ECOR 3800A – ASSIGNMENT 2 SOLUTION
DUE DATE: Monday June 2, 2014 **TERM:** SUMMER 2014
TOTAL: **100 Marks**

QUESTION ONE (35 marks)

Given
MARR = 8% 5 year production process

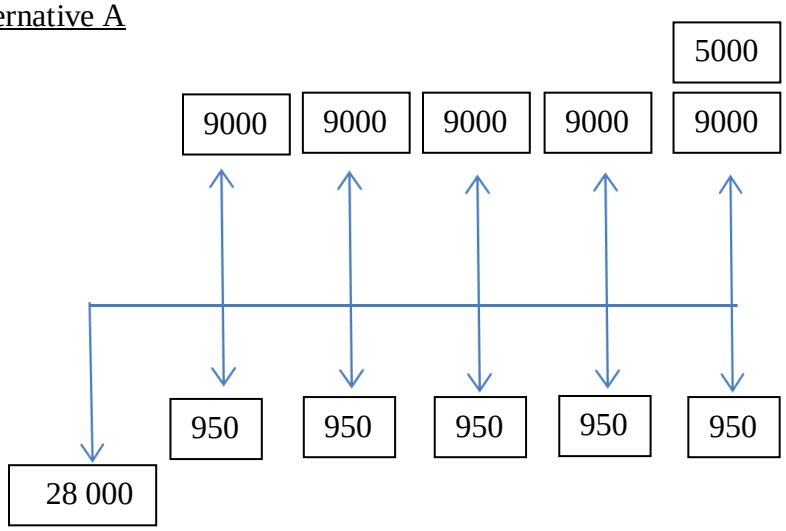
Alternative	Initial Cost	Annual Income	Annual Operation and Maintenance costs	Salvage value
A	$28,000	$9,000	$950	$5,000
B	$65,000	$16,000	$1,200	$7,500
C	$40,000	$12,500	$1,100	$6,500
D	$35,000	$9,000	$1,000	$2,200

a) Net Present Worth Calculations

Obtain P/A and P/F interest factors

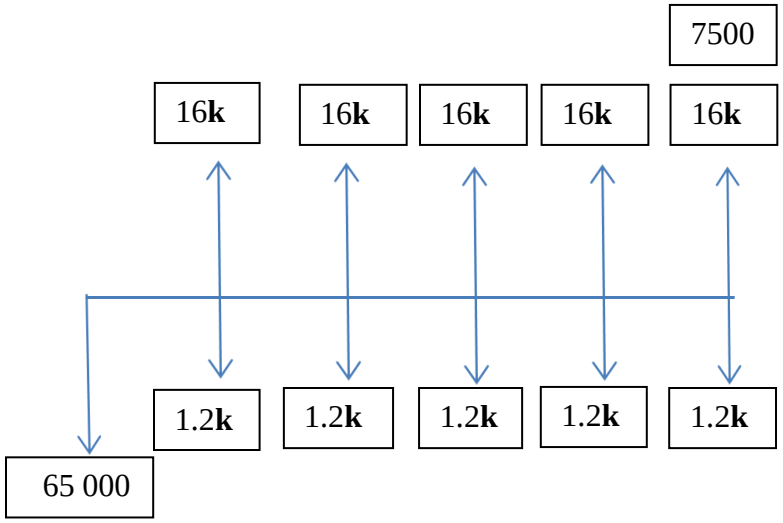
- For 8%, 5 years Interest factors for **P/A = 3.993** and for **P/F = 0.6806**

