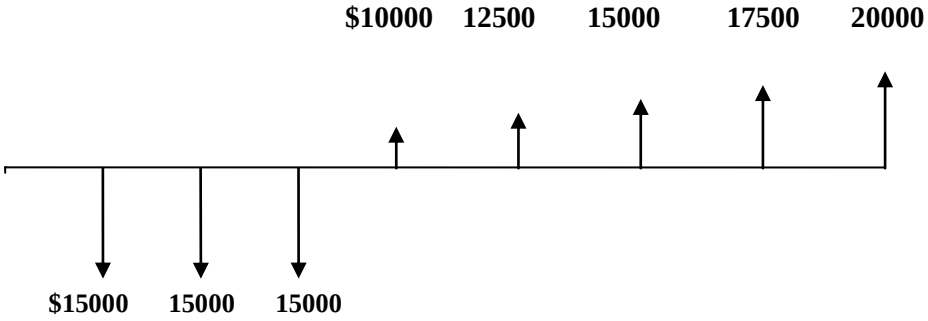
نموذج أسئلة و اجابة مادة الاقتصاد الهندسى م561

أستاذ المادة : د. محمد عبد اللطيف الشرنوبى

Benha University College of Engineering at Benha
Questions For Final Examination Time :120 min.
Subject: Engineerin Economy M 561 January/23/ 2019
Fifth year Structural and production engineering
Examiner:Dr.Moh amed Elsharnoby

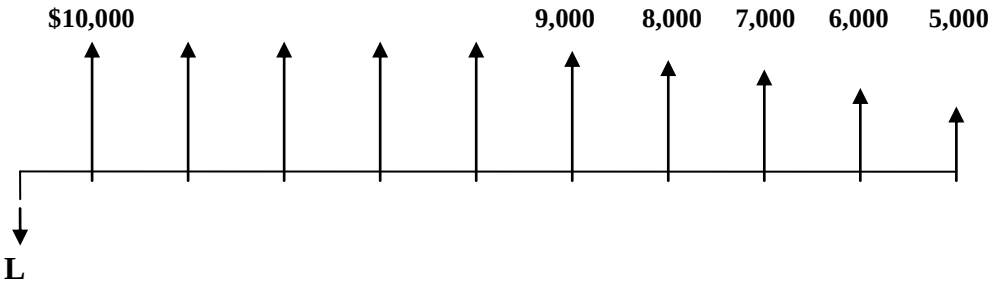
1. An investor can make three year-end payments of $15,000, which generates receipts of $10,000 at the end of year 4, that will increase annually by $2500 for the following 4 years. If the investor can earn a rate of return of 10 percent on alternative 8-year investments, is this alternative attractive?



(8 points)

2-If you get a loan (L)from a bank which should be repaid as a series of payments (shown in figure)- $10,000 at the end of each of the first five years, $9,000, at the end of the6th year, $8,000, at the end of the 7th year, $7,000, at the end of the 8th year, $6,000, at the end of the 9th and $5,000, at the end of the 10th . What is the amount of the loan you obtained if the bank gets 10% interest rate:

i) compounded annually, ii) compounded monthly, iii) compounded continuously?



3- Three mutually exclusive alternative public works projects are currently under consideration. Their respective costs and benefits are included in th table below. Each of the projects has a useful life of 50 years, and the interest rate is 10% per year. Which if any of these projects should be selected?

	Alternative		
	A	**B**	**C**
Capital investment	**$8,500,000**	**$10,000,000**	**$12,000,000**
Annual oper. &maint costs	**750,000**	**725,000**	**700,000**
Salvage value	**1,250,000**	**1,750,000**	**2,000,000**
Annual benefits	**2,150,000**	**2,265,000**	**2,500,000**

4)-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.**

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5. Consider the following two investment alternatives.

	Alternative A	Alternative B
Initial Investment	**$20,000**	**$ 10,000**
Service Life	**5 years**	**5 years**
Salvage Value	**0**	**0**
Depreciation method	**SL**	**SL**

Estimated operating costs and revenues (profits).

