PRACTICE PROBLEMS

AEC 853
FINANCIAL MANAGEMENT IN AGRICULTURE
Spring 2002

SECTION I

1. Explain the role of interest rates in determining the “time value of money.”

2. What is the different between compound and simple interest?

3. Find the following values with the tables.
   a. An initial $800 compounded for 1 year at 8 percent
   b. An initial $800 compounded for 2 years at 8 percent
   c. The present value of $800 due in 1 year at a discount rate of 8 percent.
   d. The present value of $800 due in 2 years at a discount rate of 8 percent.

4. Use the tables to find the following values.
   a. An initial $300 compounded for 10 years at 9 percent.
   b. An initial $300 compounded for 10 years at 18 percent.
   c. The present value of $300 due in 10 years at a 9 percent discount rate.
   d. The present value of $1,570.15 due in 10 years at a 18 percent discount rate. Give a verbal definition of the term “present value,” and illustrate it with data from this problem. As a part of your answer, explain why present values are dependent upon interest rates.

5. Find the future value of the following annuities. The first payment in these annuities is made at the end of Year 1—that is, they are ordinary annuities.
   a. $300 per year for 10 years at 10 percent
   b. $150 per year for 5 years at 5 percent.
   c. $400 per year for 5 years at 0 percent.
   d. Now rework Parts a, b, and c assuming that payments are made at the beginning of each year, that is, they are annuities due.

6. Find the present value of the following ordinary annuities:
   a. $300 per year for 10 years at 10 percent.
   b. $150 per year for 5 years at 5 percent.
   c. $400 per year for 5 years at 0 percent.
   d. Now rework Parts a, b, and c assuming that payments are made at the beginning of each year, that is, they are annuities due.
7. a. Find the present values of the following cash flow streams. The appropriate discount rate is 10 percent.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Stream A</th>
<th>Cash Stream B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$350</td>
<td>$650</td>
</tr>
<tr>
<td>2</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>3</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>4</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>5</td>
<td>650</td>
<td>350</td>
</tr>
</tbody>
</table>

b. What is the value of each cash flow stream at a 0 percent discount rate?
c. Can you explain the difference between your answers in part a and part b?

8. Find the present value of the following cash flow stream, discounted at 6 percent: Year 1, $300; Year 2, $450; Years 3 through 20, $500.

9. Which amount is worth more at 10 percent: $1,500 in hand today or $3,000 due after 8 years?

10. What would you prefer, $10,000 today, $20,000 10 years from now, or $30,000 20 years from now assuming,

   a. a 6 percent annual interest rate?
   b. a 8 percent annual interest rate?
   c. a 10 percent annual interest rate?

11. Explain what present value means and how it is affected by a change in the interest rate.

12. Explain what future value means and how it is affected by change in the interest rate.

13. Graper Corporation's 1991 sales were $6 million. Sales were $3 million 4 years earlier (in 1987).

   a. To the nearest percentage point, at what rate have sales been growing?
   b. Suppose someone calculated the sales growth for Graper Corporation in Part a as follows: "Sales doubled in 4 years. This represents a growth of 100 percent in 4 years, so, dividing 100 percent by 4, we find the growth rate to be 25 percent per year." Explain what is wrong with this calculation.
14. Find the interest rates, or rates of return, on each of the following:

a. You borrow $500 and promise to pay back $525 at the end of 1 year.
b. You lend $500 and receive a promise of $525 at the end of 1 year.
c. You borrow $40,000 and promise to pay back $113,576.84 at the end of 10 years.
d. You borrow $4,000 and promise to make payments of $1,001.83 per year for 5 years.

15. Oregon-Pacific invests $1 million to clear a tract of land and to set out some young pine trees. The trees will mature in 20 years, at which time Oregon-Pacific plans to sell the forest at an expected price of $3 million. What is Oregon-Pacific's expected rate of return?

16. A mortgage company offers to lend you $55,000; the loan calls for payments of $6,693.94 per year for 20 years. What interest rate is the mortgage company charging you?

