1. (35 p) The quarterly cash flows (in thousands) associated with a company are shown below at an interest rate of 16% per year compounded semiannually:

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Cash Flow, $/Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
</tr>
<tr>
<td>2-3</td>
<td>2000</td>
</tr>
<tr>
<td>5-8</td>
<td>3000</td>
</tr>
</tbody>
</table>

(a) What equal end-of-month deposit over two (2) years would accumulate the same amount under the same interest compounding (16% compounded semiannually)?

(b) What equal end-of-quarter deposit over two (2) years would accumulate the same amount at an interest rate of 16% per year compounded monthly?

(c) What equal end-of-year deposit over two (2) years would accumulate the same amount at an interest rate of 16% per year compounded continuously?

2. (35 p) Consider cash flows for the following investment projects (MARR = 15%):

<table>
<thead>
<tr>
<th>n</th>
<th>Project A</th>
<th>Project B</th>
<th>Project C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-2500</td>
<td>-4000</td>
<td>-5000</td>
</tr>
<tr>
<td>1</td>
<td>1000</td>
<td>1600</td>
<td>1800</td>
</tr>
<tr>
<td>2</td>
<td>1800</td>
<td>1500</td>
<td>1800</td>
</tr>
<tr>
<td>3</td>
<td>1000</td>
<td>1500</td>
<td>2000</td>
</tr>
<tr>
<td>4</td>
<td>400</td>
<td>1500</td>
<td>2000</td>
</tr>
</tbody>
</table>

Suppose that projects are mutually exclusive. Which project would you select based on AE criterion?

3. (30 p) You purchased computer equipment for $35 000 to use in your own business. You do not expect the computers to have a positive salvage or trade-in value after the anticipated 5-year life. For book depreciation purposes, you want depreciation cost (D) and book value (B) schedules for the following methods:

a) Straight-line depreciation method (SL),
b) 175% Declining-Balance (DB) method,
c) Double Declining-Balance (DDB) method

Hint: Use switching to reach salvage value S=0 for part (b) and (c)

<table>
<thead>
<tr>
<th>Periods</th>
<th>SL</th>
<th>DB</th>
<th>DDB</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>( D_n ($) )</td>
<td>( B_n ($) )</td>
<td>( D_n ($) )</td>
</tr>
<tr>
<td>0</td>
<td>35 000</td>
<td>35 000</td>
<td>35 000</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
1. Given: Single cash flows quarterly (K=4); \( r = 16\% \), M=2 (semiannually); C=M/K=2/4=1/2=0.5

\[
i_p = (1 + \frac{r}{M})^C - 1 = (1 + \frac{0.16}{2})^{0.5} - 1 = 0.0392 \text{ (3.92\% per quarter)}
\]

\[
P_{\text{given}} = 1000(P/F, 3.92\%, 1) + 2000(P/A, 3.92\%, 2)(P/F, 3.92\%, 1)
+ 3000(P/A, 3.92\%, 4)(P/F, 3.92\%, 4)
\]

\[
P_{\text{given}} = \frac{1000}{(1 + 0.0392)} + \frac{2000}{(1 + 0.0392)^2} - 1 \cdot \frac{1}{(1 + 0.0392)}
+ \frac{3000}{(1 + 0.0392)^4} - 1 \cdot \frac{1}{(1 + 0.0392)^4}
\]

\[
P_{\text{given}} = 1095.122
\]

\( A_M \) uniform equivalent monthly cash flow under the same interest compounding

\( K=12; \ r = 16\% \), M=2 (semiannually); C=M/K=2/12=1/6=0.1667

\[
i_p = \left(1 + \frac{r}{M}\right)^C - 1 = \left(1 + \frac{0.16}{2}\right)^{1/6} - 1 = 0.0129 \text{ (1.29\% per payment period (per month)).}
\]

\[
P_{\text{given}} = A_M \left(\frac{P}{A}, 1.29\%, 24\right)
\]

\[
$13951.22 = A_M \left(\frac{1 + 0.0129}{24} - 1\right)
\]

\[
A_M = $679.63
\]

b) Find \( A_Q \) uniform equivalent quarterly cash flow at the interest rate 16\% compounded monthly

\( K=4; \ r = 16\% \), M=12 (monthly); C=M/K=12/4=3

\[
i_p = \left(1 + \frac{r}{M}\right)^C - 1 = \left(1 + \frac{0.16}{12}\right)^3 - 1 = 0.0405 \text{ (4.05\% per payment period (per quarter).}
\]

\[
P_{\text{given}} = A_Q \left(\frac{P}{A}, 4.05\%, 8\right)
\]

\[
$13951.22 = A_Q \left(\frac{1 + 0.0405}{8} - 1\right)
\]

\[
A_Q = $2076.43
\]

c) Find \( A \) (annuity) uniform equivalent yearly cash flow at the interest rate 16\% compounded continuously

\( K=1; \ r = 16\% \), M=\( \infty \);

\[
i_p = e^{r/K} - 1 = e^{0.16} - 1 = 0.1735 \text{ (17.35\% effective annual interest rate)}
\]

\[
P_{\text{given}} = A \left(\frac{P}{A}, 17.35\%, 2\right)
\]

\[
$13951.22 = A \left(\frac{1 + 0.1735}{2} - 1\right)
\]

\[
A = $8839.32
\]

2. AE(15%)\( A = -$2500(A/P, 15\%, 4) +$1000(P/F, 15\%, 1)(A/P, 15\%, 4)
+ $1800(P/F, 15\%, 2)(A/P, 15\%, 4) +$1000(P/F, 15\%, 3)(A/P, 15\%, 4)
+ $400(P/F, 15\%, 4)(A/P, 15\%, 4)
\]

\[
= -$2500(0.3503) +$1000(0.8696)(0.3503) +$1800(0.7561)(0.3503)
+ $1000(0.6575)(0.3503) +$400(0.5718)(0.3503)
\]

\[
= -$216.07 \text{ (Interest factors were taken from Park Table/p.890)}
\]

AE(15%)\( A = -$4000(A/P, 15\%, 4) +$1000(P/F, 15\%, 1)(A/P, 15\%, 4)
+ $1500(P/F, 15\%, 2)(A/P, 15\%, 4)
\]

\[
= -$4000(0.3503) +$1000(0.8696)(0.3503)+$1500
\]

\[
= $129.26 \text{ (Interest factors were taken from Park Table/p.890)}
\]
AE(15%) = - $5000(A/P,15%,4) - $200(P/A,15%,2)(A/P,15%,4)
+ $2000(P/A,15%,4)(A/P,15%,4)
= - $5000(0.3503) - $200(1.6257)(0.3503)+$2000
= $134.60 (Interest factors were taken from Park Table/p.890)

AE_A > AE_C > AE_B, Select Project A (highest AE worth)

3.

a) \( D_{SL} = \frac{I-S}{N} = \frac{35000-0}{5} \) = $7000
\( B_n = I - nD = $35000 - n($7000) \)
\( B_N = I - ND = $35000 - 5($7000) = 0 = S \)

b) \( \alpha = \left( \frac{1}{N} \right) (Multipler) = \left( \frac{1}{5} \right) (1.75) = 0.35, D_n = \alpha B_{n-1}; B_{n-1} = I(1 - \alpha)^{n-1} \)
\( B_N = I(1 - \alpha)^N = 35000(1 - 0.35)^5 = 4061 > S \)
use switching to SL at the beginning of year 4 (s.Table below)

c) \( \alpha = \left( \frac{1}{N} \right) (Multipler) = \left( \frac{1}{5} \right) (2.0) = 0.40, D_n = \alpha B_{n-1}; B_{n-1} = I(1 - \alpha)^{n-1} \)
\( B_N = I(1 - \alpha)^N = 35000(1 - 0.40)^5 = 2722 < S \)
use switching to SL at the beginning of year 4 (s.Table below)

From the corresponding depreciation formulas of the methods given above and the using switching to SL for part (b) and (c) at the beginning of year 4, the results are tabulated as follows:

<table>
<thead>
<tr>
<th>n</th>
<th>SL</th>
<th>DB (( \alpha = 0.35 ))</th>
<th>DDB (( \alpha = 0.40 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D_n ($)</td>
<td>B_n ($)</td>
<td>D_n ($)</td>
</tr>
<tr>
<td>0</td>
<td>35000</td>
<td>35000</td>
<td>35000</td>
</tr>
<tr>
<td>1</td>
<td>7000</td>
<td>28000</td>
<td>12250</td>
</tr>
<tr>
<td>2</td>
<td>7000</td>
<td>21000</td>
<td>7963</td>
</tr>
<tr>
<td>3</td>
<td>7000</td>
<td>14000</td>
<td>(5176)<em>{DB} &gt; (4929)</em>{SL}</td>
</tr>
<tr>
<td></td>
<td>(14787)/3 = 4929</td>
<td>Do not switch to SL</td>
<td>Do not switch to SL</td>
</tr>
<tr>
<td>4</td>
<td>7000</td>
<td>7000</td>
<td>(3364)<em>{DB} &lt; (4806)</em>{SL}</td>
</tr>
<tr>
<td></td>
<td>(3024)<em>{DB} &lt; (3780)</em>{SL}</td>
<td>Switch to SL</td>
<td>Switch to SL</td>
</tr>
<tr>
<td>5</td>
<td>7000</td>
<td>0</td>
<td>4806</td>
</tr>
</tbody>
</table>

Prof.Dr. Hüseyin Oğuz 12-Jan-11  Page 3 of 3