Problem Set 8

(Due 10/29)

1. Human Capital

Ned Nightschool cares only about his consumption this year and next year. His utility function is $U = x^{1/2}y^{1/2}$, where x is this year's consumption and y is next year's. At his current job, Ned can earn $25,000 in each year. However, this year he also has the option of attending night school. Each class he takes costs $2357, but it increases his income next year. If he takes N classes, the total increase in his income will be $\$7000N^{1/2}$.

(a) Graph Ned's budget constraint showing his feasible combinations of consumption in the two periods when he is not allowed to borrow or lend.

(b) If Ned attends N classes, his consumption this year will be given by $x = 25000 - 2357\,N$ and his consumption next year will be $y = 25000 + 7000\,N^{1/2}$. Use this information to show that Ned's budget constraint is given by: $y = 25000 + 7000((25000 - x)/2357)^{1/2}$.

(c) Now suppose that Ned can borrow or lend at an interest rate of 5%. Find his equilibrium number of classes and graph his new budget constraint.

(d) Finally, solve for Ned's equilibrium consumption in each of the two periods. How much money does he invest in human capital formation? How does his consumption change in each period relative to his endowment point?

2. Uncertainty

Former baseball great Pete Geranium is considering a bet on the outcome of the World Series between the Twins and the Braves. His local bookie, Jimmy, has offered him the following deal: if Pete bets $1 on the Twins and the Twins win, Jimmy will return Pete's bet and pay him an additional $2. However, if the Braves win, Pete loses his bet. Before betting, Pete's initial wealth is $100.

(a) Graph Pete's budget constraint showing his consumption possibilities in the two states of the world: Twins win (T), and Braves win (B). Put his consumption in state B on the horizontal axis.

(b) If Pete bets $W, his consumption in state B will be $C_B = 100 - W$ and in state T it will be $C_T = 100 + 2W$. Use this information to show that Pete's budget constraint can be written: $300 = 2C_B + C_T$

(c) Suppose Pete has inside information and knows that the probability of the Twins winning is 40%. What is the expected value of a $1 bet? Is the bet actuarially fair? How much would Pete bet if he were risk-neutral?

(d) Now suppose Pete has a von Neumann-Morgenstern utility function of the form $U = \pi_B C_B^{1/2} + \pi_T C_T^{1/2}$, where π_T is the probability of a win by the Twins and π_B is the probability of a win by the Braves. If π_T is 0.4 (a 40% chance), how much will Pete bet?

(e) Graph the equilibrium from part (d). Is Pete risk-averse, risk-neutral, or risk-loving? How can you tell?

Problem Set 9

(Due 11/5)

1. Information

Walt Wildcat owns a ranch in west Texas and is thinking of drilling for oil. Suppose his initial wealth is \$500,000, drilling an oil well costs \$300,000, the probability of finding oil is 0.4 (40%), and the payoff for a successful strike is \$1,500,000. Walt has a von Neumann-Morgenstern utility function of the form:

$$U = \sum_{k=1}^{N} \pi_k u(c_k)$$

where N is the number of states of the world, π_k is the probability of state k, c_k is Walt's consumption in state k, and $u(c_k)$ is the utility he gets from consuming c_k. For Walt, $u(c_k)$ is given by $u(c_k) = (c_k)^{3/4}$.

(a) Draw Walt's decision tree.

(b) Calculate the expected utilities of drilling and not drilling. What should Walt do? Why?

(c) Now suppose Sandy Seismologist offers to test Walt's ranch for oil for a fee of \$100,000. If Walt accepts the deal, Sandy's test will reveal for certain whether or not there is oil under the ranch. If there is oil, Walt can drill and be assured of success; if there is not oil, Walt saves the \$300,000 is would have cost him to drill a dry hole. Should Walt purchase this test? Why?

(d) Explain how you would determine the maximum amount Walt would pay to find out whether or not there was oil under his ranch. You do not have to calculate this amount, but you should be able to write down an equation which determines it.

2. Profit Maximization

Suppose that Sandy Seismologist forms an oil field testing company called "Guaranteed, Accurate Seismology", or GAS for short. GAS commissions a study of the market for its oil field surveys and finds that it faces a demand curve given by $p = 300,000 - 25,000q$. That is, if GAS wants to sell exactly q tests, it will have to charge $300,000 - 25,000q$ dollars. At the same time, GAS has a total cost curve given by $TC = 25,000q^2$.

(a) Find an equation for the firm's total revenue and use it to obtain the marginal revenue curve. On a single diagram, graph the demand and marginal revenue curves.

(b) Now find the firm's marginal cost curve. Draw a diagram showing demand, marginal revenue, marginal costs and the firm's optimal output. What quantity would GAS produce? What price would it charge?

(c) Calculate GAS's profit at the equilibrium found in part (b). Verify that the quantity you obtained in (b) does in fact maximize profit by calculating the firm's profit at two quantities on either side of the optimum and plotting the results.

(d) Now suppose that the government decides to charge seismology companies a licensing fee. Each company that wants to be in the business must pay \$250,000 no matter how many tests it conducts. Discuss what happens to GAS's total and marginal costs. How does its optimal output change?

