Assignment 3 (Ch. 7-9)

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7-4 An investment of $5,000 in Biotech common stock proved to be very profitable. At the end of three years the stock was sold for $25,000. What was the rate of return on the investment?

$$PWC=PWB$$
$$5=25\cdot(1+X)^{(-3)}$$
$$X=709.98E-3$$

i = 71%

7-8 A mining firm makes annual deposits of $250,000 into a reclamation fund for 20 years. If the firm must have $10 million when the mine is closed, what interest rate must the investment earn?

$$FWC=FWB$$
$$250\cdot\frac{(1+X)^{20}-1}{X}=10000$$
$$X=67.745E-3$$

i = 6.77%

7-41 ABC Corporation is issuing some *zero coupon bonds*, which pay no interest. At maturity in 20 years they pay a face value of $10,000. The bonds are expected to sell for $3,118 when issued.

(a) What is the effective interest rate an investor receives?

(b) A 1% fee (based on the face value) is deducted by the brokerage firm from the initial sales revenue. What is the effective annual interest rate paid by ABC Corporation?

a)

$$PWC=PWB$$
$$3118=10000\cdot(1+X)^{(-20)}$$
$$X=60.001E-3$$

i = 6%

b)

Fee = 10k*1% = 100

$$3118-100=10000\cdot(1+X)^{(-20)}$$
$$X=61.730E-3$$

7-75 Two hazardous-environment facilities are being evaluated, with the projected life of each facility being 10 years. The cash flows are as follows:

	Alt. A	Alt. B
First cost	$615,000	$300,000
Maintenance and operating cost	10,000	25,000
Annual benefits	158,000	92,000
Salvage value	65,000	−5,000

The company uses a MARR of 15%. Using rate of return analysis, which alternative should be selected?

Year	Option A	Option B	Increment (A-B)
0	-615k	-300k	-615k + 300k = -315k
1	158k - 10k = 148k	92k - 25k = 67k	148k - 67k = 81k
2	148k	67k	81k
...	148k	67k	81k
10	148k + 65k = 213k	67k - 5k = 62k	213k - 62k = 151k

$$PWC=PWB$$
$$315=81\cdot\frac{(1+I)^9-1}{I\cdot(1+I)^9}+151\cdot\frac{1}{(1+I)^{10}}$$
$$I=231.51E-3$$

IRR = 23%

IRR >= MARR, so go with higher cost option, **Alt. A**

7-87 The Southern Guru Copper Company operates a large mine in a South American country. A legislator said in the National Assembly that most of the capital for the mining operation was provided by loans from the World Bank; in fact, Southern Guru has only $500,000 of its own money actually invested in the property. The cash flow for the mine is as follows:

Year	Cash Flow
0	$0.5 million investment
1	3.5 million profit
2	0.9 million profit
3	3.9 million profit
4	8.6 million profit
5	4.3 million profit
6	3.1 million profit
7	6.1 million profit

The legislator divided the $30.4 million total profit by the $0.5 million investment. This produced, he said, a 6,080% rate of return on the investment. Southern Guru claims the actual rate of return is much lower. They ask you to compute their rate of return. Use a spreadsheet.

PWC = PWB

$$.5=3.5\cdot\frac{1}{1+I}+.9\cdot\frac{1}{(1+I)^2}+3.9\cdot\frac{1}{(1+I)^3}+8.6\cdot\frac{1}{(1+I)^4}+4.3\cdot\frac{1}{(1+I)^5}+3.1\cdot\frac{1}{(1+I)^6}+6.1\cdot\frac{1}{(1+I)^7}$$

$$500.00E-3=3.5000E0\cdot\frac{1}{1+I}+900.($$

$$I=6.4288E0$$

i = 6.43%

8-2 Consider two mutually exclusive alternatives and the do-nothing alternative:

Year	Buy X	Buy Y
0	−$100.0	−$50.0
1	+31.5	+16.5
2	+31.5	+16.5
3	+31.5	+16.5
4	+31.5	+16.5

Construct a choice table for interest rates from 0% to 100%.

i(do nothing) = 0%

$$PWCx = PWBx$$

$$100 = 31.500E0 \cdot \frac{(1+I)^4 - 1}{I \cdot (1+I)^4}$$

$$I = 99.310E-3$$

i(x) = 9.9%

$$PWCy = PWBy$$

$$50 = 16.500E0 \cdot \frac{(1+I)^4 - 1}{I \cdot (1+I)^4}$$

$$I = 121.10E-3$$

i(y) = 12.1%

Incremental analysis

Year	X	Y	Increment (X-Y)
0	-100	-50	-50
1	31.5	16.5	15
…	31.5	16.5	15
4	31.5	16.5	15

$$PWCi = PWBi$$

$$50 = 15 \cdot \frac{(1+I)^4 - 1}{I \cdot (1+I)^4}$$

$$I = 77.138E-3$$

IRR = 7.7%

When IRR > MARR, go with higher cost option. So

Choice Table:

MARR	Preferable option
i < 7.7	Buy X
7.7 < i < 12.1	Buy Y
12.1 < i	Buy nothing

8-26 QZY, Inc. is evaluating new widget machines offered by three companies. The machines have the following characteristics:

	Company A	Company B	Company C
First cost	$15,000	$25,000	$20,000
Maintenance and operating	$1,600	$400	$900
Annual benefit	$8,000	$13,000	$9,000
Salvage value	$3,000	$6,000	$4,500
Useful life, in years	4	4	4

(a) Construct a choice table for interest rates from 0% to 100%.

(b) MARR = 15%. Use rate of return analysis to decide from which company, if any, you should buy the widget machine.

Start with the two lowest-cost options, A and C.

Incremental Analysis of C-A.

Initial Cost = 20k-15k = 5k
Yearly Income = (9000-900)-(8000-1600) = 1700
Salvage = 4500 - 3000 = 1500

$$PWB=PWC$$

$$1700\cdot\frac{(1+I)^4-1}{I\cdot(1+I)^4}+1500\cdot\frac{1}{(1+I)^4}=5000$$

$$I=211.79E-3$$

IRR > MARR, so use higher cost option, C.

Incremental Analysis of B-C.

Initial Cost = 25k-20k = 5k
Yearly Income = (13000-400)-(9000-900) = 4500
Salvage = 6000 - 4500 = 1500

$$PWB=PWC$$

$$4500\cdot\frac{(1+I)^4-1}{I\cdot(1+I)^4}+1500\cdot\frac{1}{(1+I)^4}=5000$$

$$I=844.07E-3$$

IRR > MARR, so use higher cost option, B.

Go with **Company B**.

8-34 A firm is considering moving its manufacturing plant from Red Deer to a new location. The industrial engineering department was asked to identify the various alternatives together with the costs to relocate the plant, and the benefits. The engineers examined six likely sites, together with the do-nothing alternative of keeping the plant at its present location. Their findings are summarized as follows:

Plant Location	First Cost ($000s)	Uniform Annual Benefit ($000s)
Halifax	$300	$52
Edmonton	550	137
Toronto	450	117
Vancouver	750	167
Calgary	150	18
Regina	200	49
Red Deer	0	0

The annual benefits are expected to be constant over the eight-year analysis period. If the firm uses 10% annual interest in its economic analysis, where should the manufacturing plant be located?

Halifax

$$300=52\cdot\frac{(1+I)^8-1}{I\cdot(1+I)^8}$$

I=78.967E-3

Edmonton

$$550=137\cdot\frac{(1+I)^8-1}{I\cdot(1+I)^8}$$

I=185.05E-3

Toronto

$$450=117\cdot\frac{(1+I)^8-1}{I\cdot(1+I)^8}$$

I=199.21E-3

Vancouver

$$750=167\cdot\frac{(1+I)^8-1}{I\cdot(1+I)^8}$$

I=149.75E-3

Calgary

$$150=18\cdot\frac{(1+I)^8-1}{I\cdot(1+I)^8}$$

I=-8.9835E-3

Regina

$$200=49\cdot\frac{(1+I)^8-1}{I\cdot(1+I)^8}$$

I=179.68E-3

Red Deer

$$0=0\cdot\frac{(1+I)^8-1}{I\cdot(1+I)^8}$$

I=0.0000E0

$$I\cdot(1+I)^{8}$$
$$I=0.0000E0$$

Reject Red Deer, Calgary, and Halifax outright because I < MARR.

Start with the two remaining lowest-cost options, **Regina and Toronto.**

Initial cost = 200-450 = -250
Yearly benefit = 49-117 = -68

$$PWB=PWC$$
$$-250=-68\cdot\frac{(1+I)^{8}-1}{I\cdot(1+I)^{8}}$$
$$I=214.56E-3$$

IRR > MARR, so keep higher cost option, Toronto. Compare to next lowest, Edmonton.

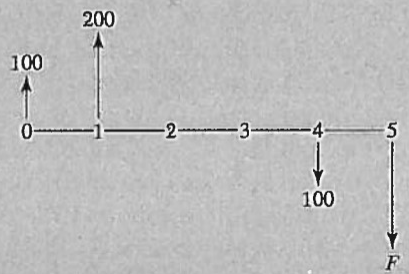
Toronto and Edmonton.

Initial cost = 450 - 550 = -100
Yearly benefit = 117 - 137 = -20

$$PWB=PWC$$
$$-100=-20\cdot\frac{(1+I)^{8}-1}{I\cdot(1+I)^{8}}$$
$$I=118.15E-3$$

IRR < MARR, so keep **Edmonton**.

9-4 For a 12% interest rate, compute the value of F so that the following cash flows have a future worth of 0.



F = 100(F/P, 0.12, 5) + 200(F/P, 0.12, 4) - 100(F/P, 0.12, 1)

$$100\cdot(1+.12)^{5}+200\cdot(1+.12)^{4}$$

$$F=378.94E0$$

9-30 UBC has two options for upgrading its athletic facilities. The off-campus option costs only $20 million, but it will require frequent bus service to those facilities at an annual cost that starts at $300,000 and increases by 4% per year. (The costs are for buses, drivers' and mechanics' salaries, maintenance, road wear, etc.) Improving the on-campus facilities will cost $50 million, but no extra transportation costs are required. Both options involve an estimated annual maintenance cost of $1 million for about 40 years before new facilities will again be needed. Using benefit-cost-ratio analysis, determine which option is more economically efficient. Use an interest rate of 8% a year.

Benefit cost ratio, PWB/PWC

Off campus option
PWC = 20M + 300k(P/A, 4%, 8%, 40) + 1M(P/A, 8%, 40)

PWC=37.767E6

On campus option
PWC = 50M + 1M(P/A, 8%, 40)

PWC=61.925E6

No data is given about the benefits. So assume both options would equally satisfy the requirement.
So the PWB/PWC of the off-campus option is higher than the PWB/PWC of the on-campus option.

So pick **off-campus option.**

9-33 An investor is considering buying some land for $100,000 and constructing an office building on it. Three different buildings are being analyzed.

	Building Height		
	2 Storeys	5 Storeys	10 Storeys
Cost of building (excluding cost of land)	$400,000	$800,000	$2,100,000
Resale value* of land and building at end of 20-year analysis period	200,000	300,000	400,000
Annual rental income after all operating expenses have been deducted	70,000	105,000	256,000

*Resale value to be considered a reduction in cost, rather than a benefit.

Using benefit-cost ratio analysis and an 8% MARR, determine which alternative, if any, should be selected.

2 Storeys

PWB/PWC =70k(P/A, 8%, 20)/(400k + 200k(P/F, 8%, 20))

$$\frac{70\cdot\frac{\left(1+\frac{8}{100}\right)^{20}-1}{\frac{8}{100}\cdot\left(1+\frac{8}{100}\right)^{20}}}{400+200\cdot\frac{1}{\left(1.0000E0+\frac{8}{100}\right)^{20}}}$$

$$\frac{PWB}{PWC}=1.5517E0$$

5 Storeys

PWB/PWC =105k(P/A, 8%, 20)/(800k + 300k(P/F, 8%, 20))

$$\frac{PWB}{PWC}=1.1927E0$$

10 Storeys

PWB/PWC =256k(P/A, 8%, 20)/(2.1M + 400k(P/F, 8%, 20))

$$\frac{PWB}{PWC}=1.1499E0$$

The highest PWB/PWC ratio belongs to the best option: **2 Storeys**.

9-50 Consider three alternatives:

	A	B	C
First cost	$50	$150	$110
Uniform annual benefit	$28.8	$39.6	$39.6
Useful life, in years*	2	6	4
Computed rate of return	10%	15%	16.4%

*At the end of its useful life, an identical alternative (with the same cost, benefits, and useful life) may be installed.

All the alternatives have no salvage value. If the MARR is 12%, which alternative should be selected?

(a) Solve the problem by future worth analysis.

(b) Solve the problem by benefit-cost ratio analysis.

(c) Solve the problem by payback period.

(d) If the answers in parts (a), (b), and (c) differ, explain why this is the case.

Plus sketch a graph of PW benefits vs. PW costs associated with part B

a) Because of variable project lifes, use lowest common multiple 12 years.

Option A: NFW = FWC - FWB

$$28.800E0\cdot\frac{(1+120.00E-3)^{12}-1}{120.00E-3}$$

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'50×(1+120.00E-3)^2'
'50×(1+120.00E-3)^4'
'50×(1+120.00E-3)^6'
'50×(1+120.00E-3)^8'
'50×(1+120.00E-3)^10'
'50×(1+120.00E-3)^12'
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$$NFW=-18.942E0$$

Option B:

$$\frac{396}{10}\cdot\frac{\left(1+\frac{12}{100}\right)^{12}-1}{\frac{12}{100}}-\left(150\cdot\left(1+\frac{12}{100}\right)^{6}+150\cdot\left(1+\frac{12}{100}\right)^{12}\right)$$

$$NFW=75.202E0$$

Option C:

$$\frac{396}{10}\cdot\frac{\left(1+\frac{12}{100}\right)^{12}-1}{\frac{12}{100}}-\left(110\cdot\left(1+\frac{12}{100}\right)^{4}+110\cdot\left(1+\frac{12}{100}\right)^{8}+110\cdot\left(1+\frac{12}{100}\right)^{12}\right)$$

$$NFW=81.672E0$$

Option C maximizes future worth, so **choose C.**

b) Start with two lowest cost options, A and C.

