SUID:

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Exam 3
Fall 2011

DO NOT OPEN THIS EXAM UNTIL YOU ARE TOLD TO DO SO.

Instructions

1. Write your SUID in the upper right corner of this exam. Do NOT write your name.

2. SHOW ALL YOUR WORK. Answers without supporting work will receive little or no credit.

3. There are 120 points on the exam and you'll have 180 minutes to complete it. Be sure to budget your time accordingly.

4. Several questions provide blank tables you can use to organize your calculations. Be sure to label the columns clearly. Where applicable, show the equation for the column in the bottom row of the table.

5. The tables may have more rows or columns than you need.

6. Do all your work on the exam. If you need extra space, write on the backs of the pages. However, if you do write an answer on the back of a page, *be sure you've noted that near the question*.

7. Some helpful PV formulas:

$$PV = \frac{B_t}{(1+r)^t} \qquad PV = \frac{B}{r}$$

Question 1 (15 points)

A government is considering upgrading a section of highway. The highway currently produces benefits of $2 million per year and could do so indefinitely if it is not replaced. Upgrading the highway would mean shutting it down for 2 years (years 1 and 2) and paying $15 million per year in construction costs (years 1 and 2). The highway would reopen in year 3 and produce benefits of $4 million per year forever. The government uses an interest of 5% in present value calculations.

Please calculate the net present value of the upgrading the highway and indicate whether or not the government should proceed with the project.

Question 2 (15 points)

A government agency believes it has evidence of wrongdoing by a financial firm it regulates. It is considering two possible actions: (1) offer to settle the case in exchange for a $250 million payment from the firm or (2) go to trial. If it goes to trial, the agency would have to pay $10 million in legal costs and it would have a 40% chance of winning. If it wins, it would be able to impose a $400 million fine on the firm.

(a) Please calculate the expected value of going to trial and determine which action is best for the agency. You may assume the agency picks the option with the highest expected value.

Now consider the situation from the firm's point of view. Suppose that if the case goes to trial, the firm would pay $50 million in legal costs. If it loses to the agency (40% probability, from above) it would have to pay the $400 million fine. However, losing to the agency would *also* provide grounds for it to be sued by investors. There is a 50% chance investors would sue and win, and if that happens the firm would have to pay $1 billion ($1000 million) in damages above and beyond what it pays in fines and legal fees. If the agency loses the original case, however, investors would not be able to sue.

(b) Please determine the expected value *to the firm* of going to trial. Given that information, indicate which option (settling or going to trial) is best for it.

Question 3 (15 points)

A city government is concerned that future changes in the climate will harm its water supply. It believes there is a 75% chance the change will be mild ("scenario M") and a 25% chance the change will be severe ("scenario S"). To address the problem, it is considering two options, A and B, for a new reservoir. Under both options, the reservoir would be paid for in year 0 and would produce annual benefits forever starting in year 11. Plan A would cost $100 million and its annual benefits would be $10 million under either climate scenario. Plan B would cost $200 million and would produce $10 million per year under scenario M and $40 million per year under scenario S. The city uses an interest rate of 5% in present value calculations.

(i) Please compute the expected net present value of each plan and indicate which one, if any, the city would adopt.

(ii) Now suppose the city could commission a $20 million research study that would indicate for certain whether scenario M or scenario S was going to occur. To keep things simple, you may assume the study could be carried out in period 0 prior to the city's decision about the reservoir. Please compute the expected net present value of the study and indicate whether the city should buy it.

Question 4 (15 points)

Anne Individual is concerned about consumption in two periods: 0 and 1. In both periods, she has an income of $100,000. However, she prefers to have twice as much consumption in period 1 as she does in period 0. She can borrow or save at an interest rate of 20 percent.

Please draw Anne's intertemporal budget constraint and a couple of her indifference curves. Then calculate her equilibrium, indicate how much she consumes in each period, and calculate how much she borrows or saves in period 0.

Question 5 (15 points)

A government agency produces a service and has a total cost is given by TC = 101,004 + Q^2 (note the square) where Q is the number of people it serves. The demand for its services is given by the equation P = 2,000 – 3*Q, and there are no other organizations providing a similar service. The organization wishes to serve as many people as possible without running a deficit.

What price should the organization charge and how many people will it be able to serve? How much profit will it earn? As a hint, the value of Q is between 440 and 450, inclusive.

Variable								
Equation								

Question 6A (15 points)

A startup company is considering a research project on a new method for charging electric vehicles quickly. The firm's device would charge a typical vehicle in 10 minutes rather than the 4-8 hours it takes now. If the project succeeds, the firm would be a monopolist for 20 years (years 1-20) during which it would face a demand curve given by the equation P = 365 – 5*Q. The firm would be able to produce the chargers for a total cost given by TC = 5*Q.

If the project succeeds, what price would the firm charge and what quantity of chargers would it produce in each year during the time it is a monopolist? What profits will it earn? As a hint, the quantity will be between 30 and 40.

Variable								
Equation								

Question 6B (15 points)

(i) Please calculate the present value of the monopoly profit from 6A assuming that the firm uses an interest rate of 20% in present value calculations. You may assume that the first payment arrives in year 1 and that after the patent expires in year 20 the firm's annual profits are 0.

(ii) Now suppose the research project itself costs $16,000, which must be paid in year 0, and the chance the project will succeed in developing the charger is 40%. What is the expected NPV of the project? Should the firm undertake it?

Question 6C (15 points)

Now suppose the firm is approached by a venture capitalist (VC) who offers to pay half of the research cost, or $8000, in exchange for 30% of the profits from the charger if the project succeeds. If the project fails, the VC would receive nothing.

(i) What is the firm's expected net present value of proceeding with the project under the VC's terms? Would it accept the offer? You should assume that the existence of the VC does not change the interest rate the firm uses in PV calculations: it's still 20%.

(ii) Suppose that the VC is able to offer the deal because it can borrow or lend at an interest rate of 5%, which it uses in its own PV calculations. Evaluate the arrangement from the VC's point of view. What is its expected NPV? If it makes sense for both parties to proceed with the deal, explain why briefly.