SUID:

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Exam 3
Fall 2008

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:

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

Part 1: Analysis of an Infrastructure Project (30 points total)

Question 1A (15 points)

Suppose that as part of an economic stimulus package the federal government considers building a new high-voltage electric transmission line. If it goes ahead, the line would take 3 years to build (years 1-3) and construction would cost $200 million in each year ($600 million total). Beginning in year 4, the line would produce $33 million of benefits every year forever. In addition, the line would impose costs on nearby residents who would dislike seeing the towers. These costs have been estimated to be $2 million per year. They would begin when construction starts in year 1 and would continue forever.

(a)   Please draw an appropriate cash flow diagram (or diagrams) and calculate the net present value of the project using an interest rate of 5%. Should the government proceed? Please explain briefly.

Question 1B (15 points)

Now suppose that a private firm is considering building a wind farm near one end of the proposed transmission line. If the wind farm is built, it would begin operating in year 6 and would produce $5 million of consumer surplus every year from then on (years 6 to infinity). However, the firm's decision depends on whether the transmission line is built. If it line is not built, the firm will definitely not build the wind farm. If the line *is* built, the chance that the wind farm will be built is 40%.

(b)   Please calculate the effect of this on the net present value of building the transmission line. You may assume that the government is risk-neutral. Does the decision from 1A change? Why or why not? (Please note that this question is not about the costs and benefits of the wind farm to the firm: it's just about the effect of the farm on the decision to build the line.)

Part 2: Uncertainty and Information (30 points total)

Question 2A (15 points)

A government is evaluating a proposed new regulation. Before it can be adopted, the regulation must be approved by two agencies: A and B. Evaluation by A must be done first and costs $5 million. Agency A has a 50% chance of approving the regulation. If A rejects the regulation, it cannot be implemented. If approved by A, the regulation goes on to Agency B. Evaluation by B also costs $5 million and there is a 20% chance B will approve it. If B approves, the regulation will be implemented and will produce $80 million in benefits.

(a) Please calculate the expected value of starting the evaluation of the regulation. Should the government proceed with it?

Question 2B (15 points)

A city is considering spending $400 million to renovate its downtown area in the hope of increasing the city's long term prosperity. There is a 20% chance the renovation would succeed and would generate $1 billion in benefits. However, if it fails it will only generate $200 million in benefits. (All costs and benefits are expressed in PV terms and you do NOT need to do any PV calculations in this problem.)

To help make the decision, the city is considering hiring a consultant to predict whether the renovation would succeed or fail. The consultant charges $2 million and it is known that the consultant's report will be imperfect: if the renovation would actually succeed, the consultant will only report that 40% of the time. However, the consultant is very conservative: if the renovation would fail, the consultant will *never* report that it would succeed.
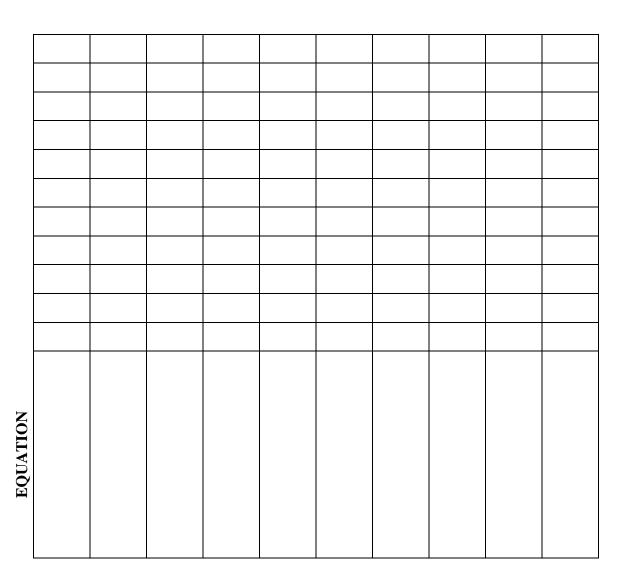
(a)   What is the expected value of hiring the consultant? Should the city do so? Explain briefly why or why not.

Part 3: Profit Maximization (15 points total)

Question 3A (15 points)

An art museum sells miniature reproductions of some of its most famous sculptures to raise money to fund its other activities. It can produce Q reproductions at a total cost given by the following equation: TC = $1000 + $14*Q. Demand for the reproductions is given by the equation P = $150 - $2*Q. The museum owns the rights to reproduce the sculptures and does not allow any other organization to produce them.

(a)   The museum wishes to maximize the profit it makes on the reproductions. What price should it charge and how many reproductions should it produce? How much profit will it earn? As a hint, the value of Q is between 30 and 40, inclusive.
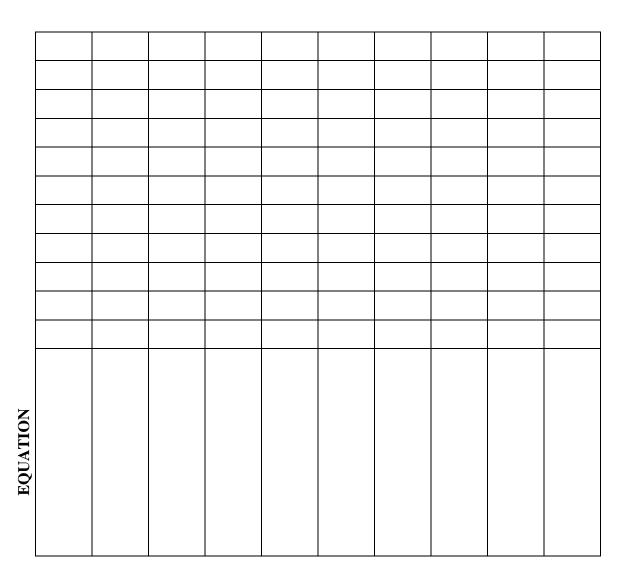
EQUATION

Part 4: Research and Development (45 points total)

Question 4A (15 points)

An automobile company is considering developing an advanced electric car. If it goes ahead and the project is successful, it will be able to patent the car's key technologies and be a monopolist for 20 years (years 1-20). During that time it will be able to produce Q cars at a total cost of TC $= 25*Q$. Demand for the car in each year will be given by the equation $P = 65 - 0.5*Q$.

(a)   If the project succeeds, what price would the firm change and what quantity would it produce during the time it is a monopolist? What profits will it earn? As a hint, the quantity will be between 35 and 45.

EQUATION

Question 4B (15 points)

(b)   Please calculate the present value of the monopoly profit from part 4A. Now suppose that the cost of developing the car would be $4,000 (paid in year 0) and the chance that the project will succeed is 25%. Please calculate the expected present value to the company of developing the car. Will it proceed with the project? You may assume that the firm is risk-neutral and uses an interest rate of 5%.

Question 4C (15 points)

(c)   Finally, suppose the government offers to set up a special public-private partnership with the firm. Under the partnership, the government would pay $3,000 of the development costs and the firm would pay the remaining $1,000. In exchange, if the project succeeds the government would give the firm a single payment of $4,000 (in year 0) for all rights to the technology. The government would then allow all automakers to use the new technology for free and the price of electric cars would immediately drop to $25 and remain there forever.

What is the expected present value of this arrangement to the firm? What is the expected PV of the consumer surplus it generates? What is the expected cost to the government? Is it more or less efficient than the outcome in 4B? Discuss.