Intermediate Microeconomic Theory
ECN 100B, Fall 2019
Professor Brendan Price

Homework #1

Due: Friday, October 4th at 5:00pm

This homework assignment will be graded 100% on the basis of effort. In future homework assignments, some questions (accounting for 50% of the total points) will be fully graded, and others (the remaining 50% of points) will be graded on the basis of effort.

1 Bubble tax (18 pts.)

Throughout this problem (and throughout the first part of the course), "total surplus" is defined as "consumer surplus + producer surplus + government tax revenue (if any)".

Davis's bubble-tea market is fiercely competitive. Suppose that demand for bubble tea is given by $Q_D(p) = 300 - 30p$, and supply is given by $Q_S(p) = 60p - 60$.

a. (3 pts.) Find the equilibrium price p^* and quantity Q^*.

b. (3 pts.) Draw a carefully labeled graph representing this market. (Since price goes on the vertical axis, you'll need to invert the demand and supply curves.) Label the Q and p axes wherever the supply and demand curves intersect each other or the axes. Also label the equilibrium outcome (Q^*, p^*).

c. (3 pts.) Calculate the consumer surplus, producer surplus, and deadweight loss (if any). What is the total surplus in this market?

d. (3 pts.) What is the most any consumer is willing to pay for bubble tea in this market? At the equilibrium price, how much is the *marginal* consumer willing to pay? How much social surplus is created by the marginal transaction? (Remember: the marginal consumer is the one who is indifferent between buying and not buying.)

Now suppose that, to finance an exciting new Bicycle-Themed Sculpture Fund, the city of Davis imposes a $3 tax on bubble-tea shops for each unit of tea they sell.

e. (3 pts.) Find the new equilibrium price and quantity.

f. (3 pts.) Calculate consumer surplus, producer surplus, tax revenue, and deadweight loss under this tax. How has total surplus changed compared to part c? How does the change in total surplus relate to the change in deadweight loss?

2 Practice makes perfect (12 pts.)

Solve each of the following optimization problems. (You should watch Lecture 2 first.)

a. (4 pts.) A drug company sells an over-the-counter medication in a perfectly competitive market, where the price is $p = 24$. For each of the following cost functions, write down the company's profit-maximization problem, and then find q^*.

   i. $C(q) = 2q^3$

   ii. $C(q) = 30q + q^2$

   iii. $C(q) = 10q$

   iv. $C(q) = 24q$

b. (4 pts.) A firm chooses q to solve the profit-maximization problem below:

$$\max_q \ \pi(q) = (10 - q)q - 2q$$

   i. Use the first-order condition to find a "candidate" solution q^*.

   ii. Use the second-order condition to verify that q^* is the optimal choice.

   iii. Find $\pi(q^*)$.

c. (4 pts.) A restaurant sells a mixture of sit-down meals (q_1) and take-out meals (q_2). The market for each meal type is perfectly competitive, with prices $p_1 = 18$ and $p_2 = 8$, respectively, and the restaurant's cost function is $C(q_1, q_2) = 3q_1^2 + q_2^2$.

   The restaurant's profit-maximization problem is therefore

$$\max_{q_1, q_2} \ \pi(q_1, q_2) = 18q_1 + 8q_2 - 3q_1^2 - q_2^2$$

   i. Find q_1^*, q_2^*, and profits $\pi(q_1^*, q_2^*)$.

   ii. Now suppose that a loud construction project reduces demand for sit-down meals in the area, so that p_1 goes down. Assuming that p_2 remains unchanged, what happens to the restaurant's optimal quantity of take-out meals (q_2^*)?