17. In order to complete your last year in school and then go through law school, you will need $8,000 per year for 4 years, starting next year (that is, you will need to withdraw $8,000 one year from today). Your rich uncle offers to put you through school, and he will deposit in a bank time deposit paying 7 percent interest a sum of money that is sufficient to provide the four payments of $8,000 each. His deposit will be made today.

a. How large must the deposit be?
b. How much will be in the account immediately after you make the first withdrawal? After the last withdrawal?

18. If you deposit $1,500 a year in an account which pays 12 percent interest compounded annually, how long will it take you to accumulate a balance of $20,000?

19. Find the amount to which $900 will grow under each of the following conditions:

a. 12 percent compounded annually for 5 years.
b. 12 percent compounded semiannually for 5 years.
c. 12 percent compounded quarterly for 5 years.
d. 12 percent compounded monthly for 1 year.

20. Find the present values of $500 due in the future under each of the following conditions:

a. 12 percent nominal rate, semiannual compounding, discounted back 5 years.
b. 12 percent nominal rate, quarterly compounding, discounted back 5 years.
c. 12 percent nominal rate, monthly compounding, discounted back 1 year.
21. Find the indicated value of the following regular annuities:

   a. FV of $300 each 6 months for 5 years at a nominal rate of 12 percent, compounded semiannually.
   b. PV of $300 each 3 months for 5 years at a nominal rate of 12 percent, compounded quarterly.

22. The First City Bank pays 10 percent interest, compounded annually, on time deposits. The Second City Bank pays 9 percent interest, compounded quarterly.

   a. In which bank would you prefer to deposit your money? Why?
   b. Could your choice of banks be influenced by the fact that you might want to withdraw your funds during the year as opposed to the end of the year? In answering this question, assume that funds must be left on deposit during the entire compounding period in order for you to receive any interest.

23. What is the present value of a perpetuity of $400 per year if the appropriate discount rate is 5 percent? If interest rates in general were to double, and the appropriate discount rate rose to 10 percent, what would happen to the present value of the perpetuity? Explain.

24. Set up an amortization schedule for a $10,000 loan to be repaid in equal installments at the end of each of the next 3 years. The interest rate is 10 percent. (Note: an amortization schedule is a table which lists the total payment, principal payment, and interest payment each period.)

25. A farmer is considering the purchase of a tractor with a total cost of $100,000. The farmer plans to pay 20 percent down (an immediate cash payment) for the tractor and finance the rest with a five year loan from a local bank. The financing terms include a 12 percent annual rate that compounded quarterly and equal quarterly payments. If the farmer buys the tractor, how large will the payment be each quarter.

26. You are considering the purchase of some farmland. You plan to lease the land to tenants in exchange for cash payments. Last year the land leased for a net payment of $100 per acre and, based on historical trends, you expect the lease payments to increase by 4% each year. Your opportunity cost is 12% and there are no taxes.

   a. What is the most you will pay for the land?
   b. What do you think the land will be worth in 10 years?
SECTION II

1. a. You are 35 years old and want to plan for retirement. You invest $1,000 each year at an effective rate of 5% per year for the next 25 years. Your first deposit is made one year from today.

Beginning at age 60 you start withdrawing $X per year for the next 20 years. How large will X be in order to use up all of your funds? (Assume your first withdrawal is on your 61st birthday.)

b. You are 30 years old today. You wish to retire at age 65 and would like to be able to withdraw $10,000 at the end of each of the next 20 years following your retirement (first withdrawal is at the end of year 66). You can earn 8% on any money you invest (compounded annually).

If you make equal deposits at the end of each year starting 1 year from today and ending on your 60th birthday, how much must you deposit annually to reach your goal?

c. Congratulations, you have just won $10 million in the lottery! However, the actual payment will be made in 20 equal annual installments, the first one to be received immediately. In present value terms, how much have you really won, assuming that you can earn 7 percent per year on your money? Explain.

d. Continuing with the lottery problem, suppose the lottery organization can invest its funds at an annual rate of 12 percent. How much money must the lottery set aside in order to pay your prize? In other words, how much money does the $10 million prize really cost them? Compare your answer to part c.

