THE HONG KONG POLYTECHNIC UNIVERSITY
HONG KONG COMMUNITY COLLEGE

Subject Title : Engineering Economics **Subject Code** : CCN3134

Session : Semester Two, 2016/17

Numerical Answers

Question B1

(b)(i) To produce the 20th jet, it takes:
Z_{20} = 152.48 days

The required cost: 152.48 × \$23,000 = \$3,507,040.00

(b)(ii) <u>First THREE jets</u>:
Z_1 = 400 days
Z_2 = 320 days
Z_3 = 280.84 days
$Z_1+Z_2+Z_3$ = 1,000.84 days

The required cost: \$23,019,320.00

(b)(iii) <u>Average time for manufacturing the first 3 jets</u>:

1,000.84 days / 3 = 333.61 days

(b)(iv) Z_3 = 276 days → K = 393.10 days

(c) Composite index for 2017 = 108.48

Question B2

(a)(ii) For the \$100 annuity:
PV_0 = \$456.376

For the increasing uniform gradient, G = \$20:
PV_0 = \$20(P/G, 12%, 5)(P/F, 12%, 2) = \$101.9941

The present-equivalent value (PV) at time zero = \$354.38

(b)(i)

Effective Interest Rate i_{eff}	
i_1	= 12.68%
i_2	= 12.55%
i_3	= 12%

(b)(ii) FV_9 = \$8815.94

Question B3

(a)(i) Try 10%, PW(10%) = +$10,156
Try 15%, PW(15%) = –$4,015

IRR of the investment is given by linear interpolation as below:

$$i\% = 10\% + \frac{\$10,156(15\% - 10\%)}{\$10,156 - (-\$4,015)} = 13.58\% > \text{MARR of } 12\%$$

(a)(ii) PW(10%) of expenses = $100,000
FW(10%) of revenues = $177,412

ERR of the investment is given by:
$i\% = [\text{FW}(10\%) / \text{PW}(10\%)]^{1/5} - 1 = 12.15\%$

(a)(iii)

End of Year	Net Cash Flow (thousand)	Cumulative PW at 12% (thousand)
0	–100	–100
1	+20	–82.1429
2	+30	–58.2271
3	+20	–43.9915
4	+40	–18.5708
5	+40	+4.1263 (positive PW)

The discounted playback period is about 5 years.

(b)(i) Real interest rate: $i_r = \frac{1+0.1}{1+0.035} - 1 = 6.28\%$

(b)(ii) $A\$)_5$ = $12,210.20

(b)(iii) $(R\$)_5$ = $(A\$)_5$(P/F, 3.5%, 5) = $10,280.66

Question B4

(a)(i) <u>For Machine A</u>: (repeats 4 cycles)
$\text{PW}(12\%)_A$ = $4,947.41

<u>For Machine B</u>: (repeats 3 cycles)
$\text{PW}(12\%)_B$ = $29,465.34 > $\text{PW}(12\%)_A$

(a)(ii) <u>For Machine A</u>:
$\text{FW}(12\%)_A$ = [–$35,000(F/P, 12%, 3) + ($20,000 – $7,000)(F/A, 12%, 3)
+ $8,000](F/P, 12%, 1)
= $3,018.01

<u>For Machine B</u>:
$\text{FW}(12\%)_B$ = $22,734.06 > $\text{FW}(12\%)_A$

(b)

End of Year	Δ(X – Y)
0	–$5,500
1	+$1,250
2	+$1,250
3	+$1,250
4	+$1,250
5	+$1,250
6	+$500
7	+$500
8	+$500
9	+$500
10	+$500

$PW_{\Delta}(12\%) = \$28.78 > 0$

Question B5

(a)(i) The 200% declining-balance rate: R = 0.4

End of Year	Annual depreciation d_k	Book value B_k
1	$4,000	$6,000
2	$2,400	$3,600
3	$1,440	$2,160
4	$864	$1,296
5	$518.4	$777.6

(a)(ii)

End of Year	200% DB		SL	
	d_k	B_k	d_k	B_k
1	$4,000	$6,000	$2,000	$6,000
2	$2,400	$3,600	$1,500	$3,600
3	$1,440	$2,160	$1,200	$2,160
4	$864	$1,296	$1,080	$1,080
5	$518.4	$777.6	$1,080	$0

(DB switches over to SL from year 4)

(b)(i) 5-year recovery period for GDS is appropriate.

(b)(ii) Cost basis = $29,000

End of Year	Depreciation factors (MACRS – GDS table)	Depreciation amount
1	20%	$5,800
2	32%	$9,280
3	19.2%	$5,568
4	11.52%	$3,340.8
5	11.52%	$3,340.8
6	5.76%	$1,167.4

Question B6

(a)

End of Year	EUAC (Equivalent Uniform Annual Cost)	Economic Service Life
1	$13,200	
2	$6,914.4	
3	$4,825.2	
4	$4,217	
5	$3,853.56 (Min EUAC)	YES
6	$3,937	
7+	For higher years, the EUCA keeps increasing.	

(b)(ii) PW(benefits) = $1,977,577
PW(O&M) = $282,511
PW(Replacement) = $28,370

Conventional $(B - C)_{PW}$

$$= \frac{\$1{,}977{,}577}{\$1{,}200{,}000 + \$282{,}511 + \$28{,}370} = 1.31 > 1$$

(b)(iii) AW(Investment) = $212,400
AW(Replacement) = $5,021.49

Modified $(B - C)_{AW}$

$$= \frac{\$350{,}000 - \$50{,}000 - \$5{,}021.49}{\$212{,}400} = 1.39 > 1$$