Alternative A



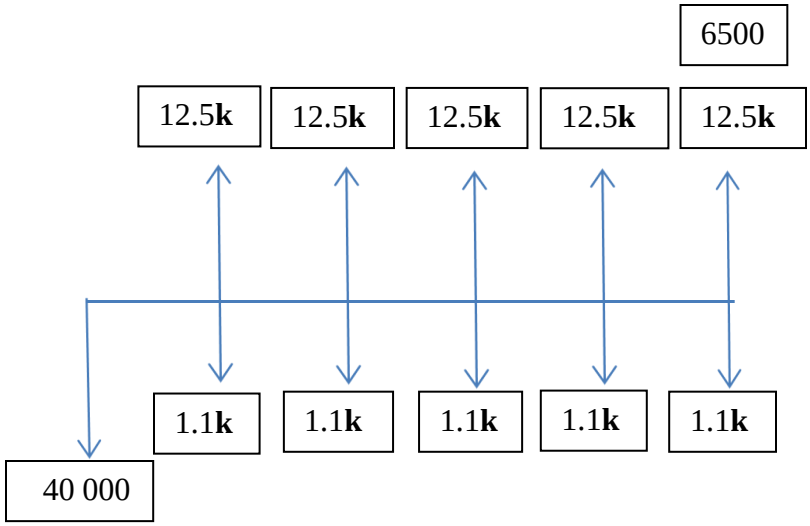
NPW = (- 28 000) + (9000 - 950) (P/A, 8%, 5) + 5000 (P/F, 8%, 5)
= (- 28 000) + (8050*3.993) + (5000*0.6806) = **$ 7546.65** **(2 marks)**

Alternative B



NPW = (- 65 000) + (16000 - 1200) (P/A, 8%, 5) + 7500 (P/F, 8%, 5)
= (- 65 000) + (14800*3.993) + (7500*0.6806) = **- $ 799.10 (Not feasible)** **(2 marks)**

Alternative C



NPW = (- 40 000) + (12500 - 1100) (P/A, 8%, 5) + 6500 (P/F, 8%, 5)
= (- 40 000) + (11400*3.993) + (6500*0.6806) = **$ 9944.10** **(2 marks)**

Alternative D (Cash flow diagram as well)

NPW = (- 35 000) + (9000 - 1000) (P/A, 8%, 5) + 2200 (P/F, 8%, 5)
= (- 35 000) + (8000*3.993) + (2200*0.6806) = **- $ 1558.68 (Not feasible)** **(2 marks)**

***NPW values without detailed calculations were docked one mark each.**

IRR Calculations

- The value of *i* for which NPW = 0
- Guess two values of *i*, which the IRR could fall in between. Calculate the NPW for each of those *i* values.
- If the NPW has a different sign at each of these *i* values, then the IRR is between those two values.
- Interpolate to find the actual IRR

Alternative A

@ 15%

NPW = (- 28 000) + (9000 - 950) (P/A, 15%, 5) + 5000 (P/F, 15%, 5)
= (- 28 000) + (8050*3.352) + (5000*0.4972) = **$ 1469.60**

@ 20%

NPW = (- 28 000) + (9000 - 950) (P/A, 20%, 5) + 5000 (P/F, 20%, 5)
= (- 28 000) + (8050*2.991) + (5000*0.4019) = - **$ 1912.95**

There is a sign change so the IRR falls between 15 and 20 %. So interpolate:

$$\frac{20\% - IRR}{20\% - 15\%} = \frac{-1912.95 - 0}{-1912.95 - 1469.60} \qquad \boldsymbol{IRR = 17.2\ \%}$$

(2 marks)

Alternative B

@ 5%

NPW = (- 65 000) + (16000 - 1200) (P/A, 5%, 5) + 7500 (P/F, 5%, 5)
= (- 65 000) + (14800*4.329) + (7500*0.7835) = **$ 4945.45**

@ 10%

NPW = (- 65 000) + (16000 - 1200) (P/A, 10%, 5) + 7500 (P/F, 10%, 5)
= (- 65 000) + (14800*3.791) + (7500*0.6209) = **- $ 4236.45**

There is a sign change so the IRR falls between 5 and 10 %. So interpolate:

$$\frac{10\% - IRR}{10\% - 5\%} = \frac{-4236.45 - 0}{-4236.45 - 4945.45} \qquad \boldsymbol{IRR = 7.7\ \%}$$

(2 marks)

Alternative C

@15%

NPW = (- 40 000) + (12500 - 1100) (P/A, 15%, 5) + 6500 (P/F, 15%, 5)
= (- 40 000) + (11400*3.352) + (6500*0.4972) = **$ 1444.60**

@ 20%

NPW = (- 40 000) + (12500 - 1100) (P/A, 20%, 5) + 6500 (P/F, 20%, 5)
= (- 40 000) + (11400*2.991) + (6500*0.4019) = **- $ 3290.25**

There is a sign change so the IRR falls between 15 and 20 %. So interpolate:

$$\frac{20\% - IRR}{20\% - 15\%} = \frac{-3290.25 - 0}{-3290.25 - 1444.60} \qquad \boldsymbol{IRR = 16.5\ \%}$$

