ENGR 610 Engineering Economics

Midterm Exam-2 (Part-2, 10%)  
Mathu Ozer, Spring 2009

Name:

*Please check your solutions. No partial Points!!! Only full solutions will be assigned with full points.*

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**Prob. 1** - An investment of 72,000 resulted in uniform income of $12,000 per year for 10 years and a single amount of $6,000 in year 2. Calculate the ROR of investment.

![Equation for calculating ROR](image)

**Prob. 2** - By applying incremental ROR analysis for the below machines:

a) Write the equation of the calculation of $\Delta i$ for the incremental cash flow series using AW-based equation.

b) Calculate $\Delta i$ when life is 3-yr and salvage values are zero for both alternatives.

<table>
<thead>
<tr>
<th></th>
<th>Semi Automatic</th>
<th>Automatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Cost, $</td>
<td>-50,000</td>
<td>-100,000</td>
</tr>
<tr>
<td>Annual cost, $/year</td>
<td>-110,000</td>
<td>-95,000</td>
</tr>
<tr>
<td>Salvage value, $</td>
<td>7,000</td>
<td>13,000</td>
</tr>
<tr>
<td>Life, years</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

![Incremental CF diagram](image)

**a)**

$$-50 + 15 \left( \frac{P}{A}, \Delta i, 6 \right) + (50 - 7) \left( \frac{P}{F}, \Delta i, 3 \right) + 6 \left( \frac{P}{F}, \Delta i, 6 \right) = 0$$

**b)**

$$-50 + 15 \left( \frac{P}{A}, \Delta i, 3 \right) = 0$$
Prob. 3 - Compute $A'$ of equivalent uniform series below. $i = 10\%$

\[ A' = \left\{ 8000 \left( \frac{P}{A}, 10\%, 6 \right) \right\} \left( \frac{P}{F}, 10\%, 2 \right) \left( \frac{A}{P}, 10\%, 8 \right) \]

Prob. 4

- Assume that you are planning to invest money at 7% per year as shown by the increasing gradient in figure below. Further, you expect to withdraw according to the decreasing gradient shown. Find the net present worth and equivalent annual series for the entire cash flow sequence and interpret the results.

\[
\text{NPW} = -2 \left( \frac{P}{A}, 7\%, 5 \right) - 0.5 \left( \frac{P}{G}, 7\%, 5 \right) + 5 \left( \frac{P}{A}, 7\%, 5 \right) \left( \frac{P}{F}, 7\%, 5 \right) - 1 \left( \frac{P}{G}, 7\%, 5 \right) \left( \frac{P}{F}, 7\%, 5 \right) + 1 \left( \frac{P}{A}, 7\%, 2 \right) \left( \frac{P}{F}, 7\%, 10 \right)
\]

Equivalent Annual Series

\[ = (\text{NPW}) \left( \frac{A}{P}, 7\%, 12 \right) \]
**Prob. 5** Your company just purchased a piece of equipment. Maintenance costs are estimated at $1200 for the first year and are expected to rise by $300 in each of the succeeding four years. How much should be set aside in a “maintenance account” now to cover these costs for the next five years? Assume payments are made at the end of each year and an interest rate of 6%.

\[
P = 1200 \left( \frac{P}{A, 6\%/5} \right) + 300 \left( \frac{P}{G, 6\%/5} \right)
\]

**Prob. 6** You have just begun your first job as a civil engineer and decide to participate in the company’s retirement plan. You decide to invest the maximum allowed by the plan which is 6% of your salary. Your company has told you that you can expect a minimum 4% increase in salary each year assuming good performance and typical advancement within the company. Assume salary is $50K/yr.

Assuming you stay with the company, the company matches your 6% investment in the retirement plan, expected minimum salary increases, and an interest rate of 10%, how much will you have in your retirement account after 40 years?

\[
P = A_1 \left[ \frac{1 - (1+g)^n(1+i)^{-n}}{(i-g)} \right] = 44,696
\]

\[
F = P \left( \frac{F}{P, 10\%/40} \right) = 2,022,900
\]