

SUID:

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Exam 3
Fall 2010

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 reminders about Cobb-Douglas functions:

$$U = X^a Y^{1-a} \quad X = \frac{aM}{P_X} \quad Y = \frac{(1-a)M}{P_Y}$$

8. Some helpful PV formulas:

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

Question 1 (15 points)

A city would like to know if it should switch from conventional cars to hybrids for part of its vehicle fleet. No matter what kind of car it buys, it expects to pay for the vehicle in year 0, pay operating costs (fuel and maintenance) in years 1-5, and resell the vehicle in year 6 (no operating costs in years 0 or 6). It has the following data on costs and resale value for the two cars, and it uses an interest rate of 5% in present value calculations:

	Conventional	Hybrid
Initial cost	30,000	36,000
Operating cost	2,000	1,000
Resale value	15,000	18,000

- (a) Please draw an appropriate cash flow diagram and calculate the net present value of a switching from the conventional car to the hybrid. Should the city switch? Be sure to show your work.

Question 2 (15 points)

A government agency has a \$10 million legal budget for taking action against firms that violate its regulations. It knows two firms have committed similar violations and must decide whether to take action against one or both of them. However, the agency knows that its chance of winning a case depend on how much money it spends preparing. If it concentrates its efforts on a single big case against one firm (that is, it spends the whole \$10 million on one case), it has a 60% chance of winning and, if it wins, would be able to collect a \$100 million fine. However, if it splits its budget and spends \$5 million each on two separate cases, its chance of winning *each* case is 40% and *each* win would produce \$70 million in fines. Cases it loses generate no fines. The agency is risk neutral and its objective is to generate the maximum expected revenue.

- (a) Please draw an appropriate decision tree and determine the expected value of each strategy. Which approach is better: a single big case against one of the firms, or two smaller cases? Please note: you should assume that the outcomes in the two smaller cases are independent.

Question 3 (15 points)

A foundation is considering spending \$20 million on an untested urban redevelopment initiative. If the initiative succeeds, it will produce \$3 million in benefits every year forever beginning the year after it is launched. (That is, if the project is launched in year 0, it will begin producing benefits in year 1). If it fails, it produces no benefits at all. The foundation currently believes the initiative has a 40% chance of succeeding. However, a consultant has offered to carry out a \$1 million study (paid entirely in year 0) that would determine for sure whether or not the project would succeed. The catch is that study would take 5 years. If the foundation orders the study and subsequently decides to proceed, it would delay *both* the \$20 million cost (moved to year 5) and the benefits if the project is successful (would begin in year 6).

- (a) Please draw an appropriate decision tree and determine the expected net present value of both (1) implementing the initiative without the study and (2) ordering the study. What should the foundation do? Explain as intuitively as possible why that option is best. You may assume the foundation is risk neutral and uses an interest rate of 5% in present value calculations.

Question 4 (15 points)

An individual is concerned about consumption in two periods: 0 and 1. In period 0, she works and has an income of \$120,000. In period 1, she expects to be retired and receiving a pension of \$50,000. Her preferences over bundles of consumption in the two periods, C_0 and C_1 , are given by a Cobb-Douglas utility function: $U = C_0^{0.6} * C_1^{0.4}$. She can borrow or save at an interest rate of 25 percent.

- (a) Please draw her 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 nonprofit organization provides tax advice to low income entrepreneurs interested in starting their own businesses. The organization's total cost is given by $TC = 25,632 + Q^2$ (note the square) where Q is the number of people it serves. The demand for its services is given by the equation $P = 500 - Q$, and there are no other organizations providing a similar service.

- (a) The organization wishes to serve as many people as possible without running a deficit. What price should it 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 175 and 185, inclusive.

Variable							
Equation							

Question 6A (15 points)

A small startup company would like to carry out a research project aimed at developing low cost solar cells that could be easily integrated into building materials such as roofing tiles or siding. 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 $P = 74 - Q$. The firm would be able to produce the cells for a total cost given by $TC = 10*Q$.

- (a) If the project succeeds, what price would the firm charge and what quantity of solar cells 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)

- (b) Using an interest rate of 5%, please calculate the present value of the monopoly profit from 6A. If the research project itself costs \$8,000, which must be paid in year 0, what is the NPV of the project? Should the firm undertake it? You may assume that after the patent expires, other firms enter the industry, the price falls to \$10 and the firm's annual profits are 0.

Question 6C (15 points)

- (c) Suppose the firm is actually uncertain about the demand curve it would face. It believes there is a 50% chance that the curve would be the one from part 6A (call that case H) and a 50% chance the curve would be substantially lower (call that case L). To keep things simple, assume that in case L, the firm's profits would be zero. The firm would have to pay the research cost before finding out which demand curve was right.

A government agency offers to help the firm manage the risk by promising that in case L, the agency itself would step in and buy 30 units at a price of \$20 per unit during every year of the patent period. (Government efforts to expand industries by promising to buy their products are known as procurement policies.) The guarantee *only* applies in case L, and only in years 1-20: the government does not buy the product in case H, nor does it buy the product after year 20. Please calculate the firm's expected NPV with and without the policy and indicate whether the policy changes the firm's decision.