ECON 110, Prof. Hogendorn

Problem Set 2

1. *Healthcare.* Recently in my e-mail, I received notice of a new article published in an economics journal. The article is entitled "A theoretical rationale for an inelastic demand for health care."

   (a) OK, you've only taken a few days' worth of economics, but can you provide a theoretical rationale for inelastic demand for health care?

   (b) Draw a supply and demand diagram for health care making both functions linear. Draw the diagram so that at the equilibrium, demand is inelastic and supply is perfectly elastic.

   (c) If costs rose in the health care industry, show what would happen in your diagram, and discuss the relative size of the changes in the quantity and price of health care.

2. *Tokens3.* Suppose the demand for subway tokens is

$$t(p_t) = 13.39p_t^{-2/3}$$

   (a) Graph this demand function and show the price/quantity point where the price of a token is $1.50.

   (b) What is the elasticity of demand?

   (c) If the transit authority raises the price of subway tokens to $2.00, will revenue rise or fall in the short run? Can justify your answer without actually finding the new revenue?)

3. *Accord.* The elasticity of demand for Honda Accords is 4.798 (really!). Suppose the base price of an Accord is $17,445 (LX 2 door with manual transmission). Suppose a Honda dealer sells 40 Accords per month.

(a) Find a linear demand curve for Honda Accords at this dealer-ship.

(b) What is the dollar amount of the change in revenue if the dealer offers a $500 incentive discount?

(c) Why do you think the elasticity is so high?

4. *Juvenor.* You take a job at a pharmaceutical market research firm. On your first day, the woman in the cubicle next to you says, "You'd better watch yourself – there was some guy from Amherst here before you, and he only lasted a week."
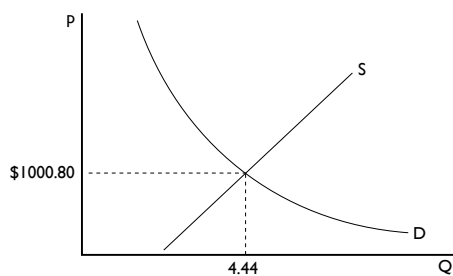
On your desk you find some handwritten notes:

Assignment: find market equilibrium for Juvenor (drug that makes people feel younger) and find consumer surplus.

Data: demand from men: $p = 100 - .02q$, demand from women: $p = 4000q^{-1}$, supply: perfectly inelastic, $q = 1000$.

Solution:

(a) Find market demand: men+women = $100 - .02q + 4000q^{-1}$.

(b) set equal to supply: $1000 = 100 - 0.02q + 4000q^{-1} \Rightarrow q = 4.44$

(c) Draw graph:

(d) Find consumer surplus: $CS = \int_0^{4.44} 100 - 0.02q + 4000q^{-1} dq$

At this point, there is some scratch work on the integral, and then a line trailing off to the lower right corner of the page. Your boss tells you that the data are correct, but you should redo each step of the solution, and explain what mistakes your predecessor made.

Review Problems only, not to turn in:

5. *Axolotls.* Suppose the market demand for axolotls, is given by the function $q = \frac{A}{p}$, where q denotes quantity demanded, p is the market price of axolotls, and A is a constant.

   (a) Graph this demand function.

   (b) Using calculus, derive an expression for the price elasticity of demand as a function of p. How does elasticity vary with the price?

   (c) For any given point on the demand function, determine the impact of changing price on consumers' total expenditure on this good.

   (d) Now suppose the demand function were instead given by $\frac{A}{p+z}$, where z is the price of zuzus, a different good. Are axolotls and zuzus substitutes or complements? Explain.

6. *Textbooks.* Suppose the market supply curve for economics textbooks is given by $s(p) = 10p$ and the market demand by $q(p) = 100 - 10p$. Derive and graph the competitive equilibrium price, quantity exchanged, and consumer and producer surplus.

7. *London.* In February 2003, drivers entering central London began paying a toll of £5 to help mitigate congestion. Previously there was no toll, and about 250,000 cars entered central London each day. The toll cut traffic by 15% and the city uses the toll revenue to fund public transportation projects.

   (a) Using the data above, find an approximate linear demand curve for automobile access to central London. (Hint: do not try to use elasticity to do this.)

(b) Using your demand curve, what is the approximate price elasticity of demand with the £5 toll in place?

(c) What was the price elasticity of demand without the toll? Do not use any math to answer this question.

(d) How much revenue does the toll generate? Do you know whether London could obtain more revenue by raising the toll?

8. *Wesley.* In Muller's *The Mind and the Market,* he quotes 18th century religious leader John Wesley as follows:

"Wherever riches have increased, the essence of religion has decreased in the same proportion. Therefore I do not see how it is possible in the nature of things for any revival of religion to continue long. For religion must necessarily produce both industry and frugality, and these cannot but produce riches. But as riches increase, so will pride, anger, and love of the world in all its branches."

Consider the market for "grain," which we will take to be the major good produced by a typical agricultural economy of Wesley's time period. Let grain have conventional, upward-sloping supply and downward-sloping demand.

(a) How will demand and/or supply shift if a religious revival produces "industry," that is, a desire to work harder?

