accelerated depreciation.

- a. \$22M; \$48M
- b. \$38M; \$48M
- c. **\$48M; \$52M**
- d. \$52M; \$37M

ANSWER: **c**

SOLUTION:

After tax operating cash flow (assuming straight-line depreciation):	
Revenues	\$200.0 MM
Total operating expenses	\$130.0 MM
Depreciation	<u>\$15.0 MM</u>
Operating earnings before taxes	\$55.0 MM
Tax @ 40%	<u>22.0 MM</u>
Operating earnings after taxes	\$33.0 MM
Depreciation	<u>\$15.0 MM</u>
After tax operating cash flow	\$48.0 MM
After tax operating cash flow (assuming accelerated depreciation):	
Revenues	\$200.0 MM
Total operating expenses	\$130.0 MM
Depreciation	<u>\$25.0 MM</u>
Operating earning before tax	\$45.0 MM
Tax @ 40%	<u>18.0 MM</u>
Operating earnings after tax	\$27.0 MM
Depreciation	<u>\$25.0 MM</u>
After tax operating cash flow	\$52.0 MM

17. A new machine costing \$100,000 is expected to save the McKaig Brick Company \$15,000 per year for 12 years before depreciation and taxes. The machine will be depreciated on a straight-line basis for a 12-year period to an estimated salvage value of \$0. The firm's marginal tax rate is 40 percent. What are the annual net cash flows(NCF) associated with the purchase of this machine? Also compute the initial investment outlay for this project.

- a. **NCF \$12,333; initial investment outlay \$100,000**
- b. NCF \$8,333; initial investment outlay \$100,000
- c. NCF \$15,000; initial investment outlay \$50,000
- d. NCF \$12,333; initial investment outlay \$50,000

ANSWER: **a**

SOLUTION:

Initial investment outlay = \$100,000 (There are no tax consequences assumed to be associated with this purchase.)

Annual net cash flow:

Annual depreciation = $\$100,000 / 12 = \$8,333$

$NCF = (\Delta \text{Revenues} - \Delta \text{Oper. Exp.} - \Delta \text{Dep}) (1 - T) + \Delta \text{Dep}$

$NCF = [\$0 - (-\$15,000) - \$8,333] (1 - 0.4) + \$8,333 = \$12,333$

KEYSTROKES:

HP

100,000 [\div]

12 [=]

Partial solution: 8,333.33

[$\rightarrow M$]

15,000 [-]

[RM] [x]

.6 [+]

[RM] [=]

Solution: 12,333.33

TI

100,000 [\div]

12 [=]

Partial solution: 8,333.33

[STO] 1

15,000 [-]

[RCL] 1 [x]

.6 [+]

[RCL] 1 [=]

Solution: 12,333.33

18. A firm wishes to bid on a contract that is expected to yield the following after-tax net cash flows at the end of each year:

Year	Net Cash Flow
1	\$5,000
2	8,000
3	9,000
4	8,000
5	8,000
6	5,000
7	3,000
8	-1,500

To secure the contract, the firm must spend \$30,000 to retool its plant. This retooling will have no salvage value at the end of the 8 years. Comparable investment alternatives are available to the firm that earn 12 percent compounded annually. The depreciation tax benefit from the retooling is reflected in the net cash flows in the table. Compute the project's net present value. Should the project be adopted? What is the meaning of the computed net present value figure?

- a. \$200; yes.
- b. **\$158; yes.**
- c. \$158; no.
- d. \$175; yes.

ANSWER: **b**

SOLUTION:

Net Present Value

Year	Cash Flows	PVIF @ 12%	Present Value
------	------------	------------	---------------

0	-\$30,000	1.000	-\$30,000
1	5,000	0.893	4,465
2	8,000	0.797	6,376
3	9,000	0.712	6,408
4	8,000	0.636	5,088
5	8,000	0.567	4,536
6	5,000	0.507	2,535
7	3,000	0.452	1,356
8	-1,500	0.404	-606

Net Present Value \$158

Because the project has a positive NPV it should be accepted.
The value of the firm, and therefore the shareholders' wealth, is increased by \$158 as a result of undertaking the project.

19. A machine that costs \$8,000 is expected to operate for 10 years. The estimated salvage value at the end of 10 years is \$0. The machine is expected to save the company \$1,554 per year before taxes and depreciation. The company depreciates its assets on a straight-line basis and has a marginal tax rate of 40 percent. What is the internal rate of return on this investment?

- a. 9%
- b. 12.1%
- c. 12.14%
- d. **9.11%**

ANSWER: **d**

SOLUTION:

Initial investment outlay = \$8,000

$$NCF_{1-10} = (\Delta \text{Rev.} - \Delta \text{Oper. Exp.} - \Delta \text{Dep}) (1 - T) + \Delta \text{Dep}$$

$$= (0 - (-\$1,554) - \$800) (1 - 0.4) + \$800 = \$1,252.40$$

$$\$8,000 = \$1,252.40 (PVIFA_{i,10})$$

$$PVIFA_{i,10} = 6.388 \text{ (From Table IV, } i \text{ is between 9\% and 10\% or 9.11\% using a calculator)}$$

KEYSTROKES:

HP

8,000 [\div]

10 [=]

Partial solution: 800

[\rightarrow M]

1,554 [-]

[RM] [x]

.6 [+]

[RM] [=]

Partial solution: 1,252.4

[\rightarrow M]

8,000 [+/-] [CFj]

[RM] [CFj]

10 ['] [Nj]

['] [IRR/YR]

Solution: 9.11

TI

8,000 [\div]

10 [=]

Partial solution: 800

[STO] 1

1,554 [-]

[RCL] 1 [x]

.6 [+]

[RCL] 1 [=]

Partial solution: 1,252.4

[STO] 1

8,000 [+/-] [ENTER] [\downarrow]

[RCL] 1 [ENTER] [\downarrow]

10 [ENTER] [\downarrow] [IRR] [CPT]

Solution: 9.11

20. c

- Buy and hire the monkey.
- Do not buy/hire the monkey.

ANSWER: a

SOLUTION:

Initial investment outlay (cost of baboon) = \$12,000

Annual depreciation on baboon = \$12,000/20 years

= \$600

Net cash flow calculation:

$$NCF_{1-20} = (\Delta \text{Rev.} - \Delta \text{Oper. Exp.} - \Delta \text{Dep}) (1 - T) + \Delta \text{Dep}$$

$$= (0 - (\$4,000 - \$7,000) - 600) (1 - .4) + \$600 = \$2,040/\text{year}$$

$$NPV = -\$12,000 + \$2,040 (7.963) = \$4,245$$

Yes, buy the baboon, since NPV > 0.

21. Valley Products, Inc. is considering two independent investments having the following cash flow streams:

Year	Project A	Project B
0	-\$50,000	-\$40,000
1	+20,000	+20,000
2	+20,000	+10,000

3	+10,000	+5,000
4	+5,000	+40,000
5	+5,000	+40,000

Valley uses a combination of the net present value approach and the payback approach to evaluate investment alternatives. It requires that all projects have a positive net present value when cash flows are discounted at 10 percent and that all projects have a payback period no longer than 3 years. Which project or projects should the firm accept? Why?

- Accept both.
- Accept A, reject B.
- Reject A, accept B.
- Reject both.**

ANSWER: **d**

SOLUTION:

Payback period: Project A = 3 years; Project B = 3.152 years
 Project B is unacceptable because its payback period is too long.
 Net present value:
 $NPV_A = -\$50,000 + \$20,000 (0.909) + \$20,000 (0.826) + \$10,000 (0.751) + \$5,000 (0.683) + \$5,000 (0.621) = -\$1,270$
 Project A is unacceptable because it fails to meet the NPV requirement. Therefore, neither project should be undertaken by the company.