Initial cost = 110 - 50 = 60, and -50 at year 2
UAB = 39.6 - 28.8 = 10.8

PWC = PWB
60 - 50(P/F, 12%, 2) = 10.8(P/A, 12%, 4)

$$60-50\cdot\frac{1}{\left(1+\frac{12}{100}\right)^2}=\frac{108}{10}\cdot\frac{\left(1+\frac{12}{100}\right)^4-1}{\frac{12}{100}\cdot\left(1+\frac{12}{100}\right)^4}$$

$$20.14E0=32.80E0$$

PWC < PWB, so choose C. Next compare C to option B.

Initial cost = 150 - 110 = 40, +150 at year 6, and -110 at year 4 and 8
UAB = 39.6 - 39.6 = 0

PWC = PWB
40 - 150(P/F, 12%, 6) - 110(P/F, 12%, 4) - 110(P/F, 12%, 8) = 0

$$40+150\cdot\frac{1}{\left(1+\frac{12}{100}\right)^6}-\left(110\cdot\frac{1}{\left(1+\frac{12}{100}\right)^4}+110\cdot\frac{1}{\left(1+\frac{12}{100}\right)^8}\right)$$

PWC > PWB, so choose C again.

Choose C.

b) Payback period = Cost/Uniform Annual Benefit

$$PBa=\frac{50}{28.8}$$
$$PBb=\frac{150}{39.6}$$
$$PBc=\frac{110}{39.6}$$

$$PBa=1.736E0$$
$$PBb=3.788E0$$
$$PBc=2.778E0$$

A has the shortest payback period, so **choose A.**

9-74 A low-carbon-steel machine part, operating in a corrosive atmosphere, lasts six years and costs $350 installed. If the part is treated for corrosion resistance, it will cost $500 installed. How long must the treated part last to be the preferred alternative, assuming 10% interest?

350(A/P, 10%, 6) = 500(A/P, 10%, n)

$$350\cdot\frac{\frac{1}{10}\cdot\left(1+\frac{1}{10}\right)^{6}}{\left(1+\frac{1}{10}\right)^{6}-1}=500\cdot\frac{\frac{1}{10}\cdot\left(1+\frac{1}{10}\right)^{n}}{\left(1+\frac{1}{10}\right)^{n}-1}$$

n=10.212E0

It needs to last for 10.2 years.

9-80 Analyze Problem 9–74 again with the following changes:

(a) What if the installed cost of the corrosion-treated part is $600?

(b) What if the untreated part will last only four years?

(c) What if the MARR is 12% annually?

(d) What if (a), (b), and (c) happen simultaneously?

a)

$$350\cdot\frac{\frac{1}{10}\cdot\left(1+\frac{1}{10}\right)^{6}}{\left(1+\frac{1}{10}\right)^{6}-1}=600\cdot\frac{\frac{1}{10}\cdot\left(1+\frac{1}{10}\right)^{n}}{\left(1+\frac{1}{10}\right)^{n}-1}$$

n=14.404E0

14.4 years

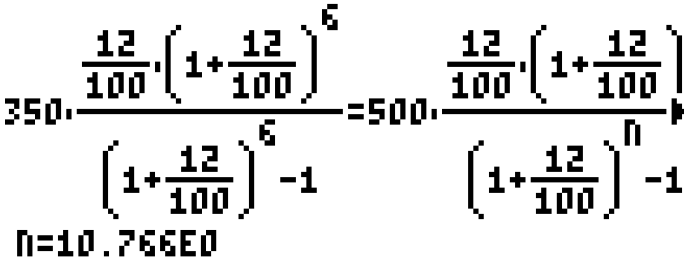
b)

$$350\cdot\frac{\frac{1}{10}\cdot\left(1+\frac{1}{10}\right)^{4}}{\left(1+\frac{1}{10}\right)^{4}-1}=500\cdot\frac{\frac{1}{10}\cdot\left(1+\frac{1}{10}\right)^{n}}{\left(1+\frac{1}{10}\right)^{n}-1}$$

n=6.3268E0

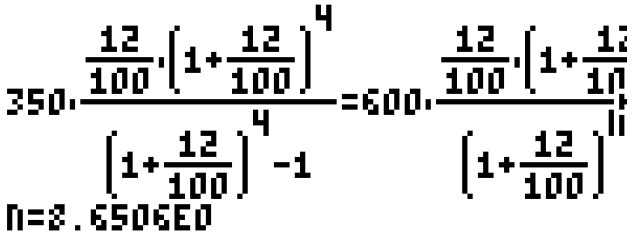
6.3 years

c)



10.8 years

d)



8.7 years