Answers to Warm-Up Exercises

E10-1. Payback period

Answer: The payback period for Project Hydrogen is 4.29 years. The payback period for Project Helium is 5.75 years. Both projects are acceptable because their payback periods are less than Elysian Fields' maximum payback period criterion of 6 years.

E10-2. NPV

Answer:

Year	Cash Inflow	Present Value
1	$400,000	$ 377,358.49
2	375,000	333,748.67
3	300,000	251,885.78
4	350,000	277,232.78
5	200,000	149,451.63
	Total	$1,389,677.35

NPV = $1,389,677.35 – $1,250,000 = $139,677.35

Herky Foods should acquire the new wrapping machine.

E10-3: NPV comparison of two projects

Answer:

Project Kelvin

Present value of expenses	–$45,000	
Present value of cash inflows	51,542	(PMT = $20,000, N = 3, I = 8, Solve for PV)
NPV	$ 6,542	

Project Thompson

Present value of expenses	–$275,000	
Present value of cash inflows	277,373	(PMT = $60,000, N = 6, I = 8, Solve for PV)
NPV	$ 2,373	

Based on NPV analysis, Axis Corporation should choose an overhaul of the existing system.

E10-4: IRR

Answer: You may use a financial calculator to determine the IRR of each project. Choose the project with the higher IRR.

Project T-Shirt

PV = –15,000, N = 4, PMT = 8,000

Solve for I

IRR = 39.08%

Project Board Shorts

PV = –25,000, N = 5, PMT = 12,000

Solve for I

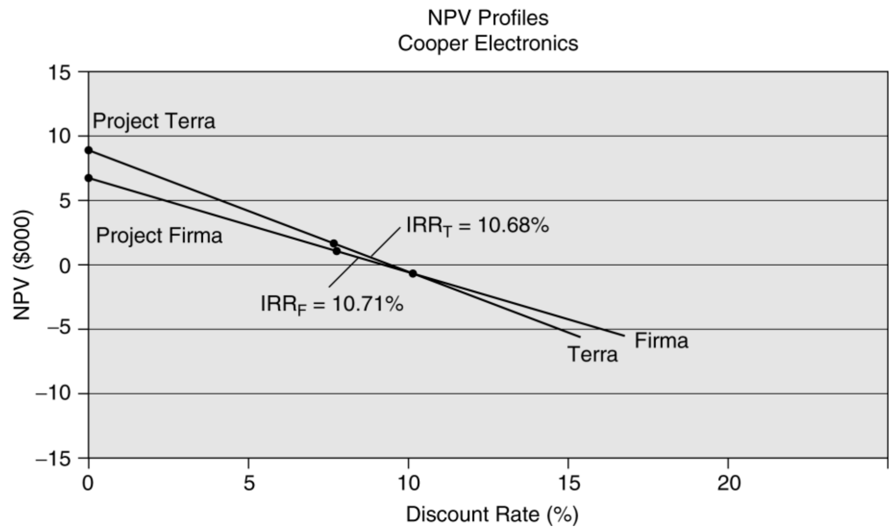
IRR = 38.62%

Based on IRR analysis, Billabong Tech should choose project T-Shirt.

E10-5: NPV

Answer:

Note: The IRR for Project Terra is 10.68% while that of Project Firma is 10.21%. Furthermore, when the discount rate is zero, the sum of Project Terra's cash flows exceed that of Project Firma. Hence, at any discount rate that produces a positive NPV, Project Terra provides the higher net present value.



■ Solutions to Problems

Note to instructor: In most problems involving the IRR calculation, a financial calculator has been used. Answers to NPV-based questions in the first ten problems provide detailed analysis of the present value of individual cash flows. Thereafter, financial calculator worksheet keystrokes are provided. Most students will probably employ calculator functionality to facilitate their problem solution in this chapter and throughout the course.

P10-1. Payback period

LG 2; Basic

a. $42,000 ÷ $7,000 = 6 years

b. The company should accept the project, since 6 < 8.

P10-2. Payback comparisons

LG 2; Intermediate

a. Machine 1: $14,000 ÷ $3,000 = 4 years, 8 months

Machine 2: $21,000 ÷ $4,000 = 5 years, 3 months

b. Only Machine 1 has a payback faster than 5 years and is acceptable.

c. The firm will accept the first machine because the payback period of 4 years, 8 months is less than the 5-year maximum payback required by Nova Products.

d. Machine 2 has returns that last 20 years while Machine 1 has only 7 years of returns. Payback cannot consider this difference; it ignores all cash inflows beyond the payback period. In this case, the total cash flow from Machine 1 is $59,000 ($80,000 – $21,000) less than Machine 2.

P10-3. Choosing between two projects with acceptable payback periods

LG 2; Intermediate

a.

