Solutions to end-of-chapter problems

Chapter 7

7.2 *Interest charged on principal:*

Interest on principal = 1,000,000(3)(0.10) = $300,000

Interest charged on unrecovered balance:

Annual payment = 1,000,000(A/P,10%,3)
= 1,000,000(0.40211)
= $402,110

Interest, year 1 = 1,000,000(0.10)
= **$100,000**

Balance, year 1 = 1,100,000 – 402,110
= $697,890

Interest, year 2 = 697,890(0.10)
= **$69,789**

Balance, year 2 = 697,890(1.10) – 402,110
= $365,569

Interest, year 3 = 365,569(0.10)
= **$36,557**

Total interest paid = 100,000 + 69,789 + 36,557
= $206,346

Difference = 300,000 – 206,346
= $93,654

7.9 *Hand:*

$$0 = -3000 - 200(P/A,i,3)(P/F,i,1) - 90(P/A,i,3)(P/F,i,5) + 7000(P/F,i,8)$$

By trial and error and interpolation

Try 5%: 0 = -3000 - 200(2.7232)(0.9524) - 90(2.7232)(0.7835) + 7000(0.6768)
= $1027.10

Try 10%: 0 = -3000 - 200(2.4869)(0.9091) - 90(2.4869)(0.6209) + 7000(0.4665)
= $-325.60

$$i = 5\% + (5)\frac{1027.10}{1352.70} = 5 + 3.79 = 8.79\%$$

Spreadsheet: Enter net cash flows (in cells B2 through B10) and the function = IRR(B2:B10) to display i = 8.59%

7.18 *Hand:* In $1 million units,

$$0 = -500 + 1.8(0.1)(2500)(P/F,i,2) + 500(1.8)(0.9)(P/A,i,5)(P/F,i,5) - 10(P/A,i,10)$$
$$0 = -500 + 450(P/F,i,2) + 810(P/A,i,5)(P/F,i,5) - 10(P/A,i,10)$$

Solve for i by trial and error

i = 42% per year

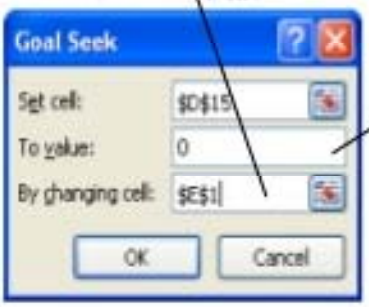
Spreadsheet:

	A	B	C	D
1	Year	Expenses	Income	NCF
2	0	-500	0	-500
3	1	-10	0	-10
4	2	-10	450	440
5	3	-10	0	-10
6	4	-10	0	-10
7	5	-10	0	-10
8	6	-10	810	800
9	7	-10	810	800
10	8	-10	810	800
11	9	-10	810	800
12	10	-10	810	800
13	ROR			40.6%

Spreadsheet: This is a good application of the Goal Seek tool. Result is i = 5.29% per year.

	A	B	C	D	E
1	Year	Expenses	Income	NCF	10.00%
2	0	0	0	0	
3	1	-400	0	-400	
4	2	-400	0	-400	
5	3	-400	0	-400	
6	4	-400	0	-400	
7	5	-400	0	-400	
8	6	-400	0	-400	
9	7	-400	0	-400	
10	8	-400	0	-400	
11	9	-400	0	-400	
12	10	-400	0	-400	
13	11	0	270	270	
14	:	0	270	270	
15	F in year 10			-3674.97	

	A	B	C	D	E
1	Year	Expenses	Income	NCF	5.29%
2	0	0	0	0	
3	1	-400	0	-400	
4	2	-400	0	-400	
5	3	-400	0	-400	
6	4	-400	0	-400	
7	5	-400	0	-400	
8	6	-400	0	-400	
9	7	-400	0	-400	
10	8	-400	0	-400	
11	9	-400	0	-400	
12	10	-400	0	-400	
13	11	0	270	270	
14	:	0	270	270	
15	F in year 10			0.00	



7.31 (a)

Year	0	1	2	3	4	5	6
NCF, $	-30	-2	-6	+21	+30	+18	+40

There is only one change in sign in the net cash flow; there is only one i* value.

