

## Problem Set #1

### Section I - Economics 101 Review

1. The market for corn is described by the following expressions:

$$\begin{array}{ll} \text{Demand:} & Q(P) = 4000 - 200P \\ \text{Supply:} & Q(P) = -800 + 400P \end{array} \quad \text{Q is measured in bushels of corn.}$$

- Graph the “demand” and “supply” curves. Be sure to label your axes, the curves, and the intercepts.
  - Find the equilibrium quantity and price in the corn market.
  - Find the price elasticity of demand and supply at the equilibrium.
2. The market for six packs of microbrewery beer in Sheboygan, Wisconsin is described by the following expressions:

$$\begin{array}{ll} \text{Demand:} & Q(P) = 600 - 50P \\ \text{Supply:} & Q(P) = -600 + 150P \end{array} \quad \text{Q is measured in six packs.}$$

- Graph the “demand” and “supply” curves. Be sure to label your axes, the curves, and the intercepts.
  - Find the equilibrium quantity and price in this market.
  - Find the price elasticity of demand and supply at the equilibrium.
3. The market for land in Huron, Michigan is described by the following equations:

$$\begin{array}{ll} \text{Demand:} & Q(P) = 2000 - 2P \\ \text{Supply:} & Q = 400 \end{array} \quad \text{Q is measured in acres.}$$

- Graph the “demand” and “supply” curves. Be sure to label your axes, the curves, and the intercepts.
  - Find the equilibrium quantity and price in this market.
  - Find the price elasticity of demand and supply at the equilibrium.
4. Bob’s demand for visits to the doctor is given below. Bob faces a flat fee if he makes a visit to the doctor: \$100.

$$\begin{array}{ll} \text{Inverse Demand:} & P(Q) = 420 - 80Q \\ \text{Inverse Supply:} & P = 100 \end{array} \quad \text{Q is measured in trips to the doctor.}$$

- Graph the “demand” and “supply” curves. Be sure to label your axes, the curves, and the intercepts.
- Find the equilibrium quantity and price in this market.
- Find the price elasticity of demand and supply at the equilibrium.

5. Suppose that the demand for coconut oil is given by the following expression:

$$Q(P_c, P_p, I) = 1200 - 9.5P_c + 16.2P_p + 0.2I$$

Assume that the market is currently in equilibrium and that palm oil  $P_p$  is \$0.31, coconut oil  $P_c$  is \$0.45, and that  $Q$  is 1275.

- i. Find the price elasticity of demand for coconut oil.
  - ii. Find the cross price elasticity for palm oil. Are these goods substitutes or complements? How do you know this?
  - iii. Is coconut oil a normal good? How do you know this? How would you find the expression for income elasticity?
6. Practice with partial derivatives.

For each of the following functions – take the first partial derivative of  $f$  with respect to  $x$ .

- a.  $f(x, y) = x^2 y^2$
- b.  $f(x, y) = x^2 + y^2 + xy^3$
- c.  $f(x, y) = 10x + 20y$
- d.  $f(x, y) = 6x^2 y^2 + 4y^{-2} + y^5$
- e.  $f(x, y) = \ln x + 2y^2$

## Section II – Budget Constraints

1. Bob buys two goods, Krispy Kreme doughnuts and Starbucks Coffee. Bob earns \$200 per week from his job at the local movie theater. Coffee is \$4 per cup, and doughnuts are \$0.50 each. Write down a mathematical expression for Bob's weekly budget constraint. Also, graph Bob's budget constraint. Label the axes, the intercepts, and the slope of the budget constraint.
2. Bob lives in the town of Cornelius, and Cornelius has decided that it needs to raise some tax revenue. The town council is considering two plans: Plan A is a 20% income tax, and Plan B is a \$1 per unit tax on coffee. On a new graph, draw Bob's budget constraints under each of the plans. Make sure that each budget constraint is clearly labeled (Plan A or Plan B), and label the axes, intercepts, and slopes. Which of the two plans do you think the town council should implement? Why? What does your answer depend on?
3. The town council of Cornelius recognizes that its movie theater employees need to stay awake on the job. Therefore, the council has decided to subsidize movie theater employees' consumption of coffee. Bob now receives a voucher that entitles him to 10 cups of coffee per week. (He may not sell the voucher.) Draw the budget line Bob faces when he receives the voucher. (You may assume that the town council decided to implement the *income tax* described in problem 2.) Please label the axes, the slope of the budget constraint, and the intercepts.
4. The town council wants to examine an alternate subsidy plan. Specifically, the members of the council want to examine the impact that a 25% subsidy on coffee would have on the budget constraint of movie theater employees. In order to create this new budget constraint you should assume that the movie theater employees continue to earn \$200 a week, that they continue to face a 20% income tax, that the price of doughnuts is still \$0.50, and you should also assume that an ad valorem subsidy of 25% is provided for movie theater employees who consumer coffee. To create the new price of coffee you should use the following equation:

$$P_{subsidy} = P_{old} (1 - S) \quad \text{Where } S \text{ is the subsidy rate.}$$