	Project A			Project B	
Year	**Cash Inflows**	**Investment Balance**	**Year**	**Cash Inflows**	**Investment Balance**
0		–$100,000	0		–$100,000
1	$10,000	–90,000	1	40,000	–60,000
2	20,000	–70,000	2	30,000	–30,000
3	30,000	–40,000	3	20,000	–10,000
4	40,000	0	4	10,000	0
5	20,000		5	20,000	

Both Project A and Project B have payback periods of exactly 4 years.

b. Based on the minimum payback acceptance criteria of 4 years set by John Shell, both projects should be accepted. However, since they are mutually exclusive projects, John should accept Project B.

c. Project B is preferred over A because the larger cash flows are in the early years of the project. The quicker cash inflows occur, the greater their value.

P10-4. Personal finance: Long-term investment decisions, payback period

LG 4

a. and b.

	Project A		Project B	
Year	**Annual Cash Flow**	**Cumulative Cash Flow**	**Annual Cash Flow**	**Cumulative Cash Flow**
0	$(9,000)	$(9,000)	$(9,000)	$(9,000)
1	2,00	(6,800)	1,500	(7,500)
2	2,500	(4,300)	1,500	(6,000)
3	2,500	(1,800)	1,500	(4,500)
4	2,000		3,500	(1,000)
5	1,800		4,000	
Total Cash Flow	11,000		12,000	
Payback Period	3 + 1,800/2,000 = 3.9 years		4 + 1,000/4,000 = 4.25 years	

c. The payback method would select Project A since its payback of 3.9 years is lower than Project B's payback of 4.25 years.

d. One weakness of the payback method is that it disregards expected future cash flows as in the case of Project B.

P10-5. NPV

LG 3; Basic

NPV = PV_n – Initial investment

a. N = 20, I = 14%, PMT = $2,000

Solve for PV = $13,246.26

NPV = $13,246.26 – $10,000

NPV = $3,246.26

Accept project

b. N = 20, I = 14%, PMT = $3,000

Solve for PV = 19,869.39

NPV = $19,869.39 – $25,000

NPV = –$5,130.61

Reject

c. N = 20, I = 14%, PMT = $5,000

Solve for PV = $33,115.65

NPV = $33,115.65 – $30,000

NPV = $33,115.65

NPV = $3,115

Accept

P10-6. NPV for varying cost of capital

LG 3; Basic

a. **10%**

N = 8, I = 10%, PMT = $5000

Solve for PV = $26,674.63

NPV = PV_n – Initial investment

NPV = $26,674.63 – $24,000

NPV = $2,674.63

Accept; positive NPV

b. **12%**

N = 8, I = 12%, PMT = $5,000

Solve for PV = $24,838.20

NPV = PV_n – Initial investment

NPV = $24,838.20 – $24,000

NPV = $838.20

Accept; positive NPV

c. **14%**

N = 8, I = 14%, PMT = $5,000

Solve for PV = $23,194.32

NPV = PV_n – Initial investment

NPV = $23,194.32 – $24,000

NPV = -$805.68

Reject; negative NPV

P10-7. NPV—independent projects

LG 3; Intermediate

Project A

N = 10, I = 14%, PMT = $4,000

Solve for PV = $20,864.46

NPV = $20,864.46 – $26,000

NPV = –$5,135.54

Reject

Project B—*PV* of Cash Inflows

CF_0 = -$500,000; CF_1 = $100,000; CF_2 = $120,000; CF_3 = $140,000; CF_4 = $160,000;

CF_5 = $180,000; CF^6 = $200,000

Set I = 14%

Solve for NPV = $53,887.93

Accept

Project C—*PV* of Cash Inflows

CF_0 = -$170,000; CF_1 = $20,000; CF_2 = $19,000; CF_3 = $18,000; CF_4 = $17,000;

CF_5 = $16,000; CF_6 = $15,000; CF_7 = $14,000; CF_8 = $13,000; CF_9 = $12,000; CF_{10} = $11,000,

Set I = 14%

Solve for NPV = -$83,668.24

Reject

Project D

N = 8, I = 14%, PMT = $230,000

Solve for PV = $1,066,939

NPV = PV_n – Initial investment

NPV = $1,066,939 – $950,000

NPV = $116,939

Accept

Project E—*PV* of Cash Inflows

CF_0 = -$80,000; CF_1 = $0; CF_2 = $0; CF_3 = $0; CF_4 = $20,000; CF_5 = $30,000; CF_6 = $0;
CF_7 = $50,000; CF_8 = $60,000; CF_9 = $70,000

Set I = 14%

Solve for NPV = $9,963.63

Accept

P10-8. NPV

LG 3; Challenge

a. N = 5, I = 9%, PMT = $385,000

Solve for PV = $1,497,515.74

The immediate payment of $1,500,000 is not preferred because it has a higher present value than does the annuity.

b. N = 5, I = 9%, PV = −$1,500,000

Solve for PMT = $385,638.69

c. Present value$_{\text{Annuity Due}}$ = PV$_{\text{ordinary annuity}}$ × (1 + discount rate)

$1,497,515.74 (1.09) = $1,632,292

Calculator solution: $1,632,292

Changing the annuity to a beginning-of-the-period annuity due would cause Simes Innovations to prefer to make a $1,500,000 one-time payment because the present value of the annuity due is greater than the $1,500,000 lump-sum option.

d. No, the cash flows from the project will not influence the decision on how to fund the project. The investment and financing decisions are separate.

