Tuesday, November 25, 2014-2:00 pm to 3:15 pm-5:00 pm to 6:15 pm

Name:……………………………………………………..

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Note: Formulae and Tables are provided at the end of the booklet.

Problem I. 26%

An investment company is considering building a dormitory comprising 150 studios. The land cost is \$1,000,000 and the building cost is \$2,500,000. The study period is 5 years and at the end of the study period, the full land cost and 70% of the building cost can be recovered. Assume an interest rate of 6% compounded monthly.

a) Determine the monthly charge per studio that should be charged to break even in this investment. (6%)

b) Yearly renovation cost is \$50,000 and increases by 5% every year. Determine the monthly charge per studio that should be charged to cover this renovation cost. (10%)

c) The upkeep costs are equal to \$7,000 per month and increase by \$150 per month. Determine the minimum monthly charge per studio that should be charged to recover only the upkeep cost, if the occupancy is 10 studios the first month and increases by 2 studios every month. (10%)

Solution

a) $CR = (I - S)(A/P, i, N) + i\,S$ where:

i=effective monthly interest rate=$\frac{6}{12} = 0.5$ % and N=5x12=60 months

I=1,000,000+2,500,000=3,500,000

S=1,000,000+0.7(2,500,000) =2,750,000

$CR = (3{,}500{,}000 - 2{,}750{,}000)(A/P, 0.5\%, 60) + (0.005)(2{,}750{,}000)$

$CR = (3{,}500{,}000 - 2{,}750{,}000)(0.0193)$ + (0.005) (2,750,000) =\$ 28,225 per month

The monthly charge per studio is 28,225/150=\$188 per month per studio.

Discussion:

Alternative Solution

$CR = (I - S)(A/P, i, N) + i\,S$ *where:*

i=effective yearly rate=$\left(1+\frac{0.06}{12}\right)^{12}-1$ *=6.1678% and N=5 years*

I=1,000,000+2,500,000=3,500,000

S=1,000,000+0.7(2,500,000) =2,750,000

$CR = (3{,}500{,}000 - 2{,}750{,}000)(A/P, 6.1678\%, 5) + (0.061678)(2{,}750{,}000)$

$CR =$ *\$348,474 per year.*

A per month per studio=348,474 (A/F, 0.5%,12)/150=\$188 per month per studio

b) $A = P(A/P, i,\ N)$ where A is the equivalent renovation monthly cost, i is the effective monthly interest rate and N is the service life in months.
P is the present worth of renovation works: $P = A1(P/A1, g, i, N)$ where:
A_1=50,000; g=5%; N=5 years.
i is the effective interest rate yearly, that is $i = \left(1+\frac{r}{M}\right)^{C} - 1 = \left(1+\frac{0.06}{12}\right)^{12} - 1$
i=6.1678%
$P = 50{,}000(P/A1, 5\%, 6.1678\%, 5) = (50{,}000)(4.6071)$=230,355
A=230,355 (A/P, 0.5%, 60)=(230,355) (0.0193)=\$4,446 per month

The monthly charge per studio is 4,446/150=\$30 per month per studio

c) The equivalent monthly upkeep cost is: A=7,000+150 (A/G,0.5%,60)
Let C be the equivalent monthly cost per studio:
A=10 C+ 2 C (A/G,0.5%,60)
We equate A in both equations:
7,000+150(A/G, 0.5%, 60) = (10+2 (A/G, 0.5%, 60)) C
7,000+ (150) (28.0064) = (10+2 (28.0064)) C
C=11,201/66 =**\$170 per month per studio**

Problem II. 26%

You have just purchased a new machine A that costs \$260,000 with a useful life of 8 years. At that time, its salvage value is also estimated to be \$40,000. Assume MARR=10% compounded yearly.

a) What is the capital recovery cost for this investment? (6%)
b) You have the option to purchase a more expensive machine B that can serve you for infinity. How much would you be willing to pay for this machine B so that it is more economical than machine A? (6%)
c) You are given that the operating costs are expected to be equal to \$10,000 per year and the revenues are \$ 55,000 per year.
Calculate the exact simple payback period. (6%)

d) You are given that the operating costs are expected to be equal to $10,000 per year and the revenues are $ 55,000 per year. What should be the Salvage value so that the discounted payback period is exactly 8 years? (8%)

Solution

a) CR=(260,000-40,000)(A/P,10%,8)+0.1 x 40,000
CR=(260,000-40,000)(0.1874)+0.1(40,000)=**$45,228 per month**

b) Both options should have the same annual worth, that is 45,228=CEx0.1, then **CE=$452,228**

c) Let X be the exact simple payback period.

$\frac{5-(0)}{5-(-40)}=\frac{5-X}{5-4}$ gives X=5-5/45=**4.9 years**

Year	Cash Flow	Cumulative Cash Flow
0	-220,000	-220,000
1	45,000	-175,000
2	45,000	-130,000
3	45,000	-85,000
4	**45,000**	**-40,000**
5	**45,000**	**5,000**
6	45,000	50,000
7	45,000	95,000
8	45,000	140,000

Discussion:

It shall be noted that the salvage value, in calculating the payback period, should be subtracted from the initial investment at year 0.

d) The Cumulative cash flow at year 8, taking into account the cost of fund, is actually the future worth of the cash flow at year 8. That is:

F=(-260+S) (F/P,10%,8)+45,000 (F/A,10%,8) =0

F=(-260+S)(2.1436)+45,000 (11.4359)=0 then S**=$19,929**

Problem III. 20%

You have been given the following cost and revenue estimates for 2 options for a new hotel:

Option 1: The initial costs are $10 million now with an expansion costing $2.5 million 8 years from now. The annual operating cost is $100,000 per year. The revenues are expected to be as follows: $1.5 million for the first year, increasing by $50,000 per year till year 8 and then leveling off until Year 12. The salvage value at year 12 is $7 million and the project life is 12 years.

