ECON 110, Professor Hogendorn

Problem Set 2

1. *MTA.* On December 30, 2010, the fare for one subway ride in New York City was raised from \$2.25 to \$2.50. Annual ridership was about 1.6 (measured in billions). Suppose that demand turns out to be

$$Q_d = 2.21P^{-0.4}$$

   (a) Graph this demand function and show the price/quantity point where the price of a ride is \$2.25.

   (b) Find the elasticity of demand using the derivative.

   (c) Did the increase in fare increase or decrease revenue in the short run based on the data in this problem? Can you justify your answer without actually finding the new revenue?

   (d) Suppose that you find out that ridership in 2011 was *higher* than 1.6. What do you think is the most likely explanation for such a finding? Illustrate your answer with your graph.

2. *UAW.* In the aftermath of the financial crisis of 2008, the United Auto Workers union made certain concessions to American carmakers. These concessions were complex, but the important effect is that, on average, wages fell in the American auto industry.

   Let's treat the market for GM, Ford, and Chrysler cars separate from other carmakers so we don't have to worry about imports. The car market might look something like this:
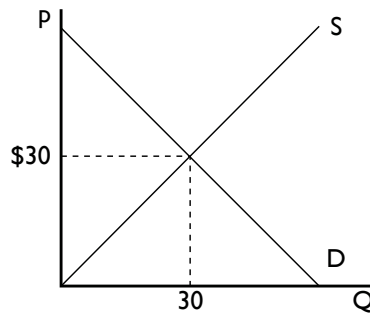
Note that both the supply and demand curves in this graph are drawn at 45-degree angles.

(a) Using the equilibrium point and the 45-degree slopes of the curves, find the demand and supply equations Q(p) and S(p).

(b) What is the price elasticity of demand and price elasticity of supply at the equilibrium point? (Answer the easiest way that you can.)

(c) How much money is spent on cars? How much of this spending is producer surplus? How much is costs? (Illustrate on a graph and give numerical answers.)

(d) Suppose the UAW concessions shifted the supply curve down by $1 (a parallel shift). Redraw the graph showing the old and new curves, and label the increase in consumer surplus, the decrease in costs, and the increase in producer surplus. (These will overlap, so you will need to use letters.)

3. *JFK.* You take a job with a cargo company at JFK Airport in New York City. The air cargo business at JFK has suffered in recent years because new aircraft are able to fly directly from international destinations to interior U.S. airports such as Memphis and Kansas City. Some of the cargo firms at JFK decide to petition the Port

Authority of New York and New Jersey to intervene in the market. Based on your economics training, you believe that demand is elastic (because there are many substitute airports) and supply is inelastic (because it is hard to leave or enter the industry).

(a) Draw supply and demand for air cargo with linear curves (be careful about the elasticities). Label the equilibrium price and quantity.

(b) Some firms are lobbying for a price floor above the market equilibrium price. Show the resulting quantity and the changes in consumer and producer surplus and deadweight loss.

(c) Do you recommend that your firm lobby for this policy? Remember that you are only considering the costs and benefits for your firm, but these may differ in the short and long run. The answer is ambiguous, so state your reasoning.

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:
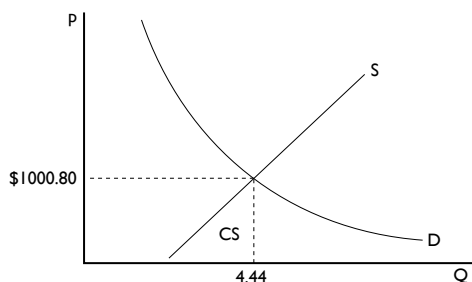
Your boss tells you that the data are correct but that the solution is all wrong. You should redo each step of the solution, and explain what mistakes Amherst Guy made.

Review Problems only, not to turn in:

5. *Accord.* The Honda Accord is a popular midsize car. The base model is called the LX and sells for $21,000. Honda sold about 33,000 Accords in the USA in the month of September 2015. An economist has estimated that the average price elasticity of demand for a particular make and model of car is -3.1.

   (a) Using the information above, do a back-of-the-envelope calculation to find a linear demand curve for Honda Accords.

   (b) Draw a diagram of the Honda Accord demand curve, showing the current price and quantity. Show the total spending on Accords and how it would change if Honda increased the price by $1,000. Would total spending go up or down from the price increase? How do you know?

   (c) Let the supply curve of Honda Accords be $Q_s = 29{,}010 + 0.19p$. What is the price elasticity of supply at the price and quantity given above?

6. *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.

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

9. *Textbooks.* Suppose the market supply curve for economics textbooks is given by $S = 10p$ and the market demand by

$Q = 100 - 10p$. Derive and graph the competitive equilibrium price, quantity exchanged, and consumer and producer surplus.

10. *Fluff.* Fluff toys are very popular. Originally they sold for $35 each, but the manufacturer has run out. So now, the only way to get one is on eBay, where the equilibrium price is $100 and the quantity is 5000.

   (a) Draw a graph of the supply and demand curves in the eBay market. Assume a linear demand curve and an inelastic (but not perfectly inelastic) supply curve. Label the consumer and producer surpluses.

   (b) Suppose that at equilibrium, the price elasticity of demand on eBay is $\epsilon = -1.2$. How many would people want to buy at the official retail price of $35?

   (c) Show what would happen if a government law prohibited sales at prices above the official retail price. Label the changes in producer and consumer surplus under the law. Label the deadweight loss. (You can just use letters instead of calculating numerically.)