P10-9. NPV and maximum return

LG 3; Challenge

a. N = 4, I = 10%, PMT = $4,000

Solve for PV = $12,679.46

NPV = PV − Initial investment

NPV = $12,679.46 − $13,000

NPV = –$320.54

Reject this project due to its negative NPV.

b. N = 4, PV= -$13,000, PMT = $4,000

Solve for I = 8.86%

8.86% is the maximum required return that the firm could have for the project to be acceptable. Since the firm’s required return is 10% the cost of capital is greater than the expected return and the project is rejected.

P10-10. NPV—mutually exclusive projects

LG 3; Intermediate

a. and b.

Press A

CF_0 = -$85,000; CF_1 = $18,000; F1 = 8

Set I = 15%

Solve for NPV = -$4,228.21

Reject

Press B

CF_0 = -\$60,000; CF_1 = \$12,000; CF_2 = \$14,000; CF_3 = \$16,000; CF_4 = \$18,000;

CF_5 = \$20,000; CF_6 = \$25,000

Set I = 15%

Solve for NPV = \$2,584.34

Accept

Press C

CF_0 = -\$130,000; CF_1 = \$50,000; CF_2 = \$30,000; CF_3 = \$20,000; CF_4 = \$20,000;

CF_5 = \$20,000; CF_6 = \$30,000; CF_7 = \$40,000; CF_8 = \$50,000

Set I = 15%

Solve for NPV = –\$15,043.89

Accept

c. Ranking—using NPV as criterion

Rank	Press	NPV
1	C	\$15,043.89
2	B	2,584.34
3	A	–4,228.21

d. Profitability Indexes

Profitability Index = Σ Present Value Cash Inflows ÷ Investment

Press A: \$80,771 ÷ \$85,000 = 0.95

Press B: \$62,588 ÷ \$60,000 = 1.04

Press C: \$145,070 ÷ \$130,000 = 1.12

e. The profitability index measure indicates that Press C is the best, then Press B, then Press A (which is unacceptable). This is the same ranking as was generated by the NPV rule.

P10-11. Personal finance: Long-term investment decisions, NPV method

LG 3

Key information:

Cost of MBA program	\$100,000
Annual incremental benefit	\$ 20,000
Time frame (years)	40
Opportunity cost	6.0%

Calculator Worksheet Keystrokes:

CF_0 = –100,000

CF_1 = 20,000

F_1 = 40

Set I = 6%

Solve for NPV = \$200,926

The financial benefits outweigh the cost of the MBA program.

P10-12. Payback and NPV

LG 2, 3; Intermediate

a.

Project	**Payback Period**
A	$40,000 ÷ $13,000 = 3.08 years
B	3 + ($10,000 ÷ $16,000) = 3.63 years
C	2 + ($5,000 ÷ $13,000) = 2.38 years

Project C, with the shortest payback period, is preferred.

b. Worksheet keystrokes

Year	**Project A**	**Project B**	**Project C**
0	–$40,000	–$40,000	–$40,000
1	13,000	7,000	19,000
2	13,000	10,000	16,000
3	13,000	13,000	13,000
4	13,000	16,000	10,000
5	13,000	19,000	7,000
Solve for NPV	$2,565.82	–$322.53	$5,454.17
	Accept	Reject	Accept

Project C is preferred using the NPV as a decision criterion.

c. At a cost of 16%, Project C has the highest NPV. Because of Project C's cash flow characteristics, high early-year cash inflows, it has the lowest payback period and the highest NPV.

P10-13. NPV and EVA

LG 3; Intermediate

a. NPV = –$2,500,000 + $240,000 ÷ 0.09 = $166,667

b. Annual EVA = $240,000 – ($2,500,000 x 0.09) = $15,000

c. Overall EVA = $15,000 ÷ 0.09 = $166,667

In this case, NPV and EVA give exactly the same answer.

P10-14. IRR—Mutually exclusive projects

LG 4; Intermediate

IRR is found by solving:

$$\$0 = \sum_{t=1}^{n}\left[\frac{CF_t}{(1+\text{IRR})^t}\right] - \text{initial investment}$$

Most financial calculators have an "IRR" key, allowing easy computation of the internal rate of return. The numerical inputs are described below for each project.

