Scoring gives priority to the correct formulation. Numerical answers without the correct formulas for justification receive no credit. Decisions without numerical justification receive no credit. Interest tables and factor formulas are at the end of the exam.

1. (16 Points) You bought a computer 2 years ago for a cost of $6000. It has been depreciated with the sum of years digits method. The tax life for depreciation purposes of the computer is 3 years, and the tax salvage is 0. The tax rate is 30%. You have depreciated the computer for 2 years.

You are considering replacing the computer with a new one. A dealer offers to sell you a new computer for $5000. With your computer as a trade in, the net cost of the new computer is $3000. The new computer has a tax life of 3 years and a tax salvage of 0. The actual life of the new computer is 4 years. If you keep the old computer you will keep it for another two years.

For a replacement analysis, call the old computer the defender, and the new computer the challenger. Give the values for $P_D$, the investment in the defender and $P_C$, the investment in the challenger. Consider taxes for your analysis.

Compute the BV of the old computer.
SYD = $3*4/2 = 6$
$D_1 = 6000(3/6) = 3000$. $D_2 = 6000(2/6) = 2000$, $BV_2 = 1000$.

The investment in the defender is $PD = Market value - Taxes$
$2000 - (2000 - 1000).3 = 1700$

The investment value for the challenger $PC$.
5000
2. (16 Points) Your company is purchasing a machine. The machine costs $28,000. The useful life of the machine is 5 years. The machine will have a salvage value of $5,000 at the end of the five years. The annual net revenue provided by the machine is $9,000.

The machine is depreciated using the straight line method using a tax life of 7 years and zero tax salvage. You pay a tax rate of 40% on all taxable net income. With an after-tax MARR of 10%, is this an acceptable investment? Use one of the methods learned in class to make this decision.

The depreciation on the machine is $4000 per year.
The taxable income is 9000 - 4000 = 5000 per year.
The tax is 5000*0.4 = 2000 per year.
The after tax cash flow is 9000 - 2000 = 7000 per year.

Compute the after tax salvage.
At year 5 the book value is 28000 - 5(4000) = 8000
The AT Salvage = 5000 - (5000 - 8000)*0.4 = 5000 + 1200 = 6200

Compute the NPW with a 10% return.
NPW = -28000 + 7000(P/A, .1, 5) + 6200(P/F, .1, 5)
NPW = 2385
Accept the investment
3. (16 Points) Two different kinds of bits are being considered for a machine tool. Bit A has an initial cost of $1000 and has a life of three years. The energy cost associated with using this bit is $300 per year. Bit B has an initial cost of $1300 and has a life of three years. The energy cost for this bit is $200 per year. In each case below evaluate the two alternatives and select the most economic alternative.

The general rate of inflation is 4% a year. Your real-dollar MARR is 10%.

a. The energy costs are increasing at a rate of 4% a year.

Since all costs are increasing at the same rate as general inflation, we can neglect inflation and analyze the alternatives with the real-MARR. The easiest way to solve this is not note that in real terms, the extra investment of 300 in B over A has a total return of 300. Thus the real-ROR of B over A is 0.

\[
\text{NPW(A)} = 1000 + 300 \times (P/A, .1, 3) = 1746 \\
\text{NPW(B)} = 1300 + 200 \times (P/A, .1, 3) = 1797 \\
\]

or

\[
\text{NAW(A)} = 1000 \times (A/P, .1, 3) + 300 = 702 \\
\text{NAW(B)} = 1300 \times (A/P, .1, 3) + 200 = 723 \\
\]

Choose A.

b. Change the inflation situation. The general inflation rate is 4%, but energy costs are increasing at 30% rate.

Compute the NPW of cost for the two alternatives using the real values of the energy cost. To compute the real values, multiply the costs by the factor \((1.30/1.04)^n = 1.25^n\)

Alternative A

\[
\text{NPW(costs)} = 1000 + 300[(1.25) (P/F, .1, 1) + 1.25^2(P/F, .1, 2) + 1.25^3(P/F, .1, 3)] = 2168 \\
\]

Alternative B

\[
\text{NPW(costs)} = 1300 + 200[(1.25) (P/F, .1, 1) + 1.25^2(P/F, .1, 2) + 1.25^3(P/F, .1, 3)] = 2079 \\
\]

Choose B.
4. (18 Points) The manager of Austin Apartment Complex has to make a decision on reconditioning or replacing the centralized air-conditioning unit. She can sell the unit she has for $10,000. If she decides to keep the unit it must be reconditioned for continued use. If she sells the unit, she doesn't have to recondition it.

The cost to recondition the existing equipment is $30,000. The annual cost of operating this old (but reconditioned) equipment will be $15,000 next year, $23,000 the following year, and continue to rise by $8,000 in each subsequent year. The reconditioned unit will have a salvage value of $20,000 whenever it is sold in the future.

The cost to buy a new energy efficient system is $120,000. This system has a life of 15 years and a zero salvage value. With the new system, the cost of operation will drop to $12,000 per year. This cost is expected to remain constant over the equipment’s life.

If the MARR is 10%, should the existing equipment be replaced? Be sure to show all relevant calculations.

Formula used for new system
The investment in the challenger is its purchase cost 120.
NAC = 120(A/P, .10, 15) + 12 = 27.77

Formula used for keep and reconditioning old system.
Working in 1000's.
The investment in A is the market value + cost of reconditioning, or 10 + 30 = 40
The salvage value is 20.
NAC = (40 - 20)(A/P, .1, n) + 20*.10 + 15 + 8(A/G, .10, n)
N = 1: NAC = 39
N = 2: NAC = 32.33
N = 3: NAC = 32.53
Economic life is 2 years. The minimum NAC is 32.33.
Buy the new system
5. (18 Points)

a. The GDS rate percentages for the MACRS method for the five year class are derived from the double rate declining balance depreciation method with a switch point at year 4. From this information explain why the depreciation percentage is 20% in the first year.

The DRDB method would prescribe \( \frac{2}{5} = 40\% \) depreciation in the first year. The GDS percentages allow \( \frac{1}{2} \) year depreciation in the first year, so the rate is cut in two to 20%.

b. You finance $150,000 for the purchase of a house. The loan is a 30 year mortgage loan with monthly payments. The interest rate on the loan is 9% a year, and the payment amount is $1,207 a month. You live in the house for ten years and then decide to move. You must pay the bank the amount that you still owe. During the period in which you have owned the house there has been a 4% annual general inflation rate. Write the formula for the amount that you still owe the bank. Use explicit interest rates, but do not evaluate.

The amount you owe is the present worth of the payments still owed. Use the interest rate of the loan. The inflation rate doesn't make any difference.

\[
\text{Owed} = 1207(P/A, .0075, 240).
\]

c. You purchase an asset with the initial cost \( P \). The tax and useful life are both 10 years. The tax and actual salvage are both \( S \). Compare straight line (SL) and sum-of-years digits (SYD) methods.

<table>
<thead>
<tr>
<th>Question</th>
<th>SL</th>
<th>SYD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which gives the greatest book value after 5 years of ownership?</td>
<td>SL</td>
<td>SYD</td>
</tr>
<tr>
<td>Which gives the greatest total depreciation over the 10 years of life?</td>
<td>Both the same</td>
<td>SYD</td>
</tr>
<tr>
<td>Which gives the greatest NPW for the asset for the 10 year period?</td>
<td>SYD</td>
<td>SYD</td>
</tr>
<tr>
<td>Assume incomes are positive</td>
<td></td>
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</tbody>
</table>
6. (16 Points) In the following assume the general inflation rate is 4% a year.

a. You borrow $20,000 to buy a car. The bank charges a nominal annual interest rate of 12% for new car loans. Using an interest table for 1% (per month) and 60 months, the bank computes your payment as $449 per month. What "real" nominal annual interest rate are you paying on this loan? (For convenience assume that inflation compounds monthly.)

The actual interest rate is 1% a month.
The general inflation rate is .04/12 = 0.0033/month

The real interest rate is $i_r = (i_c - f)/(1 + f) = (.01 - 0.0033)/(1 + 0.0033) = 0.006678$ per month

Or 0.006678*12 = 8.01% per year. (8% is OK)

b. You just received a check in the amount of $20,000 from your stock broker. The money is the proceeds from some Dell stock that the broker sold for you. You bought the stock 3 years ago for $10,000. What "real" annual rate of return do you earn from that investment?

Compute the actual rate by setting the NPW of the cash flow equal to 0.

NPW = -100000 + 20000(P/F, i, 3) = 0
or (F/P, i, 3) = (1 + i)^3 = 2. or i = 26%.

The real rate is $i_r = (i_c - f)/(1 + f) = 21%.$
<table>
<thead>
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<tr>
<td>n</td>
<td>F/P</td>
<td>P/F</td>
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<tr>
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<td>0.9091</td>
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<tr>
<td>2</td>
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<tr>
<td>15</td>
<td>4.177</td>
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</tbody>
</table>

**Compound Interest Formulas**

- **Single Payment Compound Amount Factor**
  \[(F/P, i, n) = (1 + i)^n\]

- **Single Payment Present Worth Factor**
  \[(P/F, i, n) = \frac{1}{(1 + i)^n} = \frac{1}{(F/P, i, n)}\]

- **Uniform Series Compound Amount Factor**
  \[(F/A, i, n) = \frac{(1 + i)^n - 1}{i}\]

- **Uniform Series Sinking Fund Factor**
  \[(A/F, i, n) = \frac{i}{(1 + i)^n - 1} = \frac{1}{(F/A, i, n)}\]

- **Uniform Series Present Worth Factor**
  \[(P/A, i, n) = \frac{(1 + i)^n - 1}{i(1 + i)^n}\]

- **Uniform Series Capital Recovery Factor**
  \[(A/P, i, n) = \frac{i(1 + i)^n}{(1 + i)^n - 1} = \frac{1}{(P/A, i, n)}\]

- **Arithmetic Gradient Present Worth Factor**
  \[(P/G, i, n) = \frac{(1 + i)^n - in - 1}{i^2(1 + i)^n}\]

- **Arithmetic Gradient Uniform Series Factor**
  \[(A/G, i, n) = \frac{(1 + i)^n - in - 1}{i(1 + i)^n - i}\]