Possible Solutions for Homework 1

Due Tuesday February 10, 2014

Economics of Sustainability

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- 1. What are the names of people in your study group?
- 2. Consider demand elasticities:
 - a. What goods do you personally demand (be creative!), which have a high price elasticity?
 - b. Which have a low price elasticity?
 - c. If we narrow the range to just phone apps (if you don't have a smartphone, then imagine), which ones would be highest/lowest elasticity?

Answers will vary.

3. Uber's surcharges have gotten recent publicity – what do these imply about demand and supply elasticities?

A surcharge (say a doubling of the usual price), is an attempt to clear the market – to attract more drivers and fewer passengers. The fact that prices change by such a large factor when quantity traded changes by a much smaller amount implies inelastic supply and/or demand – likely both.

- 4. Consider the supply and demand for gasoline. Sketch the changes (if any) for each contingency.
 - a. What would be the effect, on supply and demand for gasoline, of unrest in the Persian Gulf that made it difficult for oil tankers to pass? Would gas prices increase or decrease? Would quantity of gas sold increase or decrease?

A shift inward (to the left) of supply would increase the price and lower the quantity.

b. What would be the effect of new battery technology lowering the cost of hybrid or electric vehicles? Would gas prices increase or decrease? Would quantity of gas sold increase or decrease?

Better hybrids would lower long run demand for gasoline (although the effect would be small in the short run). A decrease in demand would lower prices as well as quantity.

- c. What would be the effect of a slowdown in Chinese economic growth? Would price increase or decrease? Would quantity increase or decrease?
 A slowdown in China would decrease global demand for oil, which would reduce price and quantity.
- d. Suppose the Saudis kept enough reserve production capacity to be able to increase or decrease production by 3%, with the aim of steadying prices?

If the KSA were to increase or decrease their supply, they would pump more when other oil producers faced unrest and would pump less when China slowed. But if the change is bigger than their spare capacity then they would no longer be able to moderate the swings.

This can be graphed by putting a bit of a horizontal segment to the supply curve at their target price:



- e. What would be the effect, in the gasoline market, of completing the Keystone pipeline? Would price increase or decrease? Would quantity increase or decrease?
 This would increase supply (by lowering the cost of bringing oil to market since it could be pumped through pipes rather than transported by rail) although the increase in supply would be very small. The increased supply would lower prices and increase quantity.
- f. How does enhanced recovery of 'tight oil' react to gasoline prices? What is that effect in the gasoline market?
 Better technology for pumping oil shifts the supply curve out, although if it only comes online at high prices then it is not a parallel shift but makes the supply curve more elastic at higher prices.
- 5. Consider a market that can be represented by a linear demand curve, $Q_D = 150 P_D$, (where Q_D is the quantity demanded and P_D is the price that demanders pay) and a linear supply curve that $Q_S = 2P_S$ (where Q_S is the quantity supplied and P_S is the price that suppliers get).



b. At a price of 40, how many units are demanded? How many are supplied? What would be Consumer and Producer Surplus at this price? (Remember that short side rules – can't buy something not produced nor sell something not bought!) (Recall that the area of a triangle is half the base times the height.)

At this price, there are 110 demanded and 80 supplied, so there are just 80 bought and sold. So Consumer Surplus is the orange trapezoid shown¹ while Producer Surplus is the blue triangle



Calculate area of CS as (80*30)+(.5*80*80) = 5600; PS is .5*80*40 = 1600; Total Surplus is the sum, 7200.

c. At a price of 60, how many units are demanded and supplied? What would be Consumer and Producer Surplus at this price?

At P=60, there are 120 produced and 90 purchased so there are 90 bought & sold. CS is the orange triangle and PS is the blue trapezoid:



Calculate CS = .5*90*90 = 4050; PS = (90*15) + (.5*90*45) = 3375; Total Surplus is 7425.

- d. Set $P_D=P_s$ and $Q_D=Q_s$ and solve the system of equations to find the equilibrium (find the intersection of the lines). Show on the graph. Set 150 - P = 2P so $P^* = 50$, $Q^* = 100$.
- e. What are CS & PS now? Show on the graph. Compare Total Surplus for the 3 cases.