Project A

$CF_0 = -\$90{,}000$; $CF_1 = \$20{,}000$; $CF_2 = \$25{,}000$; $CF_3 = \$30{,}000$; $CF_4 = \$35{,}000$; $CF_5 = \$40{,}000$

Solve for IRR = 17.43%

If the firm's cost of capital is below 17%, the project would be acceptable.

Project B

$CF_0 = -\$490{,}000$; $CF_1 = \$150{,}000$; $CF_2 = \$150{,}000$; $CF_3 = \$150{,}000$; $CF_4 = \$150{,}000$

[or, $CF_0 = -\$490{,}000$; $CF_1 = \$150{,}000$, $F_1 = 4$]

Solve for IRR = 8.62%

The firm's maximum cost of capital for project acceptability would be 8.62%.

Project C

$CF_0 = -\$20{,}000$; $CF_1 = \$7500$; $CF_2 = \$7500$; $CF_3 = \$7500$; $CF_4 = \$7500$; $CF_5 = \$7500$

[or, $CF_0 = -\$20{,}000$; $CF_1 = \$7500$; $F_1 = 5$]

Solve for IRR = 25.41%

The firm's maximum cost of capital for project acceptability would be 25.41%.

Project D

$CF_0 = -\$240{,}000$; $CF_1 = \$120{,}000$; $CF_2 = \$100{,}000$; $CF_3 = \$80{,}000$; $CF_4 = \$60{,}000$

Solve for IRR = 21.16%

The firm's maximum cost of capital for project acceptability would be 21% (21.16%).

P10-15. IRR—Mutually exclusive projects

LG 4; Intermediate

a. and b.

Project X

$$\$0 = \frac{\$100{,}000}{(1+\text{IRR})^1} + \frac{\$120{,}000}{(1+\text{IRR})^2} + \frac{\$150{,}000}{(1+\text{IRR})^3} + \frac{\$190{,}000}{(1+\text{IRR})^4} + \frac{\$250{,}000}{(1+\text{IRR})^5} - \$500{,}000$$

$CF_0 = -\$500{,}000$; $CF_1 = \$100{,}000$; $CF_2 = \$120{,}000$; $CF_3 = \$150{,}000$; $CF_4 = \$190{,}000$

$CF_5 = \$250{,}000$

Solve for IRR = 15.67; since IRR > cost of capital, accept.

Project Y

$$\$0 = \frac{\$140{,}000}{(1+\text{IRR})^1} + \frac{\$120{,}000}{(1+\text{IRR})^2} + \frac{\$95{,}000}{(1+\text{IRR})^3} + \frac{\$70{,}000}{(1+\text{IRR})^4} + \frac{\$50{,}000}{(1+\text{IRR})^5} - \$325{,}000$$

CF_0 = –$325,000; CF_1 = $140,000; CF_2 = $120,000; CF_3 = $95,000; CF_4 = $70,000
CF_5 = $50,000
Solve for IRR = 17.29%; since IRR > cost of capital, accept.

c. Project Y, with the higher IRR, is preferred, although both are acceptable.

P10-16. Personal Finance: Long-term investment decisions, IRR method

LG 4; Intermediate

IRR is the rate of return at which NPV equals zero

Computer inputs and output:
N = 5, PV = $25,000, PMT = $6,000
Solve for IRR = 6.40%

Required rate of return: 7.5%
Decision: Reject investment opportunity

P10-17. IRR, investment life, and cash inflows

LG 4; Challenge

a. N = 10, PV = -$61,450, PMT = $10,000
Solve for I = 10.0%
The IRR < cost of capital; reject the project.

b. I = 15%, PV = –$61,450, PMT = $10,000
Solve for N = 18.23 years
The project would have to run a little over 8 more years to make the project acceptable with the 15% cost of capital.

c. N = 10, I = 15%, PV = $61,450
Solve for PMT = $12,244.04

P10-18. NPV and IRR

LG 3, 4; Intermediate

a. N = 7, I = 10%, PMT = $4,000
Solve for PV = $19,473.68
NPV = PV – Initial investment
NPV = $19,472 – $18,250
NPV = $1,223.68

b. N = 7, PV = $18,250, PMT = $4,000
Solve for I = 12.01%

c. The project should be accepted since the NPV > 0 and the IRR > the cost of capital.

