

University of Notre Dame
Department of Finance
Economics of the Firm
Fall 2011

Problem Set #1:

- 1) Suppose that you are currently leasing your office space for \$130,000 per year. You have the opportunity to buy the facility for \$1.8M. With a 10% down payment, you can get a mortgage for 8% interest per year. You can pay for the down payment from bank account that has been earning you 5% interest per year. Setting aside all other issues, should you lease the facility? Explain.

With your down payment of 10% or \$180,000, your annual interest on the loan will be $.08(\$1.8M - \$180,000) = \$129,600$ which is less than you are paying in rent. However, to get your real opportunity cost, we need to figure in the lost interest from the money you used as the down payment. 5% interest on the \$180,000 down payment would be \$9,000 bringing your total opportunity cost at \$138,600. You should continue to lease.

- 2) Suppose that a Dentist's office is located next door to a psychiatrist's office. The psychiatrist complains of violent screams from next door and that the noise is destroying his practice. He takes the dentist to court to try and get the dentist evicted. If you were the judge and you were interested in efficiency, how would you rule and why?

Efficiency requires that every asset is allocated to its most valuable use. In this case, we are worried about the allocation of the office space. Clearly, we can't have both the dentist and the psychiatrist using the space at the same time. Suppose that the psychiatrist earns \$800 per day in the office while the dentist earns \$1,000 per day. Then the dentist has the higher value use and should be awarded the space.

- 3) Suppose you are thinking about starting a lawn service in your area. The lawn service market can be considered perfectly competitive. You own a \$200 lawnmower. You have a fixed cost of \$90 (maintenance costs on the mower, etc.). Your variable costs are as follows:

# of Lawns Mowed	Total Variable Costs	Fixed Cost	Total Costs	Average Total Costs	Average Variable Costs	Marginal Costs
1	\$5	90	95	95	5	5
2	\$15	90	105	52.5	7.5	10
3	\$30	90	120	40	10	15
4	\$50	90	140	35	12.50	20
5	\$75	90	165	33	15	25
6	\$105	90	195	32.5	17.5	30
7	\$140	90	230	32.8	20	35
8	\$180	90	270	33.75	22.5	40
9	\$225	90	315	35	25	45
10	\$275	90	365	36.5	27.5	50

- a) Calculate total costs, average total costs, average variable costs, and marginal costs.
 b) Suppose that the going rate for lawns is \$35 per lawn. How many lawns would you mow?

At a price of \$35, we only want to supply lawns as long as our marginal cost is at or below \$35. In this case, we could supply 7 lawns.

- c) Calculate your producer surplus, and your profit. Are you earning economic profit?

# of Lawns Mowed	Marginal Cost	Price	Producer Surplus
1	5	35	30
2	10	35	25
3	15	35	20
4	20	35	15
5	25	35	10
6	30	35	5
7	35	35	0
8	40	35	--
9	45	35	--
10	50	35	--
Total			105

$$\text{Profit} = \text{Total Revenues} - \text{Total Costs} = (7)(35) - 230 = \$15$$

Not that profit is also producer surplus – fixed cost – $105 - 90 = \$15$.