		End of Year				
		1	2	3	4	5
Alternative A	Operating cost	$ 10,000	$ 10,500	$ 11,000	$ 12,000	$ 14,000
	Revenue(profit)	15,000	15,900	17,000	17,500	9,000
Alternative B	Operating cost	$ 1,200	$ 1,000	$ 1,500	$ 1,300	$ 1,200
	Revenue(profit)	4,200	4,000	4,500	4,300	4,200

If the tax rate is 30%
For the actual dollar cash flow given above find the after tax ROR for alternative B when an average inflation rate of 7% is considered.
Which alternative is more attractive to undertake when the effective tax rate is only considered (no inflation) ? (12 points)

6) The annual maintenance costs of an electric pump this year are estimated to be $1,800. Since the level of maintenance is expected to be the same in the future, these costs will be constant, assuming no inflation. If the pump's life is predicted to be 13 years, find the present equivalent of its maintenance costs when the annual inflation rate is 9% and the annual market rate is 12%. Solve using:

i) Geometric gradient.
ii) Constant-dollar analysis.

G O O D L U C K

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

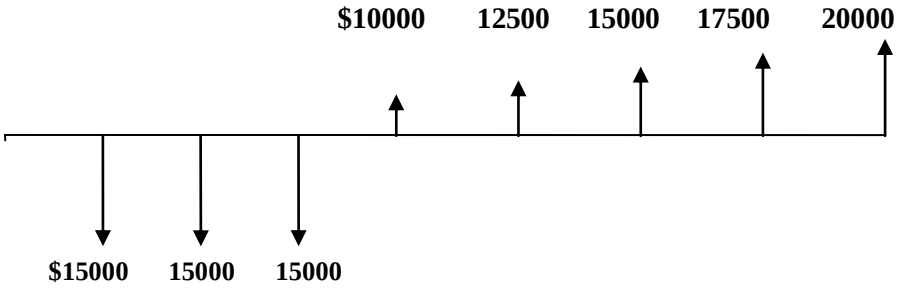
نموذج الاجابة المادة :اقتصاد هندسى م 561 الغرقة الخامسة جميع التخصصات

التاريخ الأربعاء 23 يناير 2019

أستاذ المادة : د. محمد عبد اللطيف الشرنوبى

PROPLEM 1

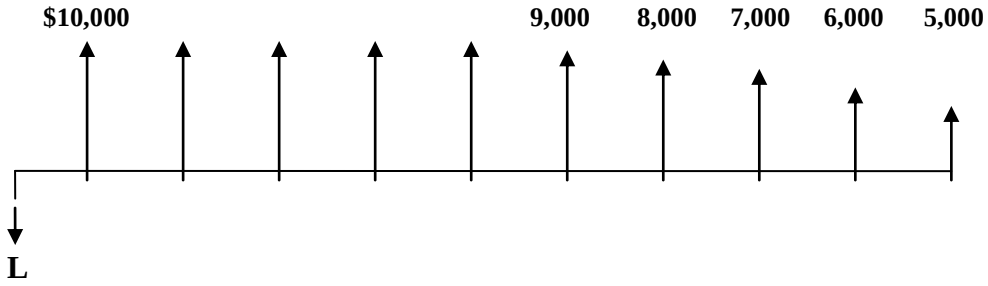
1. An investor can make three year-end payments of $15,000, which generates receipts of $10,000 at the end of year 4, that will increase annually by $2500 for the following 4 years. If the investor can earn a rate of return of 10 percent on alternative 8-year investments, is this alternative attractive?