22. Find the IRR of the following investments and determine which should be accepted, given a required rate of return of 10%:

Investment A: An investment costing \$31,140 promising a cash flow of \$3,000 per year for 15 years.

Investment B: An investment costing \$46,000 promising a cash flow of \$6,000 per year for 20 years.

- Accept A.
- Accept B.**
- Accept both A and B.
- Reject both A and B.

ANSWER: **b**

SOLUTION:

IRR is the discount rate at which: Investment = PV of Anticipated Cash Flows
 A: $\$31,140 = (C) (PVIFA_{IRR,n})$
 $\$31,140 = (\$3,000) (PVIFA_{IRR,n})$
 $PVIFA_{IRR,n} = \$31,140 / \$3,000 = 10.380$
 $IRR_A = 5\%$: $IRR < \text{required rate of return}$: Reject

 B. $\$46,000 = (C) (PVIFA_{IRR,n})$
 $\$46,000 = (\$6,000) (PVIFA_{IRR,n})$
 $PVIFA_{IRR,n} = \$46,000 / \$6,000 = 7.667$
 $11\% < IRR_B < 12\%$: $IRR > \text{required rate of return}$: Accept

23. Due to construction time, the initial outlay of a project spreads over a 2 year period and amounts to \$10,000 per year in year 0 and year 1. After completion, the investment project will produce annual cash flows of \$15,000 in year 2 and in year 3. The required rate of return is 14%. Calculate the NPV and the IRR.

- a. NPV \$2,890; IRR 24.4%
- b. NPV \$8,770; IRR 22%
- c. **NPV \$2,890; IRR 22.5%**
- d. NPV \$7,860; IRR 52.4%

ANSWER: c

SOLUTION:

Year	Cash Flow	14% PVIF	PV
0	-\$10,000	1.000	-\$10,000
1	-10,000	0.877	-8,770
2	15,000	0.769	11,535
3	15,000	0.675	<u>10,125</u>
			Total \$2,890

$$\text{NPV} = \text{PV} - \text{Cost} = \$21,660 - 18,770 = \$2,890$$

At IRR: NPV = 0

Year	Cash Flow	22%PVIF	PV	24%PVIF	PV
0	-\$10,000	1.000	-\$10,000	1.000	-\$10,000
1	-10,000	0.820	8,200	0.806	-8,060
2	15,000	0.672	10,080	0.650	9,750
3	15,000	0.551	<u>8,265</u>	0.524	<u>7,860</u>
			NPV \$145		\$ -450

24. A firm has a choice between two mutually exclusive investment alternatives, each requiring an initial outlay of \$25,000. Investment A promises cash flows of \$2,000 the first year; \$2,000 the second year; and \$35,000 the third year. Investment B offers \$21,000 the first year; \$10,000 the second year; and \$2,000 the third year. The required rate of return is 8%. Calculate the NPV and the IRR of each. Which of these two mutually exclusive investments should be accepted?

- a. **NPV_A \$6,356; IRR_A ~17%; NPV_B \$4,604; IRR_B 22.15%**
- b. NPV_A \$5,604; IRR_A ~22%; NPV_B \$4,840; IRR_B 22.15%
- c. NPV_A \$6,356; IRR_A ~17%; NPV_B \$1,710; IRR_B 21.15%
- d. NPV_A \$8,220; IRR_A 22.15%; NPV_B \$4,604; IRR_B 23.0%

ANSWER: a

SOLUTION:

At $k = 8\%$

$$\text{NPV}_A = -25,000 + (2,000)(0.926) + (2,000)(0.857) + (35,000)(0.794) \\ = -\$25,000 + 1,852 + 1,714 + 27,790 = \$6,356$$

$$\text{NPV}_A = -\$25,000 + (21,000)(0.926) + (10,000)(0.857) + (2,000)(0.794) \\ = -\$25,000 + 19,446 + 8,570 + 1,588 = \$4,604$$

To find the IRR of A, try $k = 17\%$:

$$\text{NPV} = -\$25,000 + (2,000)(0.855) + (2,000)(0.731) + (35,000)(0.624) \\ = -\$25,000 + 1,710 + 1,462 + 21,840 = \$12$$

Since $\text{NPV} \approx 0\%$, $\text{IRRA} \approx 17\%$.

To find the IRR of B, try $k = 22\%$

$$\text{NPV} = -\$25,000 + (21,000)(0.820) + (10,000)(0.672) + (2,000)(0.551) \\ = -\$25,000 + 17,220 + 6,720 + 1,102 = \$42$$

Since $\text{NPV} > 0$, $\text{IRR} > 22\%$, Try $K = 23\%$:

$$\text{NPV} = -\$25,000 + (21,000)(0.813) + (10,000)(0.661) + (2,000)(0.537) \\ = -\$25,000 + 17,073 + 6,610 + 1,074 = -\$243$$

Since $\text{NPV} < 0$, $\text{IRR} < 23\%$. Thus, $22\% < \text{IRR} < 23\%$

Investment A should be accepted because it has a higher positive NPV than Investment B. Thus, it will result in a larger increase in the firm's value.

25. An investment will generate \$30,000,000 in sales revenues each year. Annual expenses will equal \$10 million for labor, \$8 million for materials, and \$6 million for other cash expenses. Annual depreciation will equal \$2 million. The marginal tax rate is 40%. Calculate the annual after-tax cash flow of the investment by converting each item into its after-tax equivalent.

- a. \$3.6M
- b. **\$4.4M**
- c. \$4.8M
- d. \$6.1M

ANSWER: **b**

SOLUTION:

All figures in millions.

$$\text{After Tax Cash Flow} = (\$30)(1 - 0.4) - (10)(1 - 0.4) - (8)(1 - 0.4) - (6)(1 - 0.4) - (2)(-0.4) \\ = \$18 - 6 - 4.8 - 3.6 + 0.8 \\ = \$4.4$$

26. Nethers Plastics has purchased a light truck for \$30,000. The depreciation method is straight-line for 5 years (with the half-year convention). Given a 40% tax rate, find the after-tax proceeds from the sale of the truck if it is sold for \$10,000 after 3 years.

- a. **\$12,000**
- b. \$8,000
- c. \$10,000
- d. \$11,800

ANSWER: **a**

SOLUTION:

Year	Cost	Accumulated Depreciation	Book Value
1	\$30,000 -	\$3,000 =	\$27,000
2	30,000 -	9,000 =	21,000
3	30,000 -	15,000 =	15,000
4	30,000 -	21,000 =	9,000
5	30,000 -	27,000 =	3,000
6	30,000 -	30,000 =	-

Tax Effect from Sale of Asset = (Selling Price - Book Value) (Tax Rate)

After-Tax Proceeds = Selling Price - Tax Effect

Tax Effect (\$10,000 - 15,000) (0.40) = -\$2,000

After-Tax Proceeds = \$10,000 - (-2,000) = \$12,000

27. Springfield Manufacturing is considering building a new plant that will add significantly to its capacity. After taking into account all tax effects, it has determined that the cash outflow in the initial period will be \$4,900,000 and the annual after tax cash inflow will be \$750,000 for the first five years of the project's life and \$500,000 for the remaining five years. It also calculates that the after-tax termination cash flow in the tenth year is \$800,000. Should Springfield build the new plant?

- a. **Yes.**
- b. No.

ANSWER: **a**

SOLUTION:

Type of Cash Flow	Cash Flow	10%PVIF	PV
Initial	-\$4,000,000	1.000	-\$4,000,000
Project Life	750,000	PVIF _{10%,5} = 3.791	2,843,250
	500,000	PVIF _{10%,10} - ADF _{10%,5} = 2.354	1,177,000
Termination	800,000	PVIF _{10%,10} = 0.386	<u>308,800</u>
			NPV \$329,050

Since NPV > 0, Springfield should build the plant.