2. a. If you save 10 percent of your salary every year, and your salary increases by 6 percent annually, how many times your current salary will you have at the end of 20 years? Assume that you earn 8 percent annual interest over the entire period.

b. You currently have $20,000 in your savings account. One year from today you withdraw $2,000. Each year thereafter you withdraw 5 percent more than the previous year, for a total of 10 withdrawals. How much money is left in the savings account just after the final withdrawal? Assume a 10 percent interest rate.

3. You are considering the purchase of a company that processes potatoes. The company produced a net after-tax cash flow of $200,000 last year. Cash flows have been growing at a rate of 5% per year. If you buy the company you plan to make some major renovations and investments to update the facility and improve the processing technology. Your projections suggest that the cash flows will drop to $50,000 next year and $100,000 2 years from now. After three years you expect cash flows to return to a level which is 10% above the level projected by the firm’s historical 5% growth rate (because of more efficient processing). You project that sales will continue to grow...
from this level at the historical growth rate indefinitely. You can earn a rate of return of 12% per year elsewhere.

a. What would you pay for the company today? Explain.

b. What do you project you could sell the company for in 5 years? Explain.

c. Suppose after 5 years, that the rate of return you can earn elsewhere has increased to 15%. What impact, if any, will the change in interest rates have on the selling price of the company? Explain.

4. A father is planning a savings program to put his daughter through college. His daughter is now 13 years old. She plans to enroll at the university in 5 years, and it should take her 4 years to complete her education. Currently, the cost per year (for everything—food, clothing, tuition, books, transportation and so forth) is $15,000 but a 6 percent annual inflation rate in these costs is forecasted. The daughter recently received $5,000 from her grandfathers estate; this money, which is invested in a bank account paying 9 percent interest compounded annually, will be used to help meet the costs of the daughter’s education. The rest of the costs will be met by money the father will deposit in the savings account. He will make equal deposits to the account in each year from now until his daughter starts college. These deposits will also earn 9 percent interest.

a. If the first deposit is made today, how large must each deposit be in order to put the daughter through college?

b. Suppose the father plans to increase the amount deposited each year by 5%. How large would the deposit need to be today in order to put the daughter through school?

SECTION III

1. Ms. Hops receives an offer from a large brewery for a job as a taste tester. Her base salary will be $26,000. She will receive her first annual salary payment one year from the day she begins work. In addition, she will get an immediate $5,000 bonus for joining the company. Her salary will grow 4 percent each year. Also, each year she has a 25 percent chance of receiving a bonus equal to 30 percent of her salary. Ms. Hops will work for 30 years and is exempt from taxes. What is the present value of the offer if the discount rate is 11 percent?

2. Here are two useful rules of thumb. The “Rule of 72” says that with discrete compounding the time it takes for an investment to double in value is roughly 72/interest rate (in percent). The “Rule of 69” says that with continuous compounding the time that it takes to double is exactly 69.35/interest rate (in percent).
a. If the annually compounded interest rate is 12 percent, use the Rule of 72 to calculate roughly how long it takes before your money doubles. Now work it out exactly.

b. Can you prove the Rule of 69?

c. The following table shows recent rates of inflation in a sample of countries belonging to the Organization for Economic Cooperation and Development (OECD):

<table>
<thead>
<tr>
<th>Country</th>
<th>Annual Inflation Percent Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>2.8</td>
</tr>
<tr>
<td>Germany</td>
<td>3.7</td>
</tr>
<tr>
<td>Greece</td>
<td>17.6</td>
</tr>
<tr>
<td>Japan</td>
<td>2.5</td>
</tr>
<tr>
<td>Switzerland</td>
<td>4.9</td>
</tr>
<tr>
<td>Turkey</td>
<td>68.0</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>4.8</td>
</tr>
<tr>
<td>United States</td>
<td>3.6</td>
</tr>
</tbody>
</table>

If recent inflation rates persist in the future, use the Rule of 69 or 72 to determine how long it will take for price levels to double in each of these countries.

