ENMG 400
Nizam

ENMG400
Engineering Economy
Fall 2004/2005
Exam 2 (AlKhal, Nizam & Traboulsi)

Final Exam also

INSTRUCTIONS

1. Before starting this exam, place your name, student ID No., and name of your instructor on the booklet provided.
2. Answer all questions on the booklet provided.
3. Show all work, equations, calculations, and cash flow diagrams.
4. Partial credit will be given only when your work is neatly shown and is conceptually correct.
5. You have ninety (90) minutes to complete this exam.
6. This is an open book exam.

Question 1 (20 points)

A local bank offers the following personal loan called "The Seven Percent Plan" The bank adds 7% to the amount borrowed. The borrower pays back one – twelfth of this total at the end of each month for a year.

a) What is the true interest rate per month?

For a loan of X amount
Monthly payment = (X)(1.07)/12
Hence, Present worth of X = (X)(1.07)(P/A,i,12)/12
one equation in one unknown i
i = 1.057%

b) What are the nominal and annual effective interest rates?

Nominal interest rate = (12)(1.057%) = 12.68%
Annual effective interest rate = (1+ 0.01057)^12 = 13.45%

Question 2 (30 points)

The Facilities Planning & Design Unit (FPDU) at AUB is evaluating two different materials for insulating a new science building on campus namely, foam and rock and slag wool. The initial cost of the foam is $100,000 with no salvage value, maintenance costs are estimated at $5,000 every two years and savings in energy bills are estimated at $20,000 per year. In addition, the cost of removing and disposing of the foam at the end of its service life is estimated at $5,000. The

rock and slag wool may be installed for $40,000 and has an estimated salvage value of $5000 at the end of its service life. There are no maintenance costs for the rock and slag wool insulation but the savings in energy costs are expected to be only $9000 annually. The foam is expected to last 8 years whereas the rock and slag wool will have to be replaced in 4 years. AUB uses an annual interest rate of 10% to evaluate all its infrastructure related projects.

a) Calculate the Capital Recovery for both alternatives.

CR(Foam) = -100,000(A/P,10%,8) – 5,000(A/F,10%,8)
= -100,000(0.18744) – 5,000(0.08744) = -$19,181.2

CR(Rock & slag wool) = -40,000(A/P,10%,4) = 5,000(A/F,10%,4)
= -40,000(0.31547) + 5,000(0.21547) = -$11,541.45

b) Which alternative would you recommend to FPDU? (State all your assumptions)

Assuming repeatability of the alternatives which entails that:
1. Service provided by the alternatives will be needed for the LCM.
2. Selected alternative will be repeated over each life cycle of the LCM.
3. Cash flow estimates will be the same for each life cycle.

Using AW analysis:

Foam alternative:
If the maintenance is assumed to be paid at the end of each two years starting with year 2, then:

AW(Foam) = -19,181.2 + 20,000 – 5,000(A/F,10%,2) = -$1,561.95

If the maintenance is assumed to be paid to make the foam serviceable for another two years starting from the end of year 2, then:

AW(Foam) = -100,000(A/P,10%,8) + 20,000 –5,000(A/F,10%,2) = -$1,124.95

Rock & slog wool alternative:
AW(Rock & slag wool) = -11,541.45 + 9,000 = -$2,541.45

Since both are service alternatives (Do-Nothing is not an option), the foam alternative is recommended since it has lower annual cost (for both maintenance assumptions).

c) If FPDU is now looking at a brand new insulation material that promises to last for a very long time (theoretically infinite) and deliver annual savings of $20,000 in energy bills and costs $200,000 to install with no maintenance

fees or salvage value. Is this new material more attractive than the alternative selected in part (b)?

AW(New material) = 20,000 – (200,000)(0.1) = 0

Yes, the new material is more attractive than the foam alternative as it breaks even.

Question 3 (25 points)

Chekka Tile Company (CTCO) secures its tile clay from property owned by the Lebanese Cement SAL Company (LCSAL) adjacent to the tile plant. Some years ago, CTCO made a royalty contract with LCSAL by which it pays royalty fees of $1.0 per ton for all clay removed from LCSAL property. The contract has 5 more years to run. It is estimated that LCSAL holding will supply CTCO with its needs of 20,000 tons per year for the next 15 years before the clay is exhausted. CTCO owns a large deposit of clay at some distance from the plant. In relation to CTCO's needs, the deposit may be viewed as practically inexhaustible. Costs of removing the clay would be the same as from LCSAL, however, the cost of transporting the clay to the plant would be greatly increased.
LCSAL is aware of this fact. It is believed that a new royalty contract (5 years hence) for the final 10 years would need CTCO to provide a royalty fee of $2 per ton. At this royalty rate, it will continue to be advantageous to use LCSAL's clay rather than the CTCO's more distant holding.
The General Manager of CTCO has just learned that LCSAL would consider an outright sale of its land to CTCO. By purchasing the land, CTCO would no longer have to pay royalty for the clay removed. It is believed that at the end of 15 years, when the clay is exhausted the land can be sold for $30,000.

a) What is the maximum price that CTCO would be willing to pay for LCSAL's land and stop paying royalty fees if money is worth 14% to CTCO?

Let X be the maximum price that CTCO is willing to pay for LCSAL's land..

Equating the FW or PW to zero :

20,000(P/A,14%,5) + 40,000(P/a,14%,10)(P/F,14%,5) - X + 30,000(P/F,14%,15) = 0

X = $ 181,228

b) LCSAL is facing operational difficulties and is convinced that it cannot manage and control the tonnage removed unless they employ a part- time engineer to survey the clay removed at a cost of $ 2,000 per year. What is the minimum price that LCSAL should ask for the land, should it decide to sell it? (Considering 11% as the interest rate used by LCSAL)

Let X be the minimum price that LCSAL should ask for the land.

Equating the FW or PW to zero :

20,000(P/A,11%,5) + 40,000(P/A,11%,10)(P/F,11%,5) -X
-2,000(P/A,11%,15) + 30,000(P/F,11%,15) =0

X= $205,615.

c) Do you think that LCSAL and CTCO will be able to reach an agreement? Why or why not?

There is about 12% difference between the two prices (requested by seller and offered by the buyer).
Deal may not be completed without further negotiations

Question 4 (25 points)

A $5,000 deposit is made at the present. Over the first 10 years the deposit will earn 8% compounded annually. For the following 5 years the rate of interest will be 12% compounded quarterly. Annual withdrawals begin exactly 16 years from the present with an initial withdrawal of $1,500. Withdrawals are to increase at the rate of 6% per year, and the interest rate beyond 15 years from the present is 10% compounded annually. For how many years can the withdrawal be made?

F_{15} = 5,000(F/P,8%,10)(F/P,3%,20) = 19,496

19,496 = 1,500 /(0.10-0.06) [1 – ((1+0.06)/(1+0.10))^n] → n = 19.81