P10-19. NPV, with rankings

LG 3, 4; Intermediate

a. NPV_A = \$45,665.50 (N = 3, I = 15, PMT = \$20,000) – \$50,000

NPV_A = -\$4,335.50

Or, using NPV keystrokes

CF_0 = –\$50,000; CF_1 = \$20,000; CF_2 = \$20,000; CF_3 = \$20,000

Set I = 15%

NPV_A = –\$4,335.50

Reject

NPV_B Key strokes

CF_0 = –\$100,000; CF_1 = \$35,000; CF_2 = \$50,000; CF_3 = \$50,000

Set I = 15%

Solve for NPV = \$1,117.78

Accept

NPV_C Key strokes

CF_0 = –\$80,000; CF_1 = \$20,000; CF_2 = \$40,000; CF_3 = \$60,000

Set I = 15%

Solve for NPV = \$7,088.02

Accept

NPV_D Key strokes

CF_0 = –\$180,000; CF_1 = \$100,000; CF_2 = \$80,000; CF_3 = \$60,000

Set I = 15%

Solve for NPV = \$6,898.99

Accept

b.

Rank	**Press**	**NPV**
1	C	\$7,088.02
2	D	6,898.99
3	B	1,117.78
4	A	–4335.50

c. Using the calculator, the IRRs of the projects are:

Project	**IRR**
A	9.70%
B	15.63%
C	19.44%
D	17.51%

Since the lowest IRR is 9.7%, all of the projects would be acceptable if the cost of capital was 9.7%.

Note: Since Project A was the only rejected project from the four projects, all that was needed to find the minimum acceptable cost of capital was to find the IRR of A.

P10-20. All techniques, conflicting rankings

LG 2, 3, 4: Intermediate

a.

Project A				**Project B**		
Year	**Cash Inflows**	**Investment Balance**		**Year**	**Cash Inflows**	**Investment Balance**
0		–$150,000		0		–$150,000
1	$45,000	–105,000		1	$75,000	–75,000
2	45,000	–60,000		2	60,000	–15,000
3	45,000	–15,000		3	30,000	+15,000
4	45,000	+30,000		4	30,000	0
5	45,000				30,000	
6	45,000				30,000	

$$\text{Payback}_A = \frac{\$150{,}000}{\$45{,}000} = 3.33 \text{ years} = 3 \text{ years } 4 \text{ months}$$

$$\text{Payback}_B = 2 \text{ years} + \frac{\$15{,}000}{\$30{,}000} \text{ years} = 2.5 \text{ years} = 2 \text{ years } 6 \text{ months}$$

b. At a discount rate of zero, dollars have the same value through time and all that is needed is a summation of the cash flows across time.

NPV_A = (\$45,000 × 6) - \$150,000 = \$270,000 – \$150,000 = \$120,000

NPV_B = \$75,000 + \$60,000 + \$120,000 – \$150,000 = \$105,000

c. NPV_A:

CF_0 = –\$150,000; CF_1 = \$45,000; F_1 = 6

Set I = 9%

Solve for NPV_A = \$51,886.34

NPV_B:

CF_0 = –\$150,000; CF_1 = \$75,000; CF_2 = \$60,000; CF_3 = \$120,000

Set I = 9%

Solve for NPV = \$51,112.36

Accept

d. IRR_A:

CF_0 = –\$150,000; CF_1 = \$45,000; F_1 = 6

Solve for IRR = 19.91%

IRR_B:

CF_0 = –\$150,000; CF_1 = \$75,000; CF_2 = \$60,000; CF_3 = \$120,000

Solve for IRR = 22.71%

e.

Project	Rank		
	Payback	**NPV**	**IRR**
A	2	1	2
B	1	2	1

The project that should be selected is A. The conflict between NPV and IRR is due partially to the reinvestment rate assumption. The assumed reinvestment rate of Project B is 22.71%, the project's IRR. The reinvestment rate assumption of A is 9%, the firm's cost of capital. On a practical level Project B may be selected due to management's preference for making decisions based on percentage returns and their desire to receive a return of cash quickly.

P10-21. Payback, NPV, and IRR

LG 2, 3, 4; Intermediate

a. Payback period

Balance after 3 years: \$95,000 – \$20,000 – \$25,000 – \$30,000 = \$20,000

3 + (\$20,000 ÷ \$35,000) = 3.57 years

b. NPV computation

$CF_0 = -\$95{,}000$; $CF_1 = \$20{,}000$; $CF_2 = \$25{,}000$; $CF_3 = \$30{,}000$; $CF_4 = \$35{,}000$

$CF_5 = \$40{,}000$

Set I = 12%

Solve for NPV = \$9,080.60

c. $$\$0 = \frac{\$20{,}000}{(1+\text{IRR})^1} + \frac{\$25{,}000}{(1+\text{IRR})^2} + \frac{\$30{,}000}{(1+\text{IRR})^3} + \frac{\$35{,}000}{(1+\text{IRR})^4} + \frac{\$40{,}000}{(1+\text{IRR})^5} - \$95{,}000$$

$CF_0 = -\$95{,}000$; $CF_1 = \$20{,}000$; $CF_2 = \$25{,}000$; $CF_3 = \$30{,}000$; $CF_4 = \$35{,}000$

$CF_5 = \$40{,}000$

Solve for IRR = 15.36%

d. NPV = \$9,080; since NPV > 0; accept

IRR = 15%; since IRR > 12% cost of capital; accept

The project should be implemented since it meets the decision criteria for both NPV and IRR.

