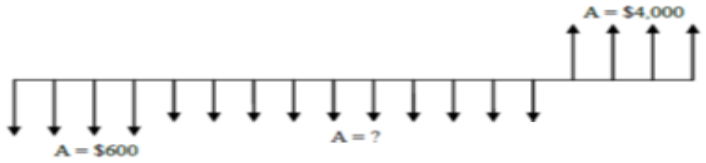
أستاذ المادة : د. محمد عبد اللطيف الشرنوبى

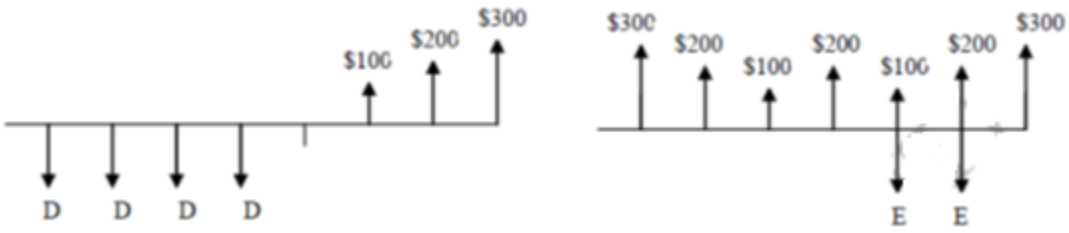
Benha University College of Engineering at Benha

Questions For Final Examination **Time :120 min.**
Subject: Engineerin Economy M1482 **June/6/ 2018**
Fourth Year Mechanical Engineering
Examiner:Dr.Mohamed Elsharnoby
Number of questions = 6 , number of pages = 2

1.A man wants to help provide a college education for his young daughter. He can afford toinvest $600/yr for the next 4 years, beginning on the girl's fourth birthday.He sishes to give his daughter $4000 on her 18th,19th,20th , and 21st birthdays, for atotal of $16,000. Assuming 5% interest, what uniform annual investment will he have to make on girl's 8th through 17th birthdays?



2- Compute the value of D&E in the diagram. At an interest rate of 10%.



3- Consider the following two mutually exclusive alternatives:

Alt.	A	B
cost	$100	$150
Uniform annual benefit	16	24
Useful life, in years	∞	20

Alternative B may be replaced with an identical item every 20 years at the same $150 cost and will have the same $24 uniform annual benefit. Using a 10% interest rate, and an annual cash flow analysis. determine which alternative should be selected.

4- Given the following data, use present worth analysis to find the best alternative, A, B, or C. Use 10% interest.

Alternative	A	B	C
Initial cost	$10,000	$15,000	$12,000
Annual benefit	6,000	10,000	5,000
Salvage value	1,000	-2,000	3,000
Useful life	2 years	3 years	4 years

Using the PW Method,, **Using the B/C ratio**

5.The operating costs of a small electric generating unit are expected to remain the same ($150,000 per year) if the effects of inflation are not considered. The best estimates indicate that the annual real (inflation-free) rate of interest will be 4% and the annual inflation e is 8%. If the generator is to be used 4 more years, what is the present equivalent of its operating costs? Solve using

i) Constant dollar analysis.

ii) Actual dollar analysis.

6)-A large heat treating oven (with appurtenances) for powder-coating automobile frames and large pieces of furniture was purchased for $60,000.The estimated operating costs, maintenance costs, and salvage values are shown below.

Year	Operating Cost,$	Maintenance Cost,$	Salvage Value, $
1	--15,000	-3000	35.000
2	-17,000	-3000	30.000
3	-19,000	-3000	25.0000
4	-21,000	-3000	20,000
5	-23,000	-3000	15,000

Assuming the interest rate is 10%, determine:

i) The economic service life and the associated annual worth
ii) Determine the marginal total cost of the oven.

GOOD LUCK

Note: A table of formulae are on the back of the questions if you need.

- ***Single Payment formulas:***
  Compound amount: $F = P(1+i)^n = P(F/P,i,n)$

  Present worth: $P = F(1+i)^{-n} = F(P/F,i,n)$

- ***Uniform Series Formulas:***
  Compound Amount: $F = A\{[(1+i)^n - 1]/i\} = A(F/A,i,n)$

  Sinking Fund: $A = F\{i/[(1+i)^n - 1]\} = F(A/F,i,n)$

  Capital Recovery $A = P\{[i(1+i)^n]/[(1+i)^n - 1] = P(A/P,i,n)$

  Present Worth: $P = A\{[(1+i)^n - 1]/[i(1+i)^n]\} = A(P/A,i,n)$

- ***Arithmetic Gradient Formulas:***
  Present Worth $P = G\{[(1+i)^n - i\,n - 1]/[i^2(1+i)^n]\} = G(P/G,i,n)$

