SUID:

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

Instructions

1. Write your SUID in the box in 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 100 points possible on this exam. Question 4 is worth twice as much as the others. *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 and *show the equation for the column in the bottom row of the table.*

5. The tables may have more rows and columns than you actually 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 $X^{0.4} = Y$ then $X = Y^{1/0.4}$.

8. Some helpful PV formulas:

$$(1) \; \frac{B}{(1+i)^t} \qquad\qquad (2) \; \frac{B}{i}$$

9. Some helpful factors in case your calculator can't handle exponents:

T	1	5	10	15	20	25	30	35	40
$(1.05)^t$	1.0500	1.2763	1.6289	2.0789	2.6533	3.3864	4.3219	5.5160	7.0400

Question 1 (20 points)

A city is considering whether or not to enter the competition to host a future winter Olympics. The competition occurs now, in year 0, and the games will be held in year 12. A consultant has determined that hosting the games will bring in: (1) an extra $1 billion of tax revenue in the year of the games (year 12), and (2) an extra $25 million every year after that due to increased tourism (years 13 and beyond).

The city's chance of winning the competition depends on the quality of the Olympic facility it promises to provide. The city is deciding between two options, A and B. Under option A, it would build a very good facility, at a present value cost (today) of $300 million. Under option B, it would build a more expensive facility, at a present value cost of $600 million. It knows that if it offers to build the less expensive facility, it has a 50% chance of winning the competition. If it offers the more expensive facility, its chance of winning the bid rises to 90%.

Please compute the expected value of the two bids and determine which, if any, the city should propose. Show all your work and explain your decision in words. You may assume that the interest rate is 5% and the city is risk-neutral. Also, please note that the city does NOT have to build the facility until AFTER it knows whether or not it has won the contest. However, if it wins it must build the facility it promised.

Question 2 (20 points)

An organization wants to produce 18 units of output at the lowest possible cost. It had the following production function: $Q = K^{(1/2)} L^{(1/2)}$. The price of capital is $24 and the price of labor is $54.

How much capital and labor should it use? What will be its average cost per unit of output at this set of inputs? 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 24 and 34 inclusive.

EQUATION									

Question 3 (20 points)

A non-profit organization operates a shelter for victims of domestic violence. Its monthly costs that can be summarized by the equation: TC = 4,000 + 300*Q where Q is the number of people housed in the shelter. The demand for the shelter is given by P = 1,100 – 20*Q and there are no competitors. In addition, the shelter receives a $14,000 monthly subsidy from the city.

The organization wishes to help the maximum number of people it can without running a deficit. What should it charge and how many people should it house? As a hint, the value of Q is between 46 and 56, inclusive.

EQUATION

Question 4 (40 points)

A technology company is considering whether or not to undertake a research project to develop a better voice-recognition device for computers. If the project succeeds, it will make typing nearly obsolete. Demand for the product would be given by $P = 125 - 5*Q$, where Q is measured in millions (e.g., Q=1 is 1 million devices). The device could be patented (making the firm a monopolist for the life of the patent) and it could be manufactured for a cost of $25 per unit via a constant returns to scale production function.

    (a) If the project succeeds, what price would a profit-maximizing firm charge for the device during the patent period? What Q (to the nearest million) would it produce each year? What profits will it earn? As a hint, the quantity will be between 5 and 15 million.

EQUATION

Question 4, continued.

Now let's add in the time dimension. The patent would allow the firm to be a monopolist for 20 years (years 1 to 20; the firm doesn't sell the device in year 0). After year 20, the patent expires and the market then becomes competitive. The interest rate is 5%.

    (b) What is the present value of the stream of profits that would be generated by the device (presuming the research project succeeds)? What will the price of the device be after the patent expires? What is the present value of the consumer surplus produced by the device (including the periods before and after the patent expires)?

Question 4, continued.

OK, now we'll add the costs and uncertainty associated with the research project. The firm has the following additional information beyond that already given in parts (a) and (b):

- The research project costs $1 billion, which must be paid immediately;
- There is a 10% chance that the project will be successful;
- Research would occur in year 0; if successful, the firm could begin production in year 1;
- If the research project succeeds, the firm can sell the device, otherwise, it gets nothing;

(c) Would a risk-neutral firm proceed with the project? Please be sure to show all your work.

Question 4, continued.

    (d) Now suppose the government considers subsidizing the research project. It offers to pay half of the project's cost ($500 million). Determine whether or not that would change the firm's decision. Assuming that the government is risk-neutral, and that it raises revenue via a tax with a CV of $1.20 per $1 of revenue, is the subsidy a good idea from the government's point of view? Be sure to show your work and explain what you find in words.