3. An oil well now produces 100,000 barrels per year. The well will last forever, but production will decline by 4 percent per year. Oil prices, however, will increase by 2 percent per year. The discount rate is 8 percent. What is the present value of the well’s production if today’s price is $20 per barrel?

4. a. If the 1-year discount factor is .88, what is the 1-year interest rate?
   b. If the 2-year interest rate is 10.5 percent, what is the 2-year discount factor?
   c. Given these 1- and 2-year discount factors, calculate the 2-year annuity factor.
   d. If the present value of $10 a year for 3 years is $24.49, what is the 3-year annuity factor?
   e. From your answers to (c) and (d), calculate the 3-year discount factor.

5. In class we saw that if cash flow streams grow at a geometric rate \( C_t = C_0(1 + g)^t \) we could find “short-cut” formulas that reduce the number of calculations we have to do to solve present value problems. An alternative assumption is that cash flows exhibit a convex decay. This assumption
might be appropriate if the service capacity of an investment exhibits an increasing rate of decline toward the end of the asset's life. Mathematically, a cash flow stream that exhibits a convex decline can be described as \( C_t = C_0[1 - (1 - d)^{n-t+1}] \) where \( d \) is a decay parameter and \( n \) is the number of cash flows.

a. Assuming a cash flow of $1 today. Graph the earnings stream at the end of each year for the next five years for investments that exhibit geometric growth rates of 6% and -6%. Now graph the earning stream for an investment that generates annual cash flows for the next 5 years that exhibit convex decay where \( d = .60 \). Describe the difference between geometric and convex decay.

b. Derive a general expression for the present value interest factor of a convex decay annuity of \( n \) cash flows.

c. Top Notch had cash flow from operations of $300,000 last year. Because of increased competition, Top Notch expects earning to decline over the next 5 years according to a convex decay pattern with \( d = .50 \). After 5 years, the firm plans to scrap its operations. If Top Notch can earn 12% on alternative investments, what is the current value of Top Notch’s operations? (Use your formula from part b. to determine the answer.)

6. Suppose you will receive a payment of $20,000 at the end of each year, indefinitely.

a. How much would you sell the payment stream for if you can earn 12% compounded annually elsewhere?

b. How much would you sell annuity for if you earn 12% compounded continually elsewhere?

c. Suppose you receive the $20,000 as a continuous stream at payments during each year, beginning today. How much would you sell the annuity for if you can earn 12% compounded continually?

d. Compare and contrast your answers in parts a through c.

7. Suppose you are growing trees for use as paper products. Your estimated net cash flow per stand of trees is \( C(n) \) where \( n \) represents the length between harvests (you plan to replant after each cash harvest). You can earn a continuously compounded rate of return elsewhere of \( k \).

a. Derive a general expression for the present value interest factor.

b. Derive and interpret the first-order condition that determines the harvest length that maximizes NPV.
c. Suppose \( C(n) = 10n - .10n^2 \) and \( k = 18\% \).

i. Find the harvest length that maximizes net cash flow per harvest period.

ii. Find the harvest length that maximizes NPV. Compare your answer to part i and explain any difference.

8. You purchased 100 acres of land 10 years ago for $600 per acre. Your marginal tax rate on ordinary income is 28 percent and your average tax rate is only 22 percent. The capital gains tax rate is 20 percent.

a Suppose you have received $50 in before tax rent each year. If you sold land today for $1,000, what is the annualized after-tax return you realized on the investment (round to nearest percentage point if necessary)?

b Suppose in part A. that the rent was $50 in the first year and grew at a 3 percent rate each year. What was the return on the land investment?

c. What critical assumption are you making in regards to reinvestment rates in the determination of your above answers?

9. You are the financial officer for Big Hog Company. Your company is currently a farrow-to-finish operation, but because difficulties with manure management is interested in contracting with other companies to finish feeding the hogs. Your plan is to contract with smaller existing farms located in areas near the farrowing facilities your company owns or is planning to construct. You plan to provide 60 percent of the facility costs by loaning funds to the contracting firm to construct the finishing facilities. Each facility cost $500,000 today and the costs are expected to increase at the rate of inflation, currently 4 percent annually. It will take one year to complete the construction of each facility and the construction firm will require half of the funds at the beginning of the year and remainder upon completion. You plan to enter into an agreement for the first facility 5 years from today and will set aside funds each year to provide the financing (the last deposit will be at the end of year 5). You will make the first deposit today and hope increase the size future deposits by 10 percent each year. You will require the loan to be repaid in equal installments over a 7 year period beginning one year after the facility is complete. You can earn 10 percent on funds that you invest and will require the loan to be repaid at a 12 percent interest rate. Determine the size of each of your first and last deposit and the loan payment?
10. Suppose you need to make four semi-annual payments of $1,000 each.

a. How much would you need to deposit today if you can earn 12% compounded semi-annually elsewhere?

b. How much would you need to deposit today if you can earn 12% compounded quarterly elsewhere?

c. How much would you need to deposit today if you can earn 12% compounded annually elsewhere?

11. The Hanson Company is considering four mutually exclusive projects as follows:

<table>
<thead>
<tr>
<th></th>
<th>Project A</th>
<th>Project B</th>
<th>Project C</th>
<th>Project D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>$40,000</td>
<td>$25,000</td>
<td>$40,000</td>
<td>$30,000</td>
</tr>
<tr>
<td>CF</td>
<td>12,000</td>
<td>8,000</td>
<td>8,000</td>
<td>6,500</td>
</tr>
<tr>
<td>N</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>k</td>
<td>12%</td>
<td>12%</td>
<td>12%</td>
<td>12%</td>
</tr>
</tbody>
</table>

a. Compute the NPV and IRR for each project and rank the investments from best to worst under each method. What factors are responsible for differences in the ranking between the two approaches?

b. Compute the PI for each project and rank the alternatives. What are the implicit assumptions of the PI method with respect to scale and duration of the projects? When is it appropriate to use the PI method?

c. If the projects are mutually exclusive, which should be accepted? Does your answer change if the projects are independent?

12. Plaid Scotch Ltd. has just kegged its latest Scotch whiskey at a cost of $50,000. The whiskey’s value will increase over the years according to the following formula:

\[ V_t = 100,000 \ln t \]

Show that the optimal time of bottling (assuming unlimited replication) for the Scotch is 3.58 years if the firm's cost of capital is 15 percent compounded continuously.
13. The cash flows for two mutually exclusive projects are given below. The discount rate for project A is 10%, while project B’s cash flows require a 20% discount rate.

<table>
<thead>
<tr>
<th>Year</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>($10,000)</td>
<td>($8,000)</td>
</tr>
<tr>
<td>1</td>
<td>5,000</td>
<td>7,000</td>
</tr>
<tr>
<td>2</td>
<td>5,000</td>
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<tr>
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<tr>
<td>4</td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td>5,000</td>
<td></td>
</tr>
</tbody>
</table>

a. What is the simple NPV for each project?

b. What is the annual equivalent value for each project?

c. Which project should be selected? Explain.

14. Suppose you are offered the following investment

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-800</td>
</tr>
<tr>
<td>1</td>
<td>6,000</td>
</tr>
<tr>
<td>2</td>
<td>-6,000</td>
</tr>
</tbody>
</table>

a. Find the two IRRs for the investment.

b. Determine the values of k that will result in the project being accepted. Explain.

c. Explain how the IRR model can be modified so that the multiple IRR problem is eliminated.