FOR 466W: Forest Resource Management
MIDTERM TEST I
Wednesday, February 19, 2003

1. Explain why a dollar earned in the future does not have the same value as a dollar earned today.

   Because of inflation the purchasing power of a dollar earned in the future will probably be less than the purchasing power of a dollar earned today. However, even without inflation, having a dollar today would be better than having the dollar later. Almost all of us prefer to have things today rather than wait, and we are willing to pay interest to borrow money so we can have things today. Furthermore, a dollar earned today can be invested and converted to an even larger amount in the future.

2. Explain in words the difference between discounting and deflating.

   Discounting is the process of converting a future value into a present value. A future value is expressed in terms of a payment that is received (or paid) at some time in the future. A present value is expressed in terms of a payment that is received (or paid) today. Deflating converts a nominal future value to a real future value, but the result is still a future value. A nominal future value is expressed in inflated dollars, while a real future value is expressed in current, uninflated dollars.

3. Assume you are a forestry consultant. You have a client who owns 250 acres of timberland, and she has asked you to do some financial analyses of different management options. Her primary reasons for owning the land are for recreation and hunting, but she is also interested in making some income from timber production. What are some questions you might ask the client in order to determine an appropriate alternate rate of return to use in analyzing her forest management alternatives.

   Do you have an alternate rate of return that you would like me to use?
   What is the minimum rate of return that you expect to earn on your timberland investments?
   If you weren’t going to invest in your timberland, where else would you invest the money?
   Are you going to need to borrow money for investments in your timberland? If so, what kind of interest rate do you expect to pay on the borrowed money?
   Do you think timberland investments are more or less risky than the other investments you might make?
4. You wish to endow your alma matter with a fund that will generate a real value of $1,000 each year, forever, for scholarships. The fund is expected to earn a nominal rate of 7%, and inflation is expected to average 3%.

(a) What real rate of return is the fund expected to earn?

\[ r = \frac{(1 + i)}{(1 + k)} - 1 = \frac{1.07}{1.03} - 1 = 0.038835 = 3.8835\% \]

(b) How much money will you need to place in the fund to ensure that a real value of $1,000 can be withdrawn each year?

*This is an application of the infinite annual series formula. Since the payments are real future values the interest rate should be the real rate.*

\[ V_0 = \frac{R}{r} = \frac{\$1,000}{0.038835} = \$25,750 \]

5. In southwestern PA, the average stumpage price for red oak sawtimber is now $448/mbf (as of the 4th quarter of 2002). In the 4th quarter of 1994 it was $454/mbf.

(a) What was the nominal annual rate of price change for red oak sawtimber in the region between the 4th quarters of 1994 and 2002?

\[ k_{ro} = \left[ \frac{T_2 - T_1}{\sqrt[4]{P_{T_2}^*}} \right] - 1 = \left[ \frac{\sqrt[4]{448}}{\sqrt[4]{454}} \right] - 1 = -0.0016616 = -0.16616\% \]

(b) If the average rate of inflation for lumber and wood products was -0.968% between 1994 and 2002, what was the real rate of price change for red oak sawtimber in southwestern PA during this period?

\[ r_{ro} = \frac{(1 + k_{ro})}{(1 + k)} - 1 = \frac{(1 - 0.0016616)}{(1 - 0.00968)} - 1 = \frac{(0.99834)}{(0.99032)} - 1 = 0.0080968 = 0.80968\% \]

(c) If this same real rate of price change continues for red oak in the region for the next 20 years, what will the real price of red oak be in southwestern PA in the year 2022?

\[ P_{2022} = P_{2002}(1 + r_{ro})^{20} = 448(1.0080968)^{20} = \$526.41 / mbf \]
6. The NPV and B/C ratios for two investments, Option A and Option B, are shown below in Figures 6.1 and 6.2, respectively.

![NPV Graph](image1)

![B/C Ratio Graph](image2)

(8) a. Estimate the internal rates of return (IRR) for the two options. Explain how you estimated these values.

*The internal rate of return for Option A is about 6.2% (±0.1% is ok).*

*The internal rate of return for Option B is about 7.1% (±0.1% is ok).*

This is determined by estimating the point where the NPV curve crosses 0 or by estimating the point where the B/C curve crosses 1.

(12) b. Under what conditions is Option A the best project? Under what conditions is Option B the best project? Under what conditions is neither project acceptable? Explain your answers.

*Option A is best for any alternative rate of return (ARR) less than 5.8% (±0.1% is ok).*

*Option B is best for ARRs between 5.8% and 7.1% (this number should match your estimated IRR for Option B from part a).*

*Neither option is acceptable for ARRs greater than 7.1%. Neither option will be acceptable when the NPV is less than zero. If at least one option has a NPV>0, then the option with the largest NPV is best. The NPV curves cross at about 5.8%, with the NPV of Option A being greater for ARRs lower than this, and the NPV of Option B being greater for ARRs larger than this.*
7. Consider the following yield table for "gold pine" plantations:

<table>
<thead>
<tr>
<th>Age</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield (mbf/ac)</td>
<td>4</td>
<td>8</td>
<td>15</td>
<td>21</td>
<td>26</td>
</tr>
</tbody>
</table>

(a) What is the periodic annual increment of gold pine between ages 50 and 60?

\[ PAI_{50,60} = \frac{Y_{60} - Y_{50}}{60 - 50} = \frac{21 - 15}{10} = 0.6 \text{ mbf/ac yr} \]

(b) What is the compound interest rate of growth of gold pine between ages 40 and 50?

\[ r_{40,50} = \left[ \frac{Y_{50}}{Y_{40}} \right]^{\frac{50 - 40}{40 - 30}} - 1 = \left[ \frac{15}{8} \right]^{\frac{10}{10}} - 1 = 0.064879 = 6.4879\% \]

(c) At which of the five ages (30, 40, 50, 60, or 70) is the mean annual increment of gold pine maximized? What is the mean annual increment at that age?