Option 2: The initial cost is $42 million with an annual operating cost of $300,000 per year. The revenues are expected to be equal to $ 6 million per year for the project life of 8 years. The salvage value at year 8 is $30 million.

a. Select the best option using the net present worth analysis with MARR=10%. (12%)

b. You are considering Option 2 and assuming a negligible salvage value, with MARR=10%. If the hotel comprises 100 rooms and assuming an average occupancy of 65%, what should be the charge by room by night so that the project breaks even? (8%)

Solution

a. NPW analysis shall be carried out for **24 years:**

- NPW_1 (1cycle)=-10 -0.1 (P/A,10%,12)-2.5 (P/F,10%,8)+1.5 (P/A,10%,8)+0.05 (P/G,10%,8)+1.85 (P/A,10%,4)(P/F,10%,8)+7 (P/F,10%,12)
- NPW_1 (1 cycle) =-10-0.1 (6.8137)-2.5 (0.4665)+1.5 (5.3349)+0.05 (16.0287)+1.85 (3.1699)(0.4665)+7 (0.3186)=1.9221
- NPW_1 (2cycles) = 1.9221 [1+(P/F,10%,12)]=**2.5345**
- NPW_2 (1 cycle)=-42+(6-0.3)(P/A,10%,8)+30 (P/F,10%,8)
- NPW_2 (1 cycle)=-42+5.7 (5.3349)+30 (0.4665)=2.4039
- NPW_2 (3 cycles)=2.4039 [1+(P/F,10%,8)+(P/F,10%,16)]
- NPW_2 (3 cycles)=2.4039 (1+0.4665+0.2176)=**4.048**

For a service life of 24 years, NPW_2>NPW_1=> select **option 2.**

b. AE=-42 (A/P,10%,8)+6-0.3=-2.1725
The room charge by night is: $\frac{2.1725}{100 \times 0.65 \times 365}$**=$91.6**

Problem IV. 20%

You are considering investing in a new plant. The building and equipment would cost an estimated $16 million. Assume MARR=10%

a) The salvage value is zero and the plant can be operated for the first 8 years at an annual operating revenue of $ 0.5 million per year and after the first 8 years and till infinity, at an annual operation revenue R. What should be R so that the project breaks even? Assume MARR=10%.**(10%)**

b) The plant has a service life of 8 years and a salvage value of $ 4 million at the end of its service life. What should be the yearly operating revenues so that you are indifferent between this new plant and an alternative that has a service life of 10 years and an annual worth of $ 1 million per year? **(10%)**

Solution

a) The project breaks even when it is present worth at year 8 is zero.
-16(F/P, 10%, 8) +0.5 (F/A, 10%, 8)+R/0.1=0, then R=0.1(16(2.1436)-0.5(11.4359))=**2.85 million per year.**

b) In order to be indifferent, both alternatives should have the same annual worth.
A=-16 (A/P, 10%, 8) + 4(A/F, 10%, 8) +R=-16 (0.1874)+ 4 (0.0874) +R=1, then **R=3.65 million.**

Discussion

- *For 2 investment alternatives, if we can assume that the service period is indefinite and the replacement could be with identical projects, then the AE that are to be compared for both alternatives will be the one found on the basis of the initial life span of each alternative. (refer to slide 8 in Chapter VI part I of II). Thus $AE_{(1\text{-}8\ years)} = AE_{(2\text{-}10\ years)}$=$1 million per year.*

- *If we were to compare the alternatives using Present Worth Analysis, we need to compare both alternatives for **an equal time span**. If we can make the assumptions stated previously, we understand that two investments with the same annual worth are actually equivalent no matter what their service lives are. In other words, the investment with a service life of 10 years and an annual worth of $ 1 million per year is equivalent to an investment with a service life of **8 years** and an annual worth of 1$ million per year.*

- *Comparison of alternatives on Present Worth basis can then be done for a period of 8 years (and no need to go to the LCM (8,10)=40 years)*

NPW_1 (8 years) =-16+4(P/F, 10%,8)+R(P/A,10%,8)

=-16+4 (0.4665) +R (5.3349) =-14.134+R(5.3349)

NPW_2(8 years)= 1 (P/A,10%,8)=5.3349

Comparison of alternatives on Present Worth basis leads to:

*R=(14.134+5.3349)/5.3349=**3.65 million***

Problem V. **8%**

You are considering building a dam that has an initial construction cost of $10,000,000, annual maintenance cost of $200,000 and renovation costs of $300,000 every 5 years. The MARR is 10% compounded yearly. Assuming that the service life is an infinite period, calculate the Present Worth at year 0.

Solution

The $300,000 every 5 years are equivalent to a yearly payment of:

$300,000 (A/F, 10%, 5) =300,000 (0.1638) =$49,140 per year.

P=10,000,000+ (200,000+49,140)/ 0.1=**$ 12,491,400**.

Discussion

Alternative solution

The effective interest rate for a 5-year transaction period is:

$i = \left(1 + \frac{0.1}{1}\right)^5 - 1$ =61.0510%

P=10,000,000+200,000/0.1+300,000/0.61051=**$ 12,491,392.**