Answers to Review Problems:

5. *Accord_a.*

   (a) Substituting into the formula for elasticity,

   $$E_d = \frac{dQ_d}{dP} \frac{P}{Q_d} \Rightarrow -3.1 = \frac{dQ_d}{dP} \frac{21,000}{33,000} \Rightarrow -4.87 = \frac{dQ_d}{dP}$$

   Using linear demand $Q_d = a - bP$, $b = 4.87$ and

   $$a - 4.87 \times 21,000 = 33,000 \Rightarrow a = 135,270$$

   (b) Total spending is $P \times Q_d = 21,000 \times 33,000$, shown by areas $B + C$. If the price were raised by $1,000, those who continue

to buy would increase their spending by A, but there would be a reduction in spending C by those who stop buying Accords. Since we know we're on the elastic part of the demand curve from part (a), we can be sure that the percent decrease in quantity is bigger than the percent increase in price, so $C > A$ and spending will go down.
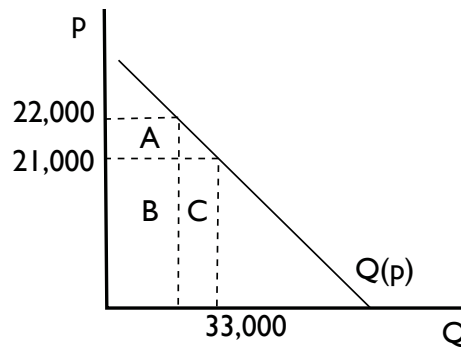

(c) Price elasticity of supply is

$$E_s = \frac{dQ_s}{dP}\frac{P}{Q_s} = 0.19\,\frac{21,000}{33,000} = 0.121$$

6. *Healthcare_a.*

   (a) Healthcare has very few substitutes because sick people have very limited alternatives. The only source of any elasticity is people delaying elective and preventive care and the poorest people going without care altogether.

   (b) Supply must be horizontal and it must intersect the demand curve below its midpoint.
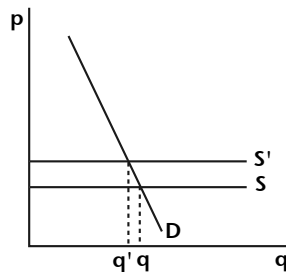
(c) Higher costs in the industry shift the supply curve up. At the new equilibrium, the percentage increase in price is greater than the percentage increase in supply due to the fact that demand is inelastic.

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:

   $$Q = 250,000 - 7,500p$$

   (b) $\epsilon = \dfrac{dQ}{dp}\dfrac{p}{Q} = -7,500\dfrac{5}{212,500} = -0.16$

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

8. *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 $Q = 50p^{-2}$.
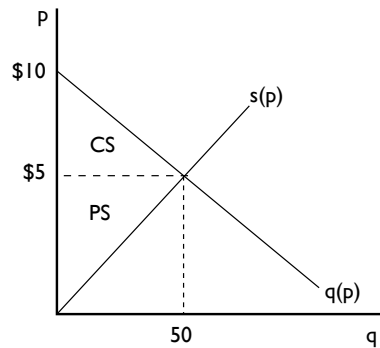
   To find the consumer surplus, note there is no choke price, and therefore the integral is improper. But the answer is:

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

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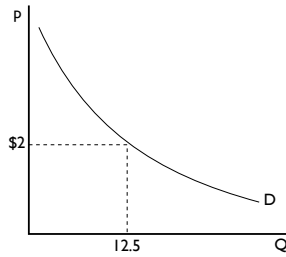
9. *Textbooks_a.* Supply equals demand when $10p = 100 - 10p$, or $p = 5$. At this price, $q = 50$. The choke price is 10; thus consumer surplus is $\frac{1}{2}(10 - 5)50 = 125$. Producer surplus is $\frac{1}{2}(5 - 0)50 = 125$ as well.

10. *Fluff_a.*

    (a) $CS = A + B$, $PS = C + D$. It might also be fair to add E to the producer surplus. This is because we are diagramming *resellers,* not manufacturers. These resellers are just selling out of a fixed inventory and whatever they paid for each Fluff, whether $35 or something else, is sunk by the time we get to the secondary market.
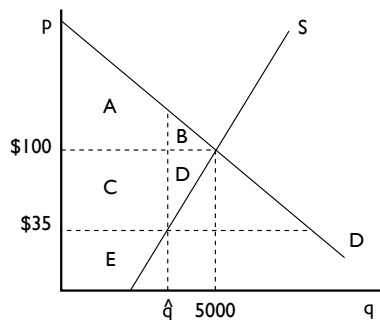
(b) By filling in the blanks in the elasticity formula, we can find the slope of the linear demand curve:

$$\epsilon = \left| \frac{dq}{dp} \frac{p}{q} \right| \Rightarrow 1.2 = \frac{dq}{dp} \frac{100}{5000} \Rightarrow \left| \frac{dq}{dp} \right| = 60$$

Now we know that there is a linear demand curve $q(p) = a - 60p$ and we know it goes through the point $(100, 5000)$. Thus:

$$5000 = a - 60 \times 100 \Rightarrow a = 11000$$

Then if the price is \$35, the quantity demanded will be

$$q(35) = 11000 - 60 \times 35 = 8900$$

(c) With the price control in place, supply would be the governing curve. The quantity traded would be reduced to q^c. Consumer surplus would change by $C - B$, while producer surplus would change by $-C - D$. The deadweight loss is $B + D$.