<table>
<thead>
<tr>
<th>Age</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAI</td>
<td>4/30=0.1333</td>
<td>8/40=0.2</td>
<td>15/50=0.3</td>
<td>21/60=0.35</td>
<td>26/70=0.3714</td>
</tr>
</tbody>
</table>

The MAI is maximized at age 70 (or older) at a value of 0.3714 mbf/ac yr.

8. You have been hired to establish a "gold pine" plantation (yield data in problem 7). It costs you $210/acre to plant the stand, and a chemical release costing $60/acre will be required at age 5 (to kill the hardwood competition). Current stumpage prices are $310/mbf. You expect stumpage prices and planting and release costs to go up over time at about the same rate as the inflation rate, which you expect to be about 4%. The landowner wants to grow the trees to a rotation age of 60 years, and she has told you that her (nominal) alternate rate of return is 8%. She pays an annual tax of $3/acre on the land. What is the LEV of the land, given these assumptions and her preferred rotation?

First, calculate the real rate of return: \( \hat{r} \)

Next, calculate the future value of the first rotation (w/o the annual tax): \( \hat{FV} \)

\[ FV_{R1} = -E(1 + r)^{60} - I_5(1 + r)^{55} + P \cdot Y \]
\[ = -210(1.04)^{60} - 60(1.04)^{55} + 310 \times 21 \]
\[ = -2,021.36 - 478.22 + 6,510 = $4,010.42 \]

Now, calculate the LEV: \( \hat{LEV} \)

\[ LEV = \frac{FV_{R1}}{(1 + r)^R} - 1 - \frac{I_{prop}}{r} = \frac{4,010.42}{(1.04)^{60} - 1} - \frac{2}{0.038462} = $386.95/ac \]
(10) 9. Does it matter whether you use a real or nominal interest rate when calculating a LEV? Explain your answer.

Yes, it does matter; you need to use a real interest rate. The LEV assumes that all of the values associated with future rotations will be the same as those for the current rotation. In other words, it assumes that costs and prices will stay the same. This is a weak assumption even for real costs and prices, but it is totally untenable for nominal prices and costs. Since all of the prices and costs used in the LEV equation must be real values for the assumptions to make sense, then it only makes sense if these values are discounted with a real interest rate.

(12) 10. How does an increase in the stand establishment cost affect the LEV and the optimal rotation for an even-aged stand? Explain your answer. In particular, explain any impact (or lack thereof) on the optimal rotation in terms of shifts in the marginal costs and/or marginal benefits of holding the stand for one more year.

Increasing the stand establishment cost will decrease the LEV and the optimal rotation will increase. The LEV is decreased because the LEV is just the discounted net revenues and if the costs are increased and nothing else changes, the net revenues have to decrease. To explain the effect on the optimal rotation, consider the marginal cost and marginal benefit of waiting to harvest the stand. The marginal benefit, which is just the increase in the value of the timber, will not be affected by a change in the stand establishment cost. The only part of the marginal cost curve that will be affected by the change in the stand establishment cost will be the rent term, which is equal to the LEV times the interest rate. Since the LEV decreases, the rent term decreases. This shifts the marginal cost curve down, which causes it to intersect the marginal benefit curve at a later rotation age. Since the optimal rotation is determined by the point where these curves cross, the optimal rotation will increase.

(8EC) Extra Credit. Pennsylvania’s state-owned liquor stores earn an annual net revenue for the state treasury of about $600 million. Many argue, for a variety of reasons, that the state should not be in this business. If the state decided to sell these stores to private companies, how much should the state be able earn from the sale? Give a specific dollar figure and explain your reasoning.

The $600 million is an annual net revenue. Since it is unlikely that people will ever stop buying liquor, it is safe to assume that this is an infinite series. Thus, the appropriate formula is the infinite annual series formula. To apply the formula, you will need an interest rate. Any rate will do, as long as you have a good reason for using it. I would use a rate of about 8%, since this is a reasonable rate for a business to expect to earn. (Note: you should be thinking about what the buyer would be willing to pay, so it is the buyer’s interest rate that you should use. Also, this should be a real interest rate, because the $600 million should increase with inflation and it only makes sense to assume it is constant if we treat it as a real value.) The formula, therefore, is \( V_0 = \frac{R}{r} = \frac{600,000}{0.08} = 7.5 \text{ billion} \). You might also want to consider whether the annual net revenue would change if the stores were privately operated. Certainly, private businesses will have to pay taxes that the State of PA does not have to pay, which would tend to reduce the potential annual net revenue. On the other hand, a company might be able to operate more efficiently or increase sales through a more aggressive advertising campaign. These possibilities would tend to increase the potential annual net revenue. Since these factors could potentially offset each other, I would leave the expected annual net revenue at $600,000.