¹ Well technically this is the maximum value of CS.

CS is a triangle .5*100*100 = 5000; PS is .5*100*50 = 2500; Total Surplus is 7500, the biggest yet.

f. Suppose the government sets a tax of \$2 per unit. This means that $P_D = P_S + 2$. What is now the quantity demanded & supplied? (You can rewrite the equations, that currently show Q as a function of P, to instead get P as a function of Q. Then substitute in the algebraic expressions for P_D and P_S to solve.) What are CS & PS now? What is government revenue (which adds to total surplus)? What is DWL (deadweight loss)?

Set Pd = 150 - Q; Ps = Q/2, then the tax condition gives Pd = Ps + 2 or (150 - Q) = Q/2 + 2. Solve so Q = 98.7, Pd = 51.3, Ps = 49.3. CS is .5*98.7*(150-51.3) = 4868. PS = .5*98.7*49.3 = 2434. Tax revenue is 2*98.7 = 197. Total Surplus is 7498.7, a bit smaller than previously, so there is a DWL = 1.3.

g. Suppose that production of this good has a marginal external cost of \$3 per item. What is the DWL of the free market equilibrium? What is the DWL of the tax case? In the case of a Marginal External Cost, neither demanders nor suppliers take notice so their behavior is unchanged and the price remains at 50 with 100 units bought & sold. However this cost of 3 means that there are additional costs so DWL is the small triangle shown (=.5*3*(100-98) = 4.5. In the case of the tax, the DWL is now reduced (to 0.35) since the amount traded is



- 6. A locality can use its coast for tourism (people are attracted to pristine coastline) or business/industry (which destroys the tourist appeal). It wants to choose what percent of coast should be preserved for tourism and how much should be kept for industry. Assume that the two industries can be modeled as follows. The coast (C) can be used for tourism, T, or business, B, where each is a percentage so $C_T + C_B = 100$. The jobs from businesses (in hundreds) can be modeled as $B = \sqrt{2C_B}$ and the number of tourists (in thousands) is $T = \sqrt{C_T}$. From combining the first two equations we can write $B = \sqrt{2(100 C_T)}$; from the third equation we can write $C_T = T^2$.
 - a. If 100% of the coast is used for tourism, what is the maximum number of tourists? If 100% were used for business, what is the maximum number of jobs? If there were a 50/50 split, how many tourists and how many jobs?

At Ct = 100, T=10. At Cb = 100, B=14. At Ct=50 and Cb=50, T=7.07 and B=10.

b. Write the equation giving B as a function of T. Graph it. (You can use Excel to plot points if it's easier.)



c. What is the opportunity cost, of business given up, if the island moves from zero to one tourist unit? (You can use calculus or find the change between values.)

From T=0, B=14.14 to T=1, B=14.07, $\frac{\Delta B}{\Delta T}$ =-.07.

d. What is the opportunity cost, of business jobs given up, for each unit of tourism, if the island moves to 100% tourism? Plot the opportunity cost.

В	$\frac{\Delta B}{\Delta T}$
14.14	
14.07	-0.07
13.86	-0.21
13.49	-0.37
12.96	-0.53
12.25	-0.71
11.31	-0.93
10.10	-1.21
8.49	-1.61
6.16	-2.32
0.00	-6.16
	B 14.14 14.07 13.86 13.49 12.96 12.25 11.31 10.10 8.49 6.16 0.00



e. Do the same exercise (find opportunity cost and plot), but find opportunity cost in terms of tourists, for integer units of business jobs.

Rewrite $B = \sqrt{2(100 - T^2)}$ as instead $T = \sqrt{100 - \frac{B^2}{2}}$ then plot with Excel. B T dT/dB 0 10.00 1 9.97 -0.03 2 9.90 -0.08



f. What is the best combination? What additional information is needed, to answer this? To answer "best" we need to know how the community values B versus T.