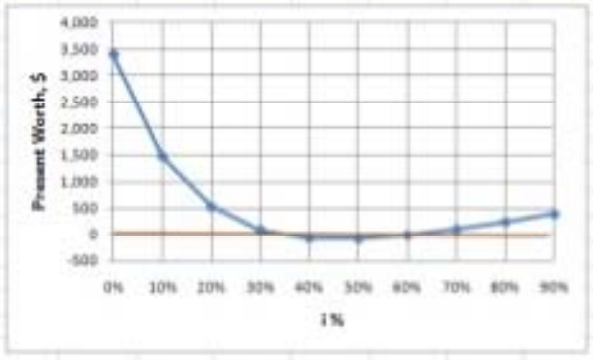
(b) $0 = -30 - 2(P/F,i,1) - 6(P/F,i,2) + 21(P/F,i,3) + 30(P/F,i,4) + 18(P/F,i,5) + 40(P/F,i,6)$

Solve for i by trial and error or spreadsheet

i* = 28.3% (IRR function on spreadsheet)

7.33

	A	B	C	D	E
1	Year	NCF, $	Cum NCF, $	i%	PW at i%, $
2	0	5,000	5,000	0%	3,400
3	1	-10,100	-5,100	10%	1,471
4	2	500	-4,600	20%	526
5	3	2,000	-2,600	30%	90
6	4	2,000	-600	40%	-72
7	5	2,000	1,400	50%	-84
8	6	2,000	3,400	60%	-14
9	Sign changes	2	No help	70%	102
10	Guess	None	100%	80%	241
11	ROR	34.1%	61.4%	90%	391



(a) Plot shows two rates at approximately 35% and 60%.

(b) IRR function (row 11) displays 34.1% and 61.4% using guess of 100% to get second value.

(c) Descartes' rule of signs: 2 sign changes
Norstrom's criterion: series starts positive; no help

Since both roots are positive, technique of next section is necessary to find one root. However, with MARR = 30%, PW = $90 (spreadsheet). Therefore, use 34.1% as most reliable at this point.

7.37 The investment rate is usually higher than the borrowing rate because viable companies can invest money at a higher a rate of return than the rate at which they borrow it. If they can't do that, they won't be in business very long.

7.38 Follow the steps of the modified ROR procedure.

$$PW_0 = -32{,}000(P/F,10\%,1) - 25{,}000(P/F,10\%,2)$$
$$= -32{,}000(0.9091) - 25{,}000(0.8264)$$
$$= \$-49{,}751$$

$$FW_3 = 16{,}000(F/P,18\%,3) + 70{,}000$$
$$= 16{,}000(1.6430) + 70{,}000$$
$$= \$96{,}288$$

$$96{,}288 = 49{,}751(F/P,i,3)$$
$$(F/P,i,3) = 1.9354$$

Use interpolation in factor tables or spreadsheet to find i'

$i' = 24.6\%$ per year (spreadsheet)

7.39 *Hand:* Follow the steps of the modified ROR procedure.

$$PW_0 = -9000 - 2000(P/F,8\%,2) - 7000(P/F,8\%,3)$$
$$= -9000 - 2000(0.8573) - 7000(0.7938)$$
$$= \$-16{,}271$$

$$FW_6 = 4100(F/P,15\%,5) + 12{,}000(F/P,15\%,2) + 700(F/P,15\%,1) + 800$$
$$= 4100(2.0114) + 12{,}000(1.3225) + 700(1.1500) + 800$$
$$= \$25{,}722$$

$$25{,}722 = 16{,}271(F/P,i,6)$$
$$(F/P,i,6) = 1.5808$$

Use interpolation in factor tables or spreadsheet to find i.

$i' = 7.9\%$ per year (spreadsheet)

Spreadsheet function: Enter NCF values (B2:B8) and = MIRR(B2:B8,8%15%) to display 7.9% per year.

$$FW_6 = 4100(F/P,15\%,5) + 12{,}000(F/P,15\%,2) + 700(F/P,15\%,1) + 800$$
$$= 4100(2.0114) + 12{,}000(1.3225) + 700(1.1500) + 800$$
$$= \$25{,}722$$

$$25{,}722 = 16{,}271(F/P,i,6)$$
$$(F/P,i,6) = 1.5808$$

Use interpolation in factor tables or spreadsheet to find i.

i′ = 7.9% per year (spreadsheet)

Spreadsheet function: Enter NCF values (B2:B8) and = MIRR(B2:B8,8%15%) to display 7.9% per year.

7.40 (a) There are three changes in sign on the net cash flow, so there are three possible rate of return values.

(b) $PW_0 = -8000(P/A,8\%,6) - 8000(P/A,8\%,2)(P/F,8\%,7)$
$= -8000(4.6229) - 8000(1.7833)(0.5835)$
$= \$-45{,}307$

$FW_{10} = 52{,}000(F/P,12\%,3) + 20{,}000$
$= 52{,}000(1.4049) + 20{,}000$
$= \$93{,}055$

$45{,}307(F/P,i,10) = 93{,}055$
$(F/P,i,10) = 2.0539$

Use interpolation in factor tables or spreadsheet to find i′

i′ = 7.5 % per year (spreadsheet)

7.41 $i_i = 20\%$ and $i_b = 9\%$. Follow the steps of the modified ROR procedure.

$PW_0 = -400{,}000 - 30{,}000(P/F,9\%,3)$
$= -400{,}000 - 30{,}000(0.7722)$
$= \$-423{,}166$

$FW_0 = 160{,}000(F/A,20\%,2)(F/P,20\%,8) + 160{,}000(F/A,20\%,7)$
$= 160{,}000(2.2000)(4.2998) + 160{,}000(12.9159)$
$= \$3{,}580{,}074$

$0 = -423{,}166 + 3{,}580{,}074(P/F,i,10)$
$(P/F,i,10) = 0.1182$

Solve by formula or spreadsheet

i′ = 23.8% per year (spreadsheet)

7.43 Descartes' rule of signs: 4 sign changes
Norstrom's criterion: series starts positive; no help

Apply the ROIC procedure with $i_i = 14\%$.

Step 1: $F_0 = 3000$ $\quad F_0 > 0$; use i_i

$F_1 = 3000(1 + 0.14) - 2000$
$= 1420$ $\quad F_1 > 0$; use i_i

$F_2 = 1420(1 + 0.14) + 1000$
$= 2618.80$ $\quad F_2 > 0$; use i_i

$F_3 = 2618.80(1 + 0.14) - 6000$
$= -3014.57$ $\quad F_3 < 0$; use i''

$F_4 = -3014.57(1 + i'') + 3800$

Step 2: Set $F_4 = 0$ and solve for i''

$0 = -3014.57(1 + i'') + 3800$

$i'' = 26.1\%$ per year

$F_2 = (-1000 - 5000\, i'')(1 + i'')$
$= -1000 - 5000\, i'' - 1000\, i'' - 5000\, i''^2$
$= -1000 - 6000\, i'' - 5000\, i''^2$ $\quad F_2 < 0$; use i''

$F_3 = (-1000 - 6000\, i'' - 5000\, i''^2)(1 + i'')$
$= -1000 - 6000\, i'' - 5000\, i''^2 - 1000\, i'' - 6000\, i''^2 - 5000\, i''^3$
$= -1000 - 7000\, i'' - 11{,}000\, i''^2 - 5000 i^3$ $\quad F_3 < 0$; use i''

$F_4 = (-1000 - 7000\, i'' - 11{,}000\, i''^2 - 5000 i^3)(1 + i'') + 20{,}000$
$= 19{,}000 - 8000\, i'' - 18{,}000\, i''^2 - 16{,}000 i^3 - 5000\, i''^4$ $\quad F_4 > 0$; use i_i

$F_5 = (19{,}000 - 8000\, i'' - 18{,}000\, i''^2 - 16{,}000\, i''^3 - 5000\, i''^4)(1.15) - 15{,}000$
$= 6850 - 9200\, i'' - 20{,}700\, i''^2 - 18{,}400\, i''^3 - 5750\, i''^4$

Set $F_5 = 0$ and solve for i'' by trial and error or spreadsheet for the ROIC approach.

$i'' = 35.7\%$ per year

A spreadsheet in the format of Figure 7-12 will also indicate an EROR of 35.7% per year.

7.55 I = 10,000(0.08)/4
= $200 per quarter

(a) 0 = -6000 + 200(P/A,i,20)(P/F,i,8) + 7000(P/F,i,28)

Solve for i by trial and error or enter cash flows and use IRR function on spreadsheet.

i = 2.55% per quarter (spreadsheet)

(b) Nominal annual i = 0.0255(4)
= 10.2% per year, compounded quarterly

7.56 (a) I = 10,000,000(0.12)/4
= $300,000 per quarter

By spending $11 million now, the company will save $300,000 every three months for 25 years and will save $10,000,000 at that time. The ROR relation is:

0 = -11,000,000 + 300,000(P/A,i%,100) + 10,000,000(P/F,i%,100)

i = 2.71% per quarter (spreadsheet)

(b) Nominal i per year = 2.71(4) = 10.84% per year

7.57 I = 5000(0.10)/2
= $250 per six months

0 = -5000 + 250(P/A,i%,8) + 5500(P/F,i%,8)

Solve for i by trial and error or spreadsheet

i = 6.01% per six months (spreadsheet)