NPW = -15000(P/A,10%,3) + $\left[10000(P/A,10\%,5) + 2500(P/G,10\%,5)\right](P/F,10\%,3)$,

=-15000*2.4869+(10000*3.7908+2500*6.8618)*0.7513
NPW= -37303.5 +(37908+17154.5)*0.7513= $ 4135
Then the rate of return is greater than 10%
this alternative is attractive

2-If you get a loan (L)from a bank which should be repaid as a series of payments (shown in figure)- $10,000 at the end of each of the first five years, $9,000, at the end of the6th year, $8,000, at the end of the 7th year, $7,000, at the end of the 8th year, $6,000, at the end of the 9th and $5,000, at the end of the 10th . What is the amount of the loan you obtained if the bank gets 10% interest rate:
i) compounded annually, ii) compounded monthly, iii) compounded continuously?



i) compounded annually,

$$L = 10000(P/A,10\%,5) + \left[9000(P/A,10\%,5) - 1000(P/G,10\%,5)\right](P/F,10\%,5)$$

L = 10000*3.7908+(9000*3.7908-1000*6.8618)*0.6209
L= 37908 + (34117.2-6861.8)*0.6209
L= $ 54830.88

ii) Compound monthly
Use the formula to find $(P/A,i_{eff}\%,5)$, $(P/G,i_{eff}\%,5)$., $(P/F,i_{eff}\%,5)$.
$I_{eff}=(1+10/12)^{12}-1=0.104713$

Present Worth:P = A{[(1+i)^n – 1]/[i(1+i)^n]} =A (P/A,i,n)
(P/A,i,n) = 3.74558
Present Worth P = G {[(1+i)^n – i n – 1]/[i^2(1+i)^n]} = G (P/G,i,n)
(P/G,i,n) = 6.74834

Present worth: P = F (1+i)$^{-n}$ = F (P/F,i,n)
(P/F,i,n) = 0.607788
L = 10000*3.74558+(9000*3.74558-1000*6.748343)*0.60778859
L= 37455.8 + (33710.2-6748.3)*0.6077886
L= $ 53842.9

iii) compounded continuously
i_{eff} = 0.1051709
Present Worth:P = A{[(1+i)^n – 1]/[i(1+i)^n]} =A (P/A,i,n)
(P/A,i,n) = 3.741238

Present Worth P = G {[(1+i)^n – i n – 1]/[i^2(1+i)^n]} = G (P/G,i,n)
(P/G,i,n) = 6.737457

Present worth: P = F (1+i)$^{-n}$ = F (P/F,i,n)
(P/F,i,n) = 0.60653
L = 10000*3.741238+(9000*3.741238-1000*6.737457)*0.60653
L= 37412.8 + (33671.1-6737.5)*0.60653
L= $ 53748.8

3- Three mutually exclusive alternative public works projects are currently under consideration. Their respective costs and benefits are included in th table below. Each of the projects has a useful life of 50 years, and the interest rate is 10% per year. Which if any of these projects should be selected?

	Alternative		
	A	**B**	**C**
Capital investment	**$8,500,000**	**$10,000,000**	**$12,000,000**
Annual oper. &maint costs	**750,000**	**725,000**	**700,000**
Salvage value	**1,250,000**	**1,750,000**	**2,000,000**
Annual benefits	**2,150,000**	**2,265,000**	**2,500,000**

3-We shall calculate the equivalent annual cos and benefits of each
For alternative A
EACA=8,500,000x(A/P,10%,50)+750,000 =8,500,000x 0.1009+**750,000=$1,607,650**
EABA=1,250,000x(A/F,10%,50)+2.150,000=1,250,000x 0.0009+**2.150,000=$2151125**
Benfit/cost ratio of A =2151125/ 1,607,650 =1.3380555

For alternative B
EACB=10,000,000x(A/P,10%,50)+750,000 =10,000,000x 0.1009+**725,000=$1734000**
EABA=1,250,000x(A/F,10%,50)+2.150,000=1,750,000x 0.0009+**2.265,000=$2266575**
Benfit/cost ratio of B =2266575/ 1734000=1.3071367
For alternative C
EACC=12,000,000x(A/P,10%,50)+700,000 =12,000,000x 0.1009+**700,000=$1,910,800**
EABC=2,000,000x(A/F,10%,50)+2.500,000=2,000,000x 0.0009+**2.500,000=$2501800**
Benfit/cost ratio of C =2501800/ 1,910,800=1.3092945
The best alternative is A

4)-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.**

Solution

The total Marginal cost

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

(10 points)

5. Consider the following two investment alternatives.

	Alternative A	Alternative B
Initial Investment	**$20,000**	**$ 10,000**
Service Life	**5 years**	**5 years**
Salvage Value	**0**	**0**
Depreciation method	**SL**	**SL**

Estimated operating costs and revenues (profits).

		End of Year				
		1	2	3	4	5
Alternative A	Operating cost	$ 10,000	$ 10,500	$ 11,000	$ 12,000	$ 14,000
	Revenue(profit)	15,000	15,900	17,000	17,500	9,000
Alternative B	Operating cost	$ 1,200	$ 1,000	$ 1,500	$ 1,300	$ 1,200
	Revenue(profit)	4,200	4,000	4,500	4,300	4,200

If the tax rate is 30%

For the actual dollar cash flow given above find the after tax ROR for alternative B when an average inflation rate of 7% is considered.

Which alternative is more attractive to undertake when the effective tax rate is only considered (no inflation) ? **(12 points)**

Solution

We construct the following table for alternative B.

The net cash received should be the difference between the annual revenue and operating cost

Using the straight line depreciation

SL depreciation = (10000)/5 = $2000 per year.

Constructing the table representing the cash flow before and after taxes as the following:

Year	CF before taxes	SL Depr.	Taxable Inc.	Tax (30%)	CF after taxes
	(a)	(b)	(c) = (a) – (b)	(d) = -40%(c)	(a) + (d)
0	-$10,000				-$10,000
1	3000	2000	1000	-300	2700
2	3000	2000	1000	-300	2700

3	**3000**	**2000**	**1000**	**-300**	**2700**
4	**3000**	**2000**	**1000**	**-300**	**2700**
5	**3000**	**2000**	**1000**	**-300**	**2700**

To determine the IRR ,it is so easy here as the annual receipts are constant so we have (A/P,i,5) =2700/10000 = 0.27. From tables (A/P,11,5) = 0.2706, (A/P,10,5) = 0.2638
Then IRR after tax =10.9%
Before Tax ROR I = 15.3%
After tax and include 6% inflation rate is considered then the real interest rate is

$i' = \frac{i-f}{1+f} = 4.62\%$

We construct the following table for alternative A.
The net cash received should be the difference between the annual revenue and operating cost
Using the straight line depreciation
SL depreciation = (20000)/5 = $4000 per year.
Constructing the table representing the cash flow before and after taxes as the following:

Year	**CF before taxes**	**SL Depr.**	**Taxable Inc.**	**Tax (40%)**	**CF after taxes**
	(a)	**(b)**	**(c) = (a) – (b)**	**(d) = -30%(c)**	**(a) + (d)**
0	**-$20,000**				**-$20,000**
1	**5000**	**4000**	**1000**	**-300**	**4700**
2	**5400**	**4000**	**1400**	**-420**	**4980**
3	**6000**	**4000**	**2000**	**-600**	**5400**
4	**5500**	**4000**	**1500**	**-450**	**5050**
5	**5000**	**4000**	**1000**	**-300**	**4700**

To determine the IRR ,it is so obvious that the maximum net profit after tax is 5400 , so the $(A/P,i,5) \prec 0.27$ consequently $i \prec 10.9\%$. Choose alternative B.

6) The annual maintenance costs of an electric pump this year are estimated to be $1,800. Since the level of maintenance is expected to be the same in the future, these costs will be constant, assuming no inflation. If the pump's life is predicted to be 13 years, find the present equivalent of its maintenance costs when the annual inflation rate is 9% and the annual market rate is 12%. Solve using:

i) Geometric gradient.
ii) Constant-dollar analysis.

Solution

6- Using the geometric gradient with real factor = (1+i)/(1+f)

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

P = 1800*9.9132- = -17843.8 = 1800*1.12=$ 19450

i) Constant dollar

i' = (i-f)/(1+f) = 2.75229%

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

P = 1800 *(0.42327)/(0.0275229*1.42327)=1800*10.8054 =19450