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ISE 307, Term 173
ENGINEERING ECONOMIC ANALYSIS

Quiz# 3 Solution

Date: Tuesday, July 24, 2018

Q1. Given an investment project with MARR=10% that has a negative net present worth value, we can conclude the following about the project:

- (a) The project has made a loss
- (b) The project has made a profit <10%
- (c) The project has made a profit =10%
- (d) The project may or may not have made a profit**

Q2. You are considering buying an old warehouse that you will convert into an office building for rental. Assuming that you will own the property for 10 years, how much would you be willing to pay for the old house now given the following financial data?

- Remodeling cost at period 0 = \$550,000;
- Annual rental income = \$800,000;
- Annual upkeep costs (including taxes)= \$80,000;
- Estimated net property value (after taxes) at the end of 10 years = \$2,225,000;
- The time value of your money (interest rate)= 8% per year.

- (a) \$6,311,865
- (b) \$6,812,665
- (c) \$5,311,865**
- (d) \$5,812,665

$$\begin{aligned}PW(8\%) &= -\$550,000 + \$720,000(P/A, 8\%, 10) \\ &\quad + \$2,225,000(P/F, 8\%, 10) \\ &= \$5,311,865\end{aligned}$$

Q3. A&M Corporation purchased a vibratory finishing machine for \$20,000 in year 0. The machine's useful life is 10 years at the end of which the machine is estimated to have a zero salvage value. The machine generates net annual revenues of \$10,000. The annual operating and maintenance expenses are estimated to be \$1,000. If A&M's MARR is 10%, how many years does it take before this machine becomes profitable?

- (a) 2 years < $n \leq 3$ years
- (b) 3 years < $n \leq 4$ years
- (c) 4 years < $n \leq 5$ years
- (d) 5 years < $n \leq 6$ years

0	-20000	0.0	-20000.0
1	9000	-2000.0	-13000.0
2	9000	-1300.0	-5300.0
3	9000	-530.0	3170.0

Q4. The city of Atlanta is considering adding new buses for its current mass-transit system that links Hartsfield International Airport to major city destinations on nonstop basis. The total investment package is worth \$8 million and is expected to last 10 years with a \$750,000 salvage value. The annual operating and maintenance costs for buses would be \$2 million. If the system is used for 600,000 trips per year, what would be the fair price to charge per trip? Assume that the city of Atlanta uses 5% interest rate for any city-sponsored projects.

- (a) \$3.50 per trip
- (b) \$4.00 per trip
- (c) \$4.50 per trip
- (d) **\$5.00 per trip**

- Capital cost:

$$CR(5\%) = (\$8,000,000 - \$750,000)(A/P, 5\%, 10) + 0.05(\$750,000) = \$976,409$$

- Equivalent annual O&M cost: \$2,000,000

- Total annual equivalent cost:

$$AEC(5\%) = \$976,409 + \$2,000,000 = \$2,976,409$$

- Cost per trip:

$$\frac{\$2,976,409}{600,000} = \$4.96/\text{trip}$$

Q5. You invest in a piece of equipment costing \$200,000. The equipment will be used for three years, and it will be worth \$50,000 at the end of three years. The machine will be used for 4,000 hours during the first year, 5,000 hours during the second year and 6,000 hours during the third year. The expected annual savings associated with the use of the piece of equipment will be \$30,000 for the first year, \$40,000 for the second year and \$50,000 for the third year. Your interest rate is 10%.

$$\begin{aligned} CR(10\%) &= (200,000 - 50,000)(A/P, 10\%, 3) + 0.1 * 50,000 \\ &= 150,000 * 0.4021 + 5,000 \\ &= \$65,315 \end{aligned}$$

a. What is the annual equivalent worth?

$$\begin{aligned} AE_{\text{savings}}(10\%) &= [30,000(P/F, 10\%, 1) + 40,000(P/F, 10\%, 2) + 50,000(P/F, 10\%, 3)](A/P, 10\%, 3) \\ &= [30,000 * 0.9091 + 40,000 * 0.8264 + 50,000 * 0.7513] * 0.4021 \\ &= 97,894 * 0.4021 = \$39,363.18 \end{aligned}$$

$$AE(10\%) = 39,363.18 - 65,315 = \$-25,951.82$$

b. What is the net savings generated per machine-hour?

Let C be savings per machine hour

$$\begin{aligned} \text{Then, } AE(10\%) &= 4000C(P/F, 10\%, 1) + 5000C(P/F, 10\%, 2) + 6000C(P/F, 10\%, 3) \\ &= [4,000C * 0.9091 + 5,000C * 0.8264 + 6,000C * 0.7513] * 0.4021 \\ &= 12,276.2C * 0.4021 = 4,936.3C \end{aligned}$$

Thus, $C = -25,951.82 / 4,936.3 = -\5.273 per machine hour

Thus, there is a loss of \$5.273 5 per machine hour.