P10-22. NPV, IRR, and NPV profiles

LG 3, 4, 5; Challenge

a. and b.

Project A

$CF_0 = -\$130{,}000$; $CF_1 = \$25{,}000$; $CF_2 = \$35{,}000$; $CF_3 = \$45{,}000$

$CF_4 = \$50{,}000$; $CF_5 = \$55{,}000$

Set I = 12%

$NPV_A = \$15{,}237.71$

Based on the NPV the project is acceptable since the NPV is greater than zero.

Solve for $IRR_A = 16.06\%$

Based on the IRR the project is acceptable since the IRR of 16% is greater than the 12% cost of capital.

Project B

$CF_0 = -\$85,000$; $CF_1 = \$40,000$; $CF_2 = \$35,000$; $CF_3 = \$30,000$

$CF_4 = \$10,000$; $CF_5 = \$5,000$

Set I = 12%

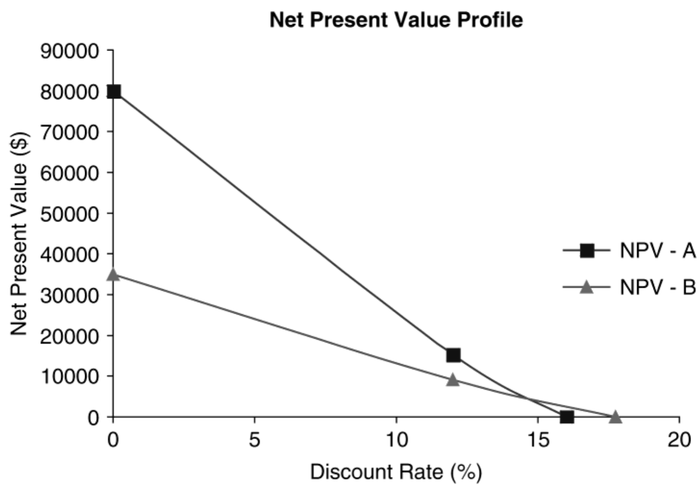
$NPV_B = \$9,161.79$

Based on the NPV the project is acceptable since the NPV is greater than zero.

Solve for $IRR_B = 17.75\%$

Based on the IRR the project is acceptable since the IRR of 17.75% is greater than the 12% cost of capital.

c.



Data for NPV Profiles

	NPV	
Discount Rate	**A**	**B**
0%	\$80,000	\$35,000
12%	\$15,238	\$9,161
15%	—	\$ 4,177
16%	0	—
18%	—	0

d. The net present value profile indicates that there are conflicting rankings at a discount rate less than the intersection point of the two profiles (approximately 15%). The conflict in rankings is caused by the relative cash flow pattern of the two projects. At discount rates above approximately 15%, Project B is preferable; below approximately 15%, Project A is better. Based on Thomas Company's 12% cost of capital, Project A should be chosen.

e. Project A has an increasing cash flow from Year 1 through Year 5, whereas Project B has a decreasing cash flow from Year 1 through Year 5. Cash flows moving in opposite directions often cause conflicting rankings. The *IRR* method reinvests Project B's larger early cash flows at the higher IRR rate, not the 12% cost of capital.

P10-23. All techniques—decision among mutually exclusive investments

LG 2, 3, 4, 5, 6; Challenge

	Project		
	A	**B**	**C**
Cash inflows (years 1–5)	$20,000	$ 31,500	$ 32,500
a. Payback*	3 years	3.2 years	3.4 years
b. NPV*	$10,345	$ 10,793	$ 4,310
c. IRR*	19.86%	17.33%	14.59%

*Supporting calculations shown below:

a. **Payback Period:** Project A: $60,000 ÷ $20,000 = 3 years
Project B: $100,000 ÷ $31,500 = 3.2 years
Project C: $110,000 ÷ $32,500 = 3.4 years

