ECON 110, Prof. Hogendorn

Problem Set 2

1. *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:

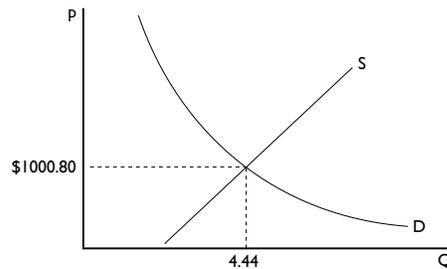   Assignment: find market equilibrium for Juvenor (drug that makes people feel younger) and find consumer surplus.

   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.

2. *JFK.* You take a job with a cargo company at JFK Airport in New York City. JFK's air cargo business has been suffering in recent years because new aircraft are able to fly directly from Europe to interior U.S. airports such as Memphis and Kansas City. Some of the other cargo firms serving 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 quite elastic (because there are many substitute airports) and supply is inelastic (because it is hard to leave or enter the industry).

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

   (b) Some firms are lobbying for a price floor p_f above the market equilibrium price. Show the resulting quantity q_f and show the effect on 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.

3. *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?

4. *Dollar-sales-tax.* Let demand be $Q(p) = 40 - 3p$ and supply is $s(p) = 2p$.

(a) What is the equilibrium price and quantity? What is the consumer and producer surplus?

(b) If a $1 per unit sales tax is imposed on Q, what is the new equilibrium price and quantity? What is the new consumer and producer surplus? What is the deadweight loss of the tax? How much revenue does the tax generate?

Review Problems only, not to turn in:

5. *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!)

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

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

(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?)

7. *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.

8. *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 $p = 2$?

9. *Veerman.* Dutch agriculture minister Cees Veerman owns farms in Holland and France. Let's suppose that he grows turnips, and that his supply curve for turnips is

$$s(p) = 1000 + 6.44p$$

Because he is a small producer, the demand curve for Veerman's turnips is perfectly elastic; that is, he has to accept the market price. Currently that price is €250 per tonne.

(a) Draw and label the supply and demand curves, including the quantity produced by Veerman. (note this is *not* a problem about tariffs, imports, or exports!)

(b) Suppose the European Union offers Veerman a per-unit subsidy of €63 per tonne. The subsidy is paid directly to Veerman. Show the effects of the subsidy in your diagram, including Veerman's new quantity produced.

(c) How much money does Veerman get in subsidy from the EU? How large is the deadweight loss?

(d) What do you think, is the turnip subsidy progressive in the sense that lower income farmers receive a larger subsidy per euro of income? (given the information in this problem, there is no one correct answer, but you must justify your reasoning.)

Answers to Review Problems:

5. *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 left.

   (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 prob-

lematic to people's characters, so he probably would not like consumer surplus.

6. *Tokens3_a.*

   (a) The graph is:
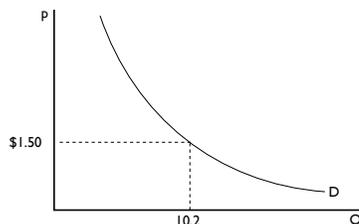
   (b) $\epsilon_p = \frac{dt}{dp_t}\frac{p_t}{t(p_t)} = -8.93p_t^{-5/3}\frac{p_t}{13.39p_t^{-2/3}} = -0.66\frac{p_t^{-2/3}}{p_t^{-2/3}} = -0.66$

   This should be no surprise since this is a constant elasticity demand curve with an exponent of $-2/3$.

   (c) Since we know that the demand is inelastic, the 33% rise in price will result in a less-than-33% decrease in quantity. Therefore the revenue must rise, since revenue is just price times quantity. If you calculated it out, the revenue was $15.32 before and $16.87 after.

7. *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.
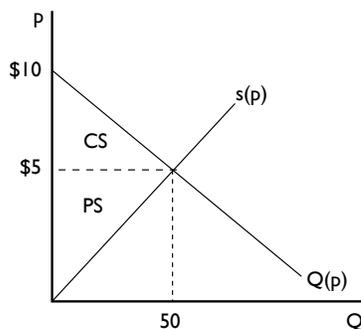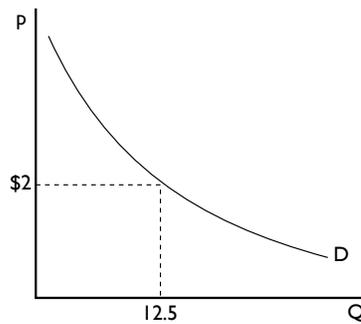
8. *Five-Households.* We can simply add quantities up (horizontal addition in the graph). Thus the market demand function is 5 times the individual demand function, or $Q(P) = 50p^{-2}$.

   To find the consumer surplus, note there is no choke price, and therefore the integral is improper. But the answer is:
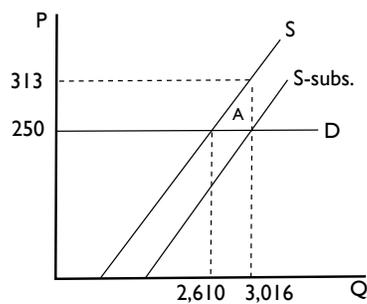
   $$\int_2^\infty 50p^{-2} = \lim_{t\to\infty} \int_2^t 50p^{-2} = \lim_{t\to\infty} -50t^{-1} + 50 \cdot 2^{-1} = 0 + 25 = 25$$

   The graph is:

9. *Veerman.*

   (a) Veerman takes the €250 price as given:

   (b) In the graph above, Veerman's supply curve is effectively shifted down by €63 because this represents a decrease in costs to him. As a result, his quantity increases.

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(c) The total subsidy to Veerman is €63 times the quantity 3,016, a total of €190,008. The area marked *A* in the diagram is dead-weight loss. In that area, the costs to Veerman, represented by line S, are greater than the value of 250 that consumers place on turnips. The area of *A*, one-half the base times the height, is $\frac{1}{2}(3016 - 2610) \times 63 = 12,789$.

(d) We know the turnip subsidy is a flat in the sense that it is the same regardless of the quantity of turnips produced. So the answer to the question depends on whether small turnip producers have *proportionately* larger or smaller incomes than large turnip producers. I think there are several reasons to support the regressive story: (1) large turnip producers have large amounts of land, which is probably associated with large income from other sources; (2) there are probably fixed costs associated with turnip production (tractors and equipment, farm buildings, etc.), and large turnip producers can spread this overhead across their output, thus lowering their average cost. But other stories could be told to justify a progressive argument.