SUID:

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Exam 3

Fall 2009

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. A hint about handling fractional exponents: if $X^{1/4} = Y$ then $X = Y^4$.

8. Some helpful PV formulas:

(1) $\frac{B}{(1+r)^t}$ (2) $\frac{B}{r}$

Question 1 (15 points)

A city is currently paying $1.2 million per year to maintain a major local bridge. However, it would be possible to replace the bridge with a newer design that would require much less maintenance. Constructing the new bridge would take 3 years and would cost $15 million in each of years 1-3. In year 4, the old bridge could be closed. Maintenance on the new bridge would be $200 thousand per year forever starting in year 4.

(a) The city uses an interest rate of 2% (*note the unusual rate*) in infrastructure decisions of this kind. Please calculate the net present value of replacing the bridge. Should the city proceed with the project? Be sure to show your work.

Question 2 (15 points)

A large hospital is considering adopting a new electronic records system to replace its current paper-based system. The new system would reduce administrative costs and improve patient care. It would cost $7 million, which would have to be paid immediately (in period 0).

However, the hospital is not sure that its doctors will be willing to use the new system, and won't be able to tell until after the system is installed. If doctors refuse to use it, the system will have to be scrapped and will provide no benefits at all (believe it or not, that actually happens sometimes in real hospitals). Based on experience at similar hospitals, the administrators know there is a 70% chance the doctors will accept the system and a 30% chance they will reject it. If doctors accept the system, the hospital's benefit will be $400 thousand per year for years 1-5 (as the staff are learning the new system) and $600 thousand per year forever beginning in year 6.

(a) The hospital uses a 5% interest rate in present value calculations. Please calculate the expected present value of the system and briefly explain whether or not the hospital should adopt it.

Question 3 (15 points)

A government agency is considering a research project that would cost $1 million. If the project succeeds, it will generate a gross benefit of $1.8 million. However, if the project fails, the gross benefit will only be $0.5 million. The chance of success is known to be 40%. In addition, it is possible to carry out a pilot study for $60 thousand. The pilot study is imperfect, however. If the project would actually succeed, the pilot has a 25% chance of incorrectly indicating that it will fail. If the project would fail, the pilot has a 50% chance of incorrectly indicating that it would succeed.

(a) What is the expected value of the pilot study? Should the government proceed ahead with it? Explain briefly why or why not.

Question 4 (15 points)

An organization wants to produce 100 units of output at the lowest possible cost. It has the following production function: $Q = K^{0.6} L^{0.4}$. The price of capital is \$30 and the price of labor is \$10.

(a) How much capital and labor should it use? What will be its average cost per unit of output at this set of inputs (in dollars and cents)? You may assume that the organization can buy fractional amounts of labor. As a hint to reduce the number of calculations you'll need to do, the amount of capital is between 70 and 80 inclusive.

Variable								
Equation								

Question 5 (15 points)

A nonprofit organization provides low income clients with legal advice. The organization's total cost of assisting Q clients per month is given by TC = \$2200 + \$50*Q. Its monthly demand is given by P = \$150 - \$2*Q and there are no other organizations producing a similar service. In addition, the organization receives a monthly \$3000 grant from the federal government to help support its efforts.

(a) The organization wishes to serve as many clients as possible each month without running a deficit. What price should it charge and how many clients will it serve? How much profit will it earn per month? As a hint, the value of Q is between 50 and 60, inclusive.

Variable								
Equation								

Question 6A (15 points)

A biotech company is considering a research project that would attempt to find a new way to manufacture flu vaccines more quickly. If the project is successful, the firm will be granted a patent that it can license to other firms. The demand for licenses in each year would be given by the equation P = 2000 – 50*Q. The firm would be able to produce licenses at zero cost: TC = 0. The patent would last for 20 years (years 1-20).

(a) If the project succeeds, what price would the firm charge and what quantity of licenses would it issue in each year during the time it is a monopolist? What profits will it earn? As a hint, the quantity will be between 16 and 26.

Variable								
Equation								

Question 6B (15 points)

(b) Please calculate the present value of the monopoly profit from 6A. Now suppose that the cost of carrying out the research project is $20,000, and it would have to be paid in year 0. The chance of the project succeeding is 20% and the first licenses could be issued in year 1. What is the expected present value of undertaking the project? You may assume the firm is risk-neutral and uses an interest rate of 5%. You may also assume that the price drops to 0 after the patent expires.

Question 6C (15 points)

(c) Finally, suppose the government could buy the patent from the firm in year 1 and then immediately put it in the public domain so that anyone could use it for free. How much would it have to pay the firm to leave it no worse off? What would be the net present value gain in social surplus? Please express both numbers as present values in year 0 and explain briefly.