(2 marks)

Alternative D

@ 5%

NPW = (- 35 000) + (9000 - 1000) (P/A, 5%, 5) + 2200 (P/F, 5%, 5)
= (- 35 000) + (8000*4.329) + (2200*0.7835) = **$1355.70**

@ 10%

NPW = (- 35 000) + (9000 - 1000) (P/A, 10%, 5) + 2200 (P/F, 10%, 5)
= (- 35 000) + (8000*3.791) + (2200*0.6209) = **- $ 3306.02**

There is a sign change so the IRR falls between 5 and 10 %. So interpolate:

$$\frac{10\% - IRR}{10\% - 5\%} = \frac{-3306.02 - 0}{-3290.25 - 1444.60} \qquad \boldsymbol{IRR = 6.4\ \%}$$

(2 marks)

***Half a mark was deducted for IRR values which were slightly off.**

b) Incremental IRR Analysis Calculations

Rank the feasible alternatives in order of increasing investment: **A, C**

Find IRR of moving from alternative A to C

A→ C [NPW of C @ *i*] - [NPW of A @ *i*] = 0. (Solve for the IRR, *i*) **(2 marks)**

Start with guesses of 10% and 15%

@10 %

NPW = - (40 000 – 28 000) + (11 400 – 8050) (P/A, 10%, 5) + (6500 - 1500) (P/F, 10%, 5)

NPW = - (12 000) + (3350*3.791) + (5000*0.6209) = **$ 1631.20**

@ 15%

NPW = - (40 000 – 28 000) + (11 400 – 8050) (P/A, 15%, 5) + (6500 - 1500) (P/F, 15%, 5)

NPW = - (12 000) + (3350*3.352) + (5000*0.4972) = **- $ 25.00**

There is a sign change so the IRR for going from A to C falls between 5 and 10 %. So interpolate:

$$\frac{15\% - IRR}{15\% - 10\%} = \frac{-25 - 0}{-25 - 1631.20} \qquad \boldsymbol{IRR = 14.9\,\%}$$

(2 marks)

Since **14.9% > MARR = 8%**, It is ok to choose **C over A** **(1 mark)**

Ranking: **C then A**. B and D are not feasible since their IRR is less than the MARR. C is the most feasible by the Incremental IRR method. **(1 mark)**

***Marks were deducted for answers without sample calculations or explanations of how those answers were arrived at.**

Benefit Cost Analysis Calculations

Alternative	Costs (C)	Benefits (B)	B/C
A	28 000 + (950*3.993) = **$ 31 793.35**	(9000*3.993) + (5000*0.6806) **= $ 39 340.00**	**1.237**
B	65 000 + (1200*3.993) = **$ 69 791.60**	(16 000* 3.993) + (7500*0.6806) = **$ 68 452.50**	**0.981**
C	40 000 + (1100*3.993) = **$ 44 392.30**	(12500 *3.993) + (6500*0.6806) = **$ 54 336. 40**	**1.224**
D	35 000 + (1000*3.993) = **$ 38 993.00**	(9000*3.993) + (1200*0.6806) = **$ 36 753.72**	**0.943**

(8 marks)… doesn't have to be in a table. Non feasible alternative calculations can be excluded.

For an incremental analysis, rank based on cost. C has a larger cost followed by A. Alternatives B and D are not feasible as their B/C ratio is less than 1.

Therefore, if C- A has a B/C ratio greater than 1, then C is more economically feasible than A.

B/C (C – A) $= \frac{\$\ 54\ 336.40 - \$\ 39\ 340.00}{\$\ 44\ 392.30 - \$\ 31\ 793.35} = \mathbf{1.19}$ **If excluded, minus 3 marks**

Since **1.19 > 1**, **C** is more feasible than A using the B/C ratio method. **(5 marks)**

***If the incremental B/C for C-A was calculated correctly without going through the full B/C calculations for A-D, full marks will be awarded.**

QUESTION TWO (25 Marks)

8 % compounded daily

P/A interest factor for daily compounding

Effective interest rate $= (1 + \frac{0.08}{365})^{365} - 1 = \mathbf{8.328}$ %

$= \left[\frac{(1+ 0.08328)^5 - 1}{0.08328\ (1+0.08328)^5}\right] = \mathbf{3.958}$

P/F interest factor for daily compounding

$= \left[\left(1 + \frac{0.08}{365}\right)^{-(5*365)}\right] = \mathbf{0.6703}$

(4 marks for correct interest factors used, and correct calculation of the effective interest rate)

NPW Calculations

A: - 28 000 + (9000 – 950)*(3.958) + (5000*0.6703) = **$ 7213.40** **(2 marks)**

B: - 65 000 + (16 000 – 1200)*(3.958) + (7500*0.6703) = **- $ 1394.35 (Not feasible)** **(2 marks)**

C: - 40 000 + (12 500 – 1100)*(3.958) + (6500*0.6703) = **$ 9478. 15** **(2 marks)**

D: - 35 000 + (9000 – 1000)*(3.958) + (2200*0.6703) = **- $ 1861. 34 (Not feasible)** **(2 marks)**

***Some form of working or sample calculation needs to be shown or else just 1 mark for the correct answer.**

Bonds **(6 marks for bond calculations)**

5 years = 20 quarters
i = 9/4 = 2.25% **(0.5 marks)**

A = 0.0225*($1000) = $22.50 **(0.5 marks)**

Effective interest rate, quarterly $=(1+\frac{0.08}{365})^{91.25}-1=\mathbf{2.02}\ \%$ **(2marks)**

*** (Using 8.328/4 will give an approximate answer) (-1 mark)**
*** (Using 90 days gives 1.99 %...assumes a year has 360 days) (-0.5 marks)**
*** (Using 2.25%) (-2 marks)**

Calculation of NPW of bonds

NPW = -1000 + 22.5 (P/A, 2.02%, 20) + 1000(P/F, 2.02, 20)

NPW = $-1000 + 22.5\left(\frac{(1+0.0202)^{20}-1}{0.0202(1+0.0202)^{20}}\right) + 1000\ (1.0202)^{-20}$

NPW = -1000 + 367.20 + 670.34 = **$37. 54** **(3 marks)**

Options **(6 marks for the options, 1.5 marks for each – excluding non feasible ones) + (1 mark for choosing the best)**

A+ Bonds, C + Bonds, A+C + Bonds, All bonds

A+ Bonds

$42 000 left over for bonds (42 bonds) + $ 7213.40 NPW
(42*37.54) + 7213.40 = **$ 8790.08**

C+ Bonds

$ 30 000 left over for bonds (30 bonds) + $ 9478.15 NPW
(30*37.54) + 9478.15 = **$ 10 604.35**

A +C + Bonds

$ 2000 left over for bonds (2 bonds) + $ 16 691. 55 NPW
(2*37.54) + 16 691.55 = **$16 766.63 (BEST)**

All Bonds
$70 000 worth of bonds (70 bonds)
70 * 37.54 = **$ 2627. 80**

Do Nothing is also an option, but marks will not be deducted for not including it.

***Question doesn't have to be solved the exact way as in the solution. As long as the correct answer is arrived at using a proper method, full marks will be awarded.**

QUESTION THREE (25 marks)

a) Defender

Year	Overhaul	O&M	Salvage
0	1500	-	7000 (Opportunity Cost)
1	0	2200	4550
2	0	3190	2957.50
3	0	4625.50	1922.38
4	0	6706.98	1249.55
5	0	9725.11	0

Challenger

Year	Purchase	O&M	Salvage
0	10 000	-	-
1		2000	7500
2		2800	5625
3		3920	4218.75
4		5488	3164.06
5		7683.20	2373.05
6		10 756.48	1779.80
7		15 059.07	1334.84

Interest factors needed

Year	P/F (10%)	A/P (10%)
1	0.9091	1.1000
2	0.8264	0.5762
3	0.7513	0.4021
4	0.6830	0.3155
5	0.6209	0.2638

Geometric Series factors (Costs) (P/G)

$$= \frac{[1-(1+G)^N(1+i)^{-N}]}{i-G}$$

Year	Defender (G =45%)	Challenger (G = 40%)
1	0.9091	0.9091
2	2.1074	2.0661
3	3.6871	3.5387

4	5.7693	5.4129
5	8.5141	7.7982
6	-	-

Defender

(Using the geometric series factors)

Year 1: EAW = (8500 – (4550-2200)*(0.9091))*1.100 **= $7000** **(3 marks)**
Year 2: EAW = ((2200*2.1074) + 8500 - (2957.5*0.8264))*0.5762 = **$6160.99** **(3 marks)**
Year 3: EAW = ((2200*3.6871) + 8500 – (1922.38*0.7513))*0.4021 = **$6098.79** **(3 marks)**
Year 4: EAW = ((2200*5.7693) + 8500 – (1249.55*0.6830))*0.3155 = **$6416.91** **(3 marks)**
Year 5: EAW = ((2200*8.5141) + 8500 – 0)*0.2638 = **$ 7183.54 (not needed)**

(1 mark for each component of the calculation)

Alternative (Without the geometric series factors)

Year 1: Same as above
Year 2: ((232.5*0.8264) + (2200*0.9091) +8500)*0.5762 = **$6160.82**
Year 3: ((2703.12*0.7513) + (2200*0.9091) + 8500 + (3190*0.8264))*0.4021 = **$6098.69**

Therefore the economic service life of the defender is 3 years **(1 mark)**

***Using 1500 instead of 8500 for calculations (-2 marks), that's if the method is correct and at least 4 calculations were done before stopping.**

Challenger

(Using the geometric series factors)

Year 1: EAW = (10 000 – ((7500 - 2000)*(0.9091)))*1.100 **= $5500** **(3 marks)**
Year 2: EAW = ((2000*2.0661) + 10 000 - (5625*0.8264))*0.5762 = **$5464.51** **(3 marks)**
Year 3: EAW = ((2000*3.5387) + 10 000 – (4218.75*0.7513))*0.4021 = **$5592.35** **(3 marks)**
Year 4: EAW = ((2000*5.4129) + 10 000 – (3164.06*0.6830))*0.3155 = **$5888.73 (not needed)**
Year 5: EAW = ((2000*7.7982) + 10 000 – (2375.05*0.6209))*0.2638 = **$ 6363.31 (not needed)**

(1 mark for each component of the calculation)

Alternative: (Without the geometric series factors)

Year 1: EAW = (10 000 – (5500*0.9091))*1.100 = **$5500**
Year 2: EAW = (10 000 – (5625*0.8264) + (2800*0.8264) + (2000*0.9091))*0.5762 = **$5464.46**
Year 3: EAW = (10 000 – (298.75*0.7513) + (2800*0.8264) + (2000*0.9091))*0.4021 = **$5592.27**

Therefore the economic service life of the challenger is 2 years. **(1 mark)**

The defender should be replaced now since **$6098.79 > $5464.51**
(2 marks for decision based on calculations)

QUESTION FOUR (15 Marks)

a) Demand – pull, cost push and quantity theory of money **(3marks)**

b) The average annual general inflation rate **(3 marks)**

$= (1 + 0.041)(1 + 0.049)(1 + 0.062) = 1.1597$

$= (1 + f)^3 = 1.1597$

$\boldsymbol{f = 5.063}$ %

***For just averaging the three rates (-2 marks)**

Conversion factors needed **(6 marks)**

- (P/F, 4.1%, 1) = 1.041^{-1} = **0.9606**
- (P/F, 4.9%, 1) (P/F, 4.1%, 1) = 0.9606*(1.049^{-1}) = **0.9157**
- (P/F, 6.2%,1) (P/F, 4.9%,1)(P/F,4.1%,1) = 0.9157* (1.062^{-1}) = **0.8622**

End of Year	Constant	Actual
0	-$60 000	**-$ 60 000**
1	$ 25 000	25 000/0.9606 = **$ 26 025. 40**
2	$ 25 000	25 000/0.9157 = **$ 27 301.52**
3	$ 35 000	35 000/0.8622 = **$ 40 593. 83**

***Using 5.06% in calculations above (- 2 marks)**
***Using just one rate for each year (-3 marks)**

c) Present worth at 8% (using constant dollars)
= - 60 000 + 25 000 (P/F, 8%, 1) + 25 000 (P/F, 8%, 2) + 35 000 (P/F, 8%, 3)
= - 60 000 + (25 000*0.9259) + (25 000*0.8573) + (35 000*0.7938) = **$12 363**
Since the PW > 0, the project is acceptable **(3 marks)**

Alternatively actual dollars can be used, but the market rate would have to be used in calculations: (1.08)*(1+f) – 1
One mark was deducted for not stating whether the project was acceptable and why