b. **NPV**

Project A

$CF_0 = -\$60,000$; $CF_1 = \$20,000$; $F_1 = 5$

Set I = 13%

Solve for $NPV_A = \$10,344.63$

Project B

$CF_0 = -\$100,000$; $CF_1 = \$31,500$; $F_1 = 5$

Set I = 13%

Solve for $NPV_B = \$10,792.78$

Project C

$CF_0 = -\$110,000$; $CF_1 = \$32,500$; $F_1 = 5$

Set I = 13%

Solve for $NPV_C = \$4,310.02$

c. **IRR**

Project A

$CF_0 = -\$60,000$; $CF_1 = \$20,000$; $F_1 = 5$

Solve for $IRR_A = 19.86\%$

Project B

$CF_0 = -\$100,000$; $CF_1 = \$31,500$; $F_1 = 5$

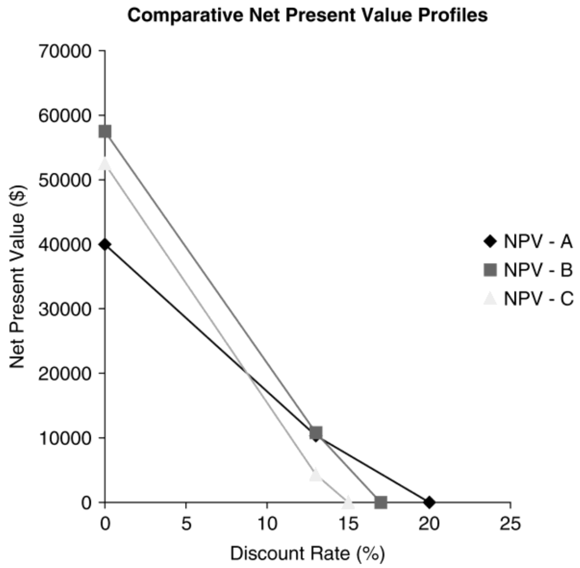
Solve for $IRR_B = 17.34\%$

Project C

$CF_0 = -\$110,000$; $CF_1 = \$32,500$; $F_1 = 5$

Solve for $IRR_C = 14.59\%$

d.



Data for NPV Profiles

	NPV		
Discount Rate	**A**	**B**	**C**
0%	$40,000	$57,500	$52,500
13%	$10,340	10,793	4,310
15%	—	—	0
17%	—	0	—
20%	0	—	—

The difference in the magnitude of the cash flow for each project causes the NPV to compare favorably or unfavorably, depending on the discount rate.

e. Even though A ranks higher in Payback and IRR, financial theorists would argue that B is superior since it has the highest NPV. Adopting B adds $448.15 more to the value of the firm than does adopting A.

P10-24. All techniques with NPV profile—mutually exclusive projects

LG 2, 3, 4, 5, 6; Challenge

a. **Project A**

Payback period

Year 1 + Year 2 + Year 3	=	$60,000
Year 4	=	<u>$20,000</u>
Initial investment	=	$80,000

Payback = 3 years + ($20,000 ÷ 30,000)

Payback = 3.67 years

Project B

Payback period

\$50,000 ÷ \$15,000 = 3.33 years

b. **Project A**

CF_0 = −\$80,000; CF_1 = \$15,000; CF_2 = \$20,000; CF_3 = \$25,000; CF_4 = \$30,000; CF_5 = \$35,000

Set I = 13%

Solve for NPV_A = \$3,659.68

Project B

CF_0 = −\$50,000; CF_1 = \$15,000; F_1 = 5

Set I = 13%

Solve for NPV_B = \$2,758.47

c. **Project A**

CF_0 = −\$80,000; CF_1 = \$15,000; CF_2 = \$20,000; CF_3 = \$25,000; CF_4 = \$30,000; CF_5 = \$35,000

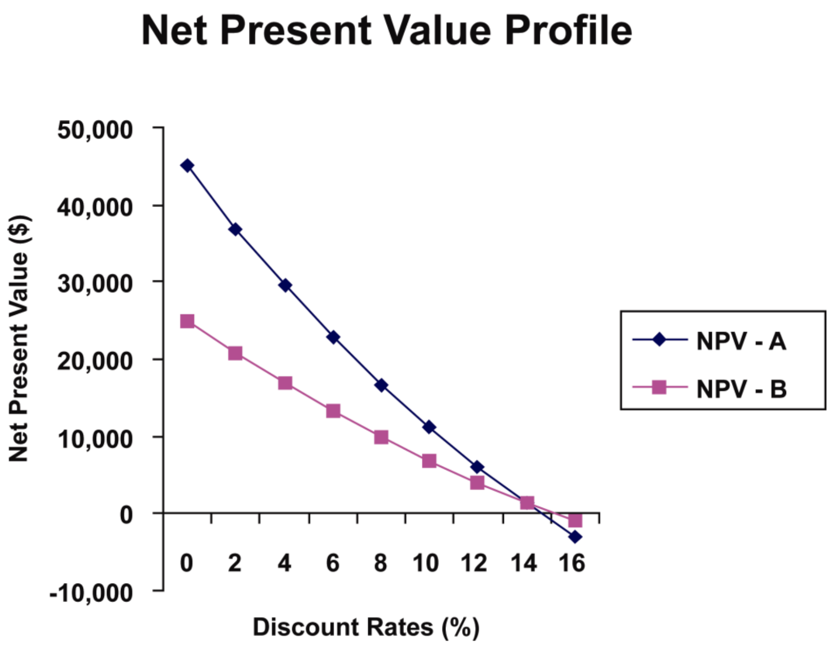
Solve for IRR_A = 14.61%

Project B

CF_0 = −\$50,000; CF_1 = \$15,000; F_1 = 5

Solve for IRR_B = 15.24%

d.



Data for NPV Profiles

	NPV	
Discount Rate	**A**	**B**
0%	$45,000	$25,000
13%	$3,655	2,755
14.6%	0	—
15.2%	—	0

Intersection—approximately 14%

If cost of capital is above 14%, conflicting rankings occur.

The calculator solution is 13.87%.

e. Both projects are acceptable. Both have similar payback periods, positive NPVs, and equivalent IRRs that are greater than the cost of capital. Although Project B has a slightly higher IRR, the rates are very close. Since Project A has a higher NPV, accept Project A.

P10-25. Integrative—Multiple IRRs

LG 6; Basic

a. First the project does not have an initial cash outflow. It has an inflow, so the payback is immediate. However, there are cash outflows in later years. After 2 years, the project's outflows are greater than its inflows, but that reverses in year 3. The oscillating cash flows (positive-negative-positive-negative-positive) make it difficult to even think about how the payback period should be defined.

b. CF_0 = $200,000, CF_1 = –920,000, CF_2 = $1,592,000, CF_3 = –$1,205,200, CF_4 = $343,200

Set I = 0%; Solve for NPV = $0.00

Set I = 5%; Solve for NPV = –$15.43

Set I = 10%; Solve for NPV = $0.00

Set I = 15%; Solve for NPV = $6.43

Set I = 20%; Solve for NPV = $0.00

Set I = 25%; Solve for NPV = –$7.68

Set I = 30%; Solve for NPV = $0.00

Set I = 35%, Solve for NPV = $39.51

c. There are multiple IRRs because there are several discount rates at which the NPV is zero.

d. It would be difficult to use the IRR approach to answer this question because it is not clear which IRR should be compared to each cost of capital. For instance, at 5%, the NPV is negative, so the project would be rejected. However, at a higher 15% discount rate the NPV is positive and the project would be accepted.

e. It is best simply to use NPV in a case where there are multiple IRRs due to the changing signs of the cash flows.

P10-26. Integrative—Conflicting Rankings

LG 3, 4, 5; Intermediate

a. *Plant Expansion*

$CF_0 = -\$3,500,000$, $CF_1 = 1,500,000$, $CF_2 = \$2,000,000$, $CF_3 = \$2,500,000$, $CF_4 = \$2,750,000$

Set I = 20%; Solve for NPV = $1,911,844.14

Solve for IRR = 43.70%

$CF_1 = 1,500,000$, $CF_2 = \$2,000,000$, $CF_3 = \$2,500,000$, $CF_4 = \$2,750,000$

Set I = 20%; Solve for NPV = $5,411,844.14 (This is the PV of the cash inflows)

PI = $5,411,844.14 ÷ $3,500,000 = 1.55

Product Introduction

$CF_0 = -\$500,000$, $CF_1 = 250,000$, $CF_2 = \$350,000$, $CF_3 = \$375,000$, $CF_4 = \$425,000$

Set I = 20%; Solve for NPV = $373,360.34

Solve for IRR = 52.33%

$CF_1 = 250,000$, $CF_2 = \$350,000$, $CF_3 = \$375,000$, $CF_4 = \$425,000$

Set I = 20%; Solve for NPV = $873,360.34 (This is the PV of the cash inflows)

PI = $873,360.34 ÷ $500,000 = 1.75

b.

	Rank		
Project	**NPV**	**IRR**	**PI**
Plant Expansion	1	2	2
Product Introduction	2	1	1

c. The NPV is higher for the plant expansion, but both the IRR and the PI are higher for the product introduction project. The rankings do not agree because the plant expansion has a much larger scale. The NPV recognizes that it is better to accept a lower return on a larger project here. The IRR and PI methods simply measure the rate of return on the project and not its scale (and therefore not how much money in total the firm makes from each project).

d. Because the NPV of the plant expansion project is higher, the firm's shareholders would be better off if the firm pursued that project, even though it has a lower rate of return.

P10-27. Ethics problem

LG 1, 6; Intermediate

Expenses are almost sure to increase for Gap. The stock price would almost surely decline in the immediate future, as cash expenses rise relative to cash revenues. In the long run, Gap may be able to attract and retain better employees (as does Chick-fil-A, interestingly enough, by being closed on Sundays), new human rights and environmentally conscious customers, and new investor demand from the burgeoning socially responsible investing mutual funds. This long-run effect is not assured, and we are again reminded that it's not merely shareholder wealth maximization we're after—but maximizing shareholder wealth subject to ethical constraints. In fact, if Gap was unwilling to renegotiate worker conditions, Calvert Group (and others) might sell Gap shares and thereby decrease shareholder wealth.