Problem Set 10

(Due 11/19)

1. Production Functions

Many of the concepts discussed in class for production functions having two inputs can also be applied when there are three or more inputs. For example, consider Betty Brewski who runs a small business making beer. She uses inputs of capital (K), labor (L) and raw materials (M) according to the production function $Q = K^{\alpha} L^{\beta} M^{\gamma}$, where α, β and γ are constants.

(a) Derive expressions for the marginal physical products of each input.

(b) What is the technical rate of substitution between inputs of capital and labor? Between capital and materials?

(c) If $\alpha = \beta = \gamma = 1/4$ does Betty's business have constant, increasing or decreasing returns to scale? Show how you obtained your result.

2. Short Run Costs

Al Auditprone is an accountant who runs a tax consulting business. His company's production function is $Q = L^{1/2} + K^{1/2}$, where L is the amount of labor he hires and K is the amount of computer equipment he uses. Each unit of labor costs \$10. Al gets his computer equipment from a leasing company who charges him \$10 per unit. Al has 100 units of computers on hand and his agreement with the leasing company keeps him from changing that number in the short run. However, Al can change the amount of labor he uses.

(a) Derive Al's short run total cost function. Graph your result.

(b) From your answer to part (a) find and graph Al's short run marginal cost function.

(c) Suppose that Al can sell each consultation he produces for \$310. How many consultations will he produce in the short run? How much labor will he hire?

(d) What will be Al's total revenue, total costs and profits at the equilibrium in part (c)?

Problem Set 11

(Due 11/26)

1. Long Run Costs

Meg Marketit runs an advertising business. She uses inputs of labor and materials to produce ad campaigns for her clients according to the following production function: $Q = L^{3/5}M^{1/5}$.

(a) What, in general, is the difference between the short run and the long run? Is the long run likely to require a long time for Meg's business?

(b) Derive Meg's long run factor demands for labor and materials in terms of output and the prices of labor (P_L) and materials (P_M).

(c) Use the factor demands from part (b) to find Meg's long run total cost function.

(d) From the results of part (c), derive Meg's long run marginal and average cost functions.

(e) If Meg can sell ad campaigns for P dollars each, derive an equation showing her optimal amount of output.

(f) Compute Meg's output, average cost and total profit when P is \$332.63, P_L is \$30 and P_M is \$10. Draw a graph showing marginal revenue, marginal cost, average cost, the quantity produced and total profits.

2. Firm's Supply Curve

Hal Holistic runs his own organic carrot juice business. Hal produces carrot juice out of carrots and labor according to the production function $Q = 4C^{1/3}L^{1/3}$, where Q is the number of gallons of carrot juice he produces, C is number of pounds of carrots he uses and L is the number of hours of labor he hires. The price of carrots is \$1 per pound and the price of labor is \$4 per hour. In addition, if Hal wants to be in the carrot juice business at all he must pay a one-time licensing fee of \$288. Hal is a price-taker in both his input and factor markets.

(a) Derive Hal's total cost function.

(b) Use the results of part (a) to find Hal's marginal, average and average variable cost functions. Plot your results.

(c) Suppose Hal has already bought a carrot juice license and it is nonrefundable. Find his supply curve in this situation. Give an equation for it and draw it on a graph.

(d) Identify any quantities in the graph for part (c) at which Hal would be earning negative profits. Explain why he would still produce.

(e) Now suppose that Hal hasn't bought the license yet but is thinking it over. What will his supply curve look like now? Calculate the minimum price of carrot juice that would induce Hal to supply more than zero gallons.

(f) Suppose the price of carrot juice is \$9 per gallon. Find Hal's optimum output and calculate how many pounds of carrots and hours of labor he buys.

Problem Set 12

(Due 12/5)

1. Monopoly

Suppose that the current wave of airline buyouts continues until there is only one airline left, MegaAir (its motto: "Fly Mega ... or walk"). The demand for air travel is given by $P = 2000 - 5 \cdot Q$, where P is the price consumers are willing to pay for Q flights. Mega's total cost function is $TC = 100 \cdot Q$.

(a) Find Mega's marginal revenue curve. Graph demand and marginal revenue as functions of Mega's output.

(b) How many flights will Mega produce? What price will it charge? How much profit will it make? Illustrate your answer with a graph showing demand, marginal costs, average costs, marginal revenue and total profits.

(c) Suppose that before Mega there were lots of small airlines, each of which had the same marginal costs as Mega. Assuming that these airlines acted like perfect competitors, find the price and quantity that would have prevailed in the market before Mega.

(d) How does the performance of the monopolized market compare to the competitive market described in part (c)? Compute the efficiency loss (reduction in social surplus) due to monopolization.

2. Other Market Structures

These are short essays rather than problems. Use graphs whenever they would clarify your argument.

(a) What is a cartel? How does it differ from a monopoly? Choose a particular cartel and discuss whether its behavior is consistent with microeconomic theory.

(b) Describe monopolistic competition. How does the performance of monopolistically competitive industry compare to that of perfect competition?

(c) What is a duopoly? Discuss the Cournot-Nash equilibrium and describe how it can be used to understand duopoly behavior.