(b) How will demand and/or supply shift if a religious revival produces "frugality," that is, a greater desire to save?

(c) How will demand and/or supply shift if "love of the world" increases, that is, if people become more interested in consumption?

(d) Based on your answer to (c), what will happen to the equilibrium price, quantity, consumer surplus, and producer surplus?

(e) Do you think that Wesley would view consumer surplus as a good measure of welfare? Why or why not?

(f) In what way has John Wesley affected each student in this class? (No points for this question, but you should know the answer!)

9. *Five-Households.* Suppose there are 5 households, each with demand curve $q(p) = 10p^{-2}$. Derive and graph the market demand curve. What is the total consumer surplus when $p = 2$?

Answers to Review Problems:

5. *Axolotls.*

(a) The graph is:

(b)
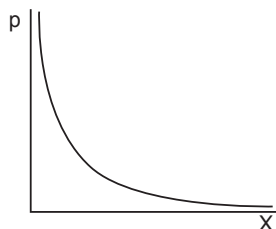
$$\varepsilon = \left| \frac{dq}{dp} \frac{p}{q} \right| = \frac{A}{p^2} \frac{p}{\frac{A}{p}} = 1$$

This is an example of a *constant elasticity demand function* along which elasticity does not vary with price. In this case, it's unit elastic along the entire curve.

(c) On this curve, total expenditure is $pq = p\frac{A}{p} = A$. Thus total expenditure on the good is A regardless of the price. This makes sense since the curve is unit elastic: total spending/revenue does not change as price changes.

(d) Suppose z increases. We find the effect on demand by taking the derivative with respect to z :

$$\frac{dq}{dz} = -\frac{A}{(p+z)^2} < 0$$

Since the derivative is negative, an increase in z reduces demand for axolotls which means the goods are complements.

6. *Textbooks_a.* Supply equals demand when $10p = 100 - 10p$, or $p = 5$. At this price, $q = 50$. The choke price is 10; thus consumer surplus is $\frac{1}{2}(10 - 5)50 = 125$. Producer surplus is $\frac{1}{2}(5 - 0)50 = 125$ as well.
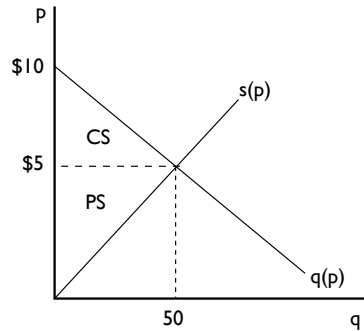
7. *London_a.*

   (a) The original point was $(p, q) = (0, 250000)$. Finding that 15% of 250,000 is 37,500, the new point is $(5, 212500)$. The equation for a linear demand curve that connects these points is:

$$q(p) = 250,000 - 7,500p$$

   (b) $\epsilon = \left| \dfrac{dq}{dp} \dfrac{p}{q} \right| = 7,500 \dfrac{5}{212,500} = 0.16$

   (c) Demand is linear, and without the toll we are at the bottom of a linear demand curve where elasticity is 0. Alternatively, if price is 0, any increase in price is an infinity percent increase, and any percent change in quantity divided by infinity is 0.

   (d) The toll generates $5 \cdot 212,500 = £1,062,050$ in revenue. Since demand is inelastic at this point, increasing the toll will increase revenue.

8. *Wesley_a.*

   (a) If workers have an increased *intrinsic* motivation to work (as opposed to just getting higher wages, better working conditions, more training, etc.), then firms' costs will fall, shifting the supply curve down. These hard workers may either need more grain to sustain them or they may earn higher incomes if they are working longer hours, in which case demand might also shift right.

   (b) Frugality means consuming less and saving more, so this clearly causes demand to shift left. But the savings of an individual must be turned into productive capital if society as a whole is to save. Therefore, there will be more investment in capital, and probably a resulting downward shift in supply as firms' costs fall.

   (c) If people just like consumption more, it is an increased taste for consuming, and demand shifts right.

   (d) The equilibrium price will rise, since demand shifts left. Producer surplus will definitely rise, since the supply curve is unchanged and price is higher. The change in consumer surplus is ambiguous. On the one hand, demand is higher, so there is more area under the demand curve. On the other hand, price has risen.

   (e) Consumer surplus measures welfare "willingness to pay," that is, it compares the amount a consumer would be willing to spend on a good versus the amount he or she actually must spend. Thus, welfare is equated with the consumption of material goods and the hypothetical high price a consumer would pay for them. Wesley views consumption of goods as problematic to people's characters, so he probably would not like consumer surplus.

9. *Five-Households_a.* We can simply add quantities up (horizontal addition in the graph). Thus the market demand function is 5 times the individual demand function, or $q(p) = 50p^{-2}$.

To find the consumer surplus, note there is no choke price, and therefore the integral is improper. But the answer is:

$$\int_2^\infty 50p^{-2} = \lim_{t\to\infty} \int_2^t 50p^{-2} = \lim_{t\to\infty} -50t^{-1} + 50 \cdot 2^{-1} = 0 + 25 = 25$$

The graph is: