14.01 Fall 2010
Problem Set 8 Solutions

1. (36 points) Two firms, A and B, are competing in the production of a homogenous good. The good's marginal cost for both firms is equal, $MC = \$25$. Assuming linear reaction functions, describe what would happen to output and price in each of the following situations if the firms are in (i) collusive equilibrium, (ii) Cournot equilibrium, (iii) Bertrand equilibrium.

   (a) (4 points for each of (i)-(iii)) The demand curve shifts to the left.

      i. In a collusive equilibrium, the two firms act like a monopolist. Both firms will decrease output, and price will decrease.

      ii. Both reaction curves shift inwards and both firms produce less. Price will decrease.

      iii. Both firms will produce less. Because marginal cost is constant, price will not change.

   (b) (4 points for each of (i)-(iii)) Because it invents a new and improved machine, the marginal cost at firm B decreases to \$20.

      i. Firm B will produce all the output in the market, with firm A not producing at all. The total amount of output will increase, and the price will decline.

      ii. When firm B has a decrease in marginal cost, its reaction function shifts outward. The quantity produced by firm A will decrease and the quantity produced by firm B will increase. Total quantity produced will increase, and the price will decline.

      iii. Firm B can produce where price equals marginal cost, at \$25. If the monopolist's price is less than 25, then the low cost firm will charge the monopolist's price. If the monopolist's price is greater than 25, then the low-cost firm B charges price 20ε, boxing out the higher-cost firm, and supplies the entire market.

   (c) (4 points for each of (i)-(iii)) Costs in the entire industry increase due to an increase in wages.

      i. When marginal cost increases, both firms will produce less and price will increase, as in the monopoly case.

      ii. Both reaction functions shift inward. Both firms decrease output, and price will increase.

      iii. Price will increase and quantity produced will decrease.

Problem 1 solution by MIT OpenCourseWare.

2. Problem solution removed due to copyright restrictions. This content is presented in audio form within the Solution Video for Problem Set 8, Problem 2.

3. (28 points) Suppose a perfectly competitive labor market has a demand curve of $L^D = 120 - 2w$ and a supply curve of $L^S = 8w$, where w is the wage rate is dollars per hour and L is the quantity of labor in person-hours.

   (a) (2 points) What are the equilibrium values of the wage and employment?
   Setting supply equal to demand gives $w = 12$ and $L = 96$.

   (b) (4 points) Suppose the government imposed a minimum wage of \$14 per hour. Now what are the equilibrium values of the wage and employment?
   If the wage were required to be \$14, firms would hire $L = 120 - 2 \cdot 14 = 92$. And, of course, $w = 14$.

   (c) (8 points) Repeat part (a), assuming now that the market is a monopsony.
   The total expenditure on labor, or $w(L) \cdot L$ (where $w(L)$ is the inverse supply of labor), is $L^2/8$. Thus, the marginal expenditure on labor is $L/4$. Setting marginal expenditure equal to marginal benefit (the inverse of the original labor demand) gives $L/4 = 60 - L/2$, or $L = 80$. The wage rate is found where $L = 80$ on the labor supply curve, which is at $w = 10$.

   (d) (8 points) Repeat part (b), assuming now that the market is a monopsony.
   The total expenditure on labor is $14L$ when the minimum wage is binding (i.e., values of L for which the inverse labor supply is less than the minimum wage of 14), which occurs when $L \leq 112$,

and the total expenditure on labor is $L^2/8$ when the minimum wage is not binding, which occurs when $L \geq 112$. Thus, the marginal expenditure on labor is 14 for $L < 112$ and $L/4$ for $L > 112$. Setting the marginal expenditure on labor equal to the marginal benefit $60 - L/2$ gives $L = 92$. And, of course, $w = 14$.

(e) (6 points) Does the imposition of the minimum wage decrease employment here under perfect competition? What about under monopsony? Give a brief intuitive explanation for your answer and why it may be different under the two different market structures.

Imposing the minimum wage decreases employment under perfect competition, but actually increases it in this case under monopsony. Monopsonists try to keep employment down to keep wages low, and imposing a minimum wage that forces wages to be high reduces their incentives to keep employment down. But the minimum wage reduces employment under perfect competition, for the usual reason that firms will not be willing to pay for labor that has a value that is less than its price.

Problem 3 solution courtesy of William Wheaton. Used with permission.

4. (11 points) Suppose you face the following lottery. You can earn 1 of 3 possible grades in this class: an "A", a "C", or an "F", with the following probabilities:

$$\pi_A = \frac{2}{10}, \quad \pi_C = \frac{6}{10}, \quad \pi_F = \frac{2}{10}$$

Your current wealth (w) is \$400. If you receive an "A", you gain (e.g. I pay you) \$500. However, if you get an "F", you lose (e.g. you pay me) \$300. If you receive a "C", you DO NOT GAIN OR LOSE anything. Assume your utility function, defined over wealth, is $U(w) = \sqrt{(w)}$.

(a) (6 points) What is your expected utility (EU)? [Hint: be sure to calculate your total wealth in each "state".]

$$EU = \pi_A U(w_A) + \pi_C U(w_C) + \pi_F U(w_F)$$

$$w_A = 400 + 500 = 900$$
$$w_C = 400 + 0 = 400$$
$$w_F = 400 - 300 = 100$$

$$EU = \frac{2}{10}\sqrt{900} + \frac{6}{10}\sqrt{400} + \frac{2}{10}\sqrt{100} = 20$$

(b) (5 points) What is the certainty equivalent level of wealth (w^*), that is, the guaranteed payoff at which a person is "indifferent" between accepting the guaranteed payoff and their expected utility from (a)?

$$U(w^*) = EU \longrightarrow \sqrt{w^*} = 20 \longrightarrow w^* = 400$$

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