  Uniform Series $A = G\{[(1+i)^n - i\,n - 1]/[i(1+i)^n - i]\} = G(A/G,i,n)$

- ***Geometric Gradient Formulas:***
  If $i \neq g$, $P = A\{[1 - (1+g)^n(1+i)^{-n}]/(i-g)\} = A(P/A,g,i,n)$

  If $i = g$, $P = A[n(1+i)^{-1}] = A(P/A,g,i,n)$

- ***Nominal interest rate per year***, ***r*** **: the annual interest rate without considering the effect of any compounding**

- **Effective interest rate per year, i_a:**
  $i_a = (1 + r/m)^m - 1 = (1+i)^m - 1$ with $i = r/m$

- ***Continuous compounding*****, :**
  r – one-period interest rate, n – number of periods

  $(P/F,r,n)^{inf} = e^{-rn}$

$(F/P,r,n)^{inf} = e^{rn}$

Benha University College of Engineering at Benha

Model Answer of the Final Exam

Elaborated by: Dr. Mohamed Elsharnoby

نموذج الاجابة المادة :اقتصاد هندسى م 1482 الفرقة الرابعة ميكانيكا

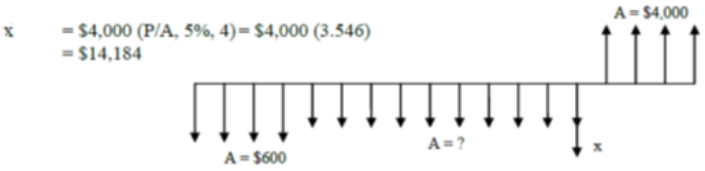
التاريخ الأربعاء 6 يونية 2018

أستاذ المادة : د. محمد عبد اللطيف الشرنوبى

problem1.

A man wants to help provide a college education for his young daughter. He can afford toinvest $600/yr for the next 4 years, beginning on the girl's fourth birthday.He sishes to give his daughter $4000 on her 18^{th},19^{th},20^{th} , and 21^{st} birthdays, for atotal of $16,000. Assuming 5% interest, what uniform annual investment will he have to make on girl's 8^{th} through 17^{th} birthdays?

Solution



x = $4,000 (P/A, 5%, 4) = $4,000 (3.546)
= $14,184

F = $600 (F/A, 5%, 4) (F/P, 5%, 10)
= $600 (4.310) (1.629)
= $4,212.59

x - F = $14,184 - $4,212.59
= $9,971.41

The series of ten deposits must be:

A = $9,971.11 (A/F, 5%, 10) = $9,971.11 (0.0745)
= $792.73

problem2-

Compute the value of D&E in the diagram. At an interest rate of 10%.

Solution

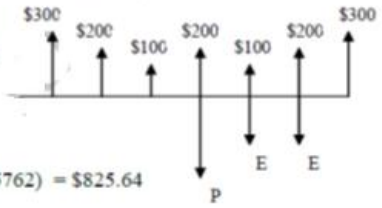
(A)-

P = $200 + $100 (P/A, 10%, 3) + $100 (P/G, 10%, 3) + $300 (F/P, 10%, 3) + $200 (F/P, 10%, 2) + $100 (F/P, 10%, 1)

= $200 + $100 (2.487) + $100 (2.329) + $300 (1.331) + $200 (1.210) + $100 (1.100)

= $1,432.90

E = $1,432.90 (A/P, 10%, 2) = $1,432.90 (0.5762) = $825.64

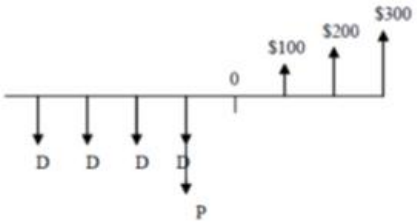


(B)-

Present Worth of gradient series:

P = $100 (P/G, 10%, 4) = $100 (4.378)
= $437.80

D = $437.80 (A/F, 10%, 4)
= $4.7.80 (0.2155)
= $94.35.



3- Consider the following two mutually exclusive alternatives:

Alt.	A	B
cost	$100	$150
Uniform annual benefit	16	24
Useful life, in years	∞	20

Alternative B may be replaced with an identical item every 20 years at the same $150 cost and will have the same $24 uniform annual benefit. Using a 10% interest rate, and an annual cash flow analysis, determine which alternative should be selected.

Solution:

Alternative A

EUAB – EUAC (for an inf. period) = $16 - $100 (A/P, 10%, ∞)
= $16 - $100 (0.10)
= +$6.00

Alternative B

EUAB – EUAC (for 20 yr. period) = $24 - $150 (A/P, 10%, 20)
= $24 - $150 (0.1175)
= +$6.38

Choose Alternative B.

4- Given the following data, use present worth analysis to find the best alternative, A, B, or C. Use 10% interest.

Alternative	A	B	C
Initial cost	$10,000	$15,000	$12,000
Annual benefit	6,000	10,000	5,000
Salvage value	1,000	-2,000	3,000
Useful life	2 years	3 years	4 years

Using the PW Method,, **Using the B/C ratio**

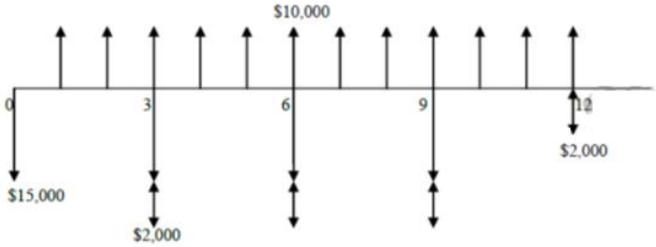
Solution

Using the PW Method,,

Alternative A

NPW = $6,000 (P/A, 10%, 12) + $1,000 (P/G, 10%, 12) - $10,000 –
($10,000 - $1,000) [(P/F, 10%, 2) + (P/F, 10%, 4) + (P/F, 10%, 6)
+ (P/F, 10%, 8) + (P/F, 10%, 10)]
= $40,884 + $319 - $10,000 - $26,331
= $4,872

Alternative B



NPW = $10,000 (P/A, 10%, 12) - $2,000 (P/F, 10%, 12) - $15,000 –
($15,000 + $2,000)[(P/F, 10%, 3) + (P/F, 10%, 6) + (P/F, 10%, 9)]
= $68,140 - $637 - $15,000 - $29,578
= $22,925

Alternative C

NPW = $5,000 (P/A, 10%, 12) + $3,000 (P/F, 10%, 12) - $12,000 –
($12,000 - $3,000) [(P/F, 10%, 4) + (P/F, 10%, 8)]
= $34,070 + $956 - $12,000 - $10,345
= $12,681

Choose Alternative B.

Benefit to cost ratio

10.0%

	Single Payment		Equal Payment Series				Gradient Series		
N	Compound Amount Factor (F/P,i,N)	Present Worth Factor (P/F,i,N)	Compound Amount Factor (F/A,i,N)	Sinking Fund Factor (A/F,i,N)	Present Worth Factor (P/A,i,N)	Capital Recovery Factor (A/P,i,N)	Gradient Uniform Series (A/G,i,N)	Gradient Present Worth (P/G,i,N)	N
1	1.1000	0.9091	1.0000	1.0000	0.9091	1.1000	0.0000	0.0000	1
2	1.2100	0.8264	2.1000	0.4762	1.7355	0.5762	0.4762	0.8264	2
3	1.3310	0.7513	3.3100	0.3021	2.4869	0.4021	0.9366	2.3291	3
4	1.4641	0.6830	4.6410	0.2155	3.1699	0.3155	1.3812	4.3781	4
5	1.6105	0.6209	6.1051	0.1638	3.7908	0.2638	1.8101	6.8618	5

For alternative A

$EUAC_A$ = 10000x(A/P,10%,2) = 10000x0.5762 =5762

$EUAB_A$ = 6000 + 1000 (A/F,10%,2) = 6000 +1000x0.4762 =6476.2

$EUAB_A/EUAC_A$= 6476.2/5762=1.12395

For alternative B

$EUAC_B$ = 15000x(A/P,10%,3) + 2000 (A/F,10%,3) = 15000x0.4021+2000x0.3021 =6031.5+604.2=6635.7

$EUAB_B$ = 10000

$EUAB_B/EUAC_B$= 10000/6635.7 =1.507

For alternative C

$EUAC_C$ = 12000x(A/P,10%,4) = 12000x0.3155 =3786

$EUAB_C$ = 5000 + 3000 (A/F,10%,4) = 5000 +3000x0.2155 =5646.5

$EUAB_C/EUAC_C$ = 5646.5/3786 =1.4914

Choose B

5.The operating costs of a small electric generating unit are expected to remain the same ($150,000 per year) if the effects of inflation are not considered. The best estimates indicate that the annual real (inflation-free) rate of interest will be 4% and the annual inflation e is 8%. If the generator is to be used 4 more years, what is the present equivalent of its operating costs? Solve using

i) Constant dollar analysis.

ii) Actual dollar analysis.

Problem # 5

Using constant

P = A(P/A, 4%,4)

P = 150000 * 3.6299 = $ 544485

Using Actual dollar

i = Exact: $i = i' + f + i' f$ **= 12.32 %**

If $i \neq g$, P = $A\{[1-(1+g)^n(1+i)^{-n}]/(i-g)\}$ = A (P/A,g,i,n)

If $i \neq f$, P = $A(1+f)\{[1-(1+f)^n(1+i)^{-n}]/(i-f)\}$ = A (P/A,f,i,n)

P = 150000 *1.08 * 3.361 = $ 544484.

