Name: KEY **Id#**

ISE 307, Term 153
ENGINEERING ECONOMIC ANALYSIS

Quiz# 3

Date: Monday, August 15, 2016

Q1. You invest in a piece of equipment costing $100,000. The equipment will be used for three years, and it will be worth $20,000 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%.

a. What is the capital recovery cost?

$C(10\%) = (100{,}000 - 20{,}000)(A/P, 10\%, 3) + 0.1 * 20{,}000$
$= 80{,}000*0.4021 + 2{,}000$
$= \$34{,}168$

b. What is the annual equivalent worth?

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

$AE(15\%) = 39{,}363.18 - 34{,}168 = \$5{,}195.18$

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

Let C be savings per machine hour
Then, $AE(15\%) = 4000C(P/F, 10\%, 1) + 5000C(P/F, 10\%, 2) + 6000C(P/F, 10\%, 3)](A/P, 10\%, 3)$
$= [4{,}000C*0.9091 + 5{,}000C*0.8264 + 6{,}000C*0.7513]*0.4021$
$= 12{,}276.2C*0.4021 = 4{,}936.26C$

Thus, $C = 5{,}195.18/4{,}936.26 = \$1.05$ per machine hour

Q2. Consider the following investment projects:

n	Project 1	Project 2
0	-$6,000	-$7,500
1	1,000	1,000
2	1,400	2,000
3	3,000	3,000
4	2,900	4,000
IRR	11.916%	10.242%

Determine the range of MARR for which Project 2 would be preferred over Project 1.

n	Project 2 - Project 1
0	-$1,500
1	0
2	600
3	0
4	1,100

$PW_{2\text{-}1} = -1{,}500 + 600(1 + IRR_{2\text{-}1})^{-2} + 1{,}100(1 + IRR_{2\text{-}1})^{-4} = 0$

Let $X = (1 + IRR_{2\text{-}1})^{-2}$

- ⇨ $-1{,}500 + 600X + 1{,}100X^2 = 0$
- ⇨ $-15 + 6X + 11X^2 = 0$
- ⇨ $X = 0.9264$ OR $X = -1.4719$
- ⇨ $(1 + IRR_{2\text{-}1})^{-2} = 0.9264$
- ⇨ $(1 + IRR_{2\text{-}1})^2 = 1.0794$
- ⇨ $1 + IRR_{2\text{-}1} = 1.03896$
- ⇨ $IRR_{2\text{-}1} = 0.03896 = 3.896\%$

Project 2 would be preferred over Project 1 for MARR < 3.896