Chapter #8
Solutions to Questions and Problems

1. Payback = 2.75 years

2. If the initial cost is $3,400, the payback period is:
Payback = 4.10 years

For the $3,400 cost, the payback period is:
Payback = 4.10 years

For an initial cost of $4,450, the payback period is:
Payback = 5.36 years

The payback period for an initial cost of $6,800 is
Total cash inflows = $6,640
If the initial cost is $6,800, the project never pays back. Notice that if you use the shortcut for annuity cash flows, you get:

Payback = $6,800 / $830
Payback = 8.19 years.

This answer does not make sense since the cash flows stop after eight years, so again, we must conclude the payback period is never

3. Project A:
Payback = 2.44 years

Project B:
Payback = 3.06 years

4. Average net income = $1,498,000
Average book value = $7,000,000
AAR = .2140 or 21.40%

5. IRR = 19.03%

6. The NPV of this project at an 11 percent required return is:
NPV = $14,186.14

The NPV of the project at a 23 percent required return is:
NPV = – $5,936.05

7. The NPV of this project at an 8 percent required return is:
NPV = $2,296.27

The NPV of the project at a 24 percent required return is:
NPV = –$921.40

IRR = .1779 or 17.79%

8. IRR = 25.02%

9. The NPV of the project at a zero percent required return is:
NPV = $15,000

The NPV at a 10 percent required return is:
NPV = $7,683.70

The NPV at a 20 percent required return is:
NPV = $2,231.48

And the NPV at a 30 percent required return is:
NPV = – $1,948.57

10. *a.* The IRR of Project A is:
IRR = 18.72%

The IRR of Project B is:
IRR = 18.13%

b. The NPV of Project A is:
NPV_A = $4,108.69

And the NPV of Project B is:
NPV_B = $5,623.44

c. To find the crossover rate, we subtract the cash flows from one project from the cash flows of the other project. Here, we will subtract the cash flows for Project B from the cash flows of Project A. Once we find these differential cash flows, we find the IRR.

R = 16.82%

At discount rates above 16.82% choose project A; for discount rates below 16.82% choose project B; indifferent between A and B at a discount rate of 16.82%.

11. The IRR of Project X is:
IRR = 16.82%

For Project Y
IRR = 16.60%

To find the crossover rate, we subtract the cash flows from one project from the cash flows of the other project, and find the IRR of the differential cash flows. We will subtract the cash flows from Project Y from the cash flows from Project X. It is irrelevant which cash flows we subtract from the other. Subtracting the cash flows, the equation to calculate the IRR for these differential cash flows is:

R = 13.28%

The table below shows the NPV of each project for different required returns. Notice that Project Y always has a higher NPV for discount rates below 13.28 percent, and always has a lower NPV for discount rates above 13.28 percent.

R	NPV_X	NPV_Y
0%	1,700.00	1,800.00
5%	1,100.21	1,155.49
10%	587.53	607.06
15%	145.56	136.35
20%	(238.43)	(270.83)
25%	(574.40)	(625.60)

12. *a.* NPV = $13,570,247.93

b. $0 = –\$28M + \$53M/(1+IRR) – \$8M/(1+IRR)^2$

From Descartes rule of signs, we know there are two IRRs since the cash flows change signs twice. From trial and error, the two IRRs are:

IRR = 72.75%, –83.46%

When there are multiple IRRs, the IRR decision rule is ambiguous. Both IRRs are correct, that is, both interest rates make the NPV of the project equal to zero. If we are evaluating whether or not to accept this project, we would not want to use the IRR to make our decision.

13. The profitability index at a required return of 10 percent is:
PI = 1.101

The profitability index at a required return of 15 percent is:
PI = 1.021

The profitability index at a required return of 22 percent is:
PI = 0.926

14. *a.* $PI_I = 1.077$
$PI_{II} = 1.161$

b. $NPV_I = \$2,689.41$
$NPV_{II} = \$887.60$

c. Using the profitability index to compare mutually exclusive projects can be ambiguous when the magnitude of the cash flows for the two projects are of different scale. In this problem, project I is roughly 3 times as large as project II and produces a larger NPV, yet the profitability index criterion implies that project II is more acceptable.

15. *a*. The payback period for each project is:

A: 3.31 years
B: 1.76 years

b. The NPV for each project is:

A: NPV = $107,716.12
B: NPV = $11,148.02

c. The IRR for each project is:

A: IRR = 26.90%

B: IRR = 38.27%

d. The profitability index for each project is:

A: PI = 1.427

B: PI = 1.465

e. In this instance, the NPV criterion implies that you should accept project A, while payback period, IRR, and the profitability index imply that you should accept project B. The final decision should be based on the NPV since it does not have the ranking problem associated with the other capital budgeting techniques. Therefore, you should accept project A.

16. *a.* The IRR for each project is:

M: IRR = 23.85%

N: IRR = 21.65%

b. The NPV for each project is:

M: NPV = $32,271.63

N: NPV = $37,458.54

c. Accept project N since the NPV is higher. IRR cannot be used to rank mutually exclusive projects.

17. *a.* The profitability index for each project is:

Y: PI = 1.123

Z: PI = 1.108

b. The NPV for each project is:

Y: NPV = $5,544.98

Z: NPV = $6,987.50

c. Accept project N since the NPV is higher. The profitability index cannot be used to rank mutually exclusive projects.

18. To find the crossover rate, we subtract the cash flows from one project from the cash flows of the other project, and find the IRR of the differential cash flows. We will subtract the cash flows from Project J from the cash flows from Project I. It is irrelevant which cash flows we subtract from the other. Subtracting the cash flows, the equation to calculate the IRR for these differential cash flows is:

Crossover rate: $0 = \$7{,}000/(1+R) + \$2{,}000/(1+R)^2 - \$3{,}000/(1+R)^3 - \$8{,}000/(1+R)^4$

$R = 8.34\%$

At a lower interest rate, project J is more valuable because of the higher total cash flows. At a higher interest rate, project I becomes more valuable since the differential cash flows received in the first two years are larger than the cash flows for project J.

21. *a*. The payback period for each project is:

F: 2.13 years

G: 3.14 years

b. The NPV for each project is:

F: NPV = $100,689.53

G: NPV = $110,147.47

c. Even though project H does not meet the payback period of three years, it does provide the largest increase in shareholder wealth, therefore, choose project H. Payback period should generally be ignored in this situation.

22. To find the crossover rate, we subtract the cash flows from one project from the cash flows of the other project, and find the IRR of the differential cash flows. We will subtract the cash flows from Project S from the cash flows from Project R. It is irrelevant which cash flows we subtract from the other. Subtracting the cash flows, the equation to calculate the IRR for these differential cash flows is:

$0 = \$18{,}000 - \$4{,}000/(1+R) - \$9{,}000/(1+R)^2 - \$3{,}000/(1+R)^3 - \$4{,}000/(1+R)^4 - \$4{,}000/(1+R)^5$

$R = 11.26\%$

The NPV of the projects at the crossover rate must be equal, The NPV of each project at the crossover rate is:

F: NPV = $10,896.47

G: NPV = $10,896.47

23. The IRR of the project is:

R = 13.16%

At an interest rate of 12 percent, the NPV is:
NPV = –$1,051.02

At an interest rate of zero percent, we can add cash flows, so the NPV is:
NPV = –$14,000.00

And at an interest rate of 24 percent, the NPV is:
NPV = +$8,588.97

The cash flows for the project are unconventional. Since the initial cash flow is positive and the remaining cash flows are negative, the decision rule for IRR in invalid in this case. The NPV profile is upward sloping, indicating that the project is more valuable when the interest rate increases.