6)-A large heat treating oven (with appurtenances) for powder-coating automobile frames and large pieces of furniture was purchased for $60,000.The estimated operating costs, maintenance costs, and salvage values are shown below.

Year	Operating Cost,$	Maintenance Cost,$	Salvage Value, $
1	--15,000	-3000	35.000
2	-17,000	-3000	30.000
3	-19,000	-3000	25.0000
4	-21,000	-3000	20,000
5	-23,000	-3000	15,000

Assuming the interest rate is 10%, determine:

i) The economic service life and the associated annual worth
ii) Determine the marginal total cost of the oven.

Year	Market value	Loss in Market value	Foregone interest	Operating Cost,$	Maintenance Cost,$	Salvage Value, $	Total Recovery Cost
0	$60000						
1	35.000	-$25000	-$6000	--15,000	-3000	35.000	-$49000
2	30.000	-$5000	-$3500	-17,000	-3000	30.000	-$28500
3	25.0000	-$5000	-$3000	-19,000	-3000	25.0000	--$30000
4	20,000	-$5000	-$2500	-21,000	-3000	20,000	-$31500
5	15,000	-$5000	-$2000	-23,000	-3000	15,000	--$33000

The life cost of one year is 49000

The EUAC for two years is = (49000+28500/(1+i))*(A/P,10%,2)= (49000+28500/(1+i))*5762= (49000 +25909)*0.5762=-$43162.6

The EUAC for three years is = (49000+28500/(1+i)+30000*$(1+i)^{-2}$)* A/P,10%,3)= (49000 +25909+ 24793.3)*0.4021=-$40090.3

The EUAC for four years is = (49000+28500/(1+i)+30000*$(1+i)^{-2}$)*+31500*$(1+i)^{-3}$)(A/P,10%,4)= (49000 +25909+ 24793.3+23666.3)*0.3155=-$38922

The EUAC for five years is = (49000+28500/(1+i)+30000*$(1+i)^{-2}$)*+31500*$(1+i)^{-3}$+33000*$(1+i)^{-4}$)(A/P,10%,5)= (49000 +25909+24793.3 +23666.3+22539.4)*0.2638=-$38409

Economic life is 5 years

Year	Market value	EUAC of Capital recovery	Foregone interest	Operating Cost,$	Maintenance Cost,$	Salvage Value, $	Total Recovery Cost
0	$60000						
1	35.000	-$25000	-$6000	--15,000	-3000	35.000	-$49000
2	30.000	-$5000	-$3500	-17,000	-3000	30.000	-$28500
3	25.0000	-$5000	-$3000	-19,000	-3000	25.0000	--$30000
4	20,000	-$5000	-$2500	-21,000	-3000	20,000	-$31500
5	15,000	-$5000	-$2000	-23,000	-3000	15,000	--$33000

For one year

EUAC of Capital recovery for one year = -$60000*(A/P,10%,1) +$ 35000*(A/F,10%,1)

=-$ 66000+$ 35000 =-$31000

EUAC of Capital recovery for two years =-$ 60000*(A/P,10%,2) + $ 30000*(A/F,10%,2)

=-$ 60000*0.5762 +$ 30000* 0.476 =-$ 20292

EUAC of Capital recovery for three years = -$60000*(A/P,10%,3) +$ 25000*(A/F,10%,3)

=-$ 60000*0.4021 +$25000* 0.3021=-$16573.5

EUAC of Capital recovery for four years =-$ 60000*(A/P,10%,4) +$ 20000*(A/F,10%,4)

=-$ 60000*0.3155 +$20000* 0.2155=-$14620

EUAC of Capital recovery for five years =-$ 60000*(A/P,10%,5) +$ 15000*(A/F,10%,5)

=-$ 60000*0..2638 +$15000* 0.1638 =-$13371

Year	Market value	EUAC of Capital recovery	Operating Cost,$	Maintenance Cost,$	Total EUAC
0	$60000				
1	35.000	-$31000	--15,000	-3000	-$49000
2	30.000	-$20292	-17,000	-3000	-$40292
3	25.0000	-$16573.5	-19,000	-3000	--$38573
4	20,000	-$14620	-21,000	-3000	-$38620
5	15,000	-$13371	-23,000	-3000	--$39391

Year	Market value	EUAC of Capital recovery	EUAC OP cost,$	Maintenance Cost,$	Total EUAC
0	$60000				
1	35.000	-$31000	--15,000	-3000	-$49000
2	30.000	-$20292	-15,932.4	-3000	-$39224.4
3	25.0000	-$16573.5	-16873.2	-3000	--$36446.7
4	20,000	-$14620	-17636	-3000	-$35256
5	15,000	-$13371	-18620	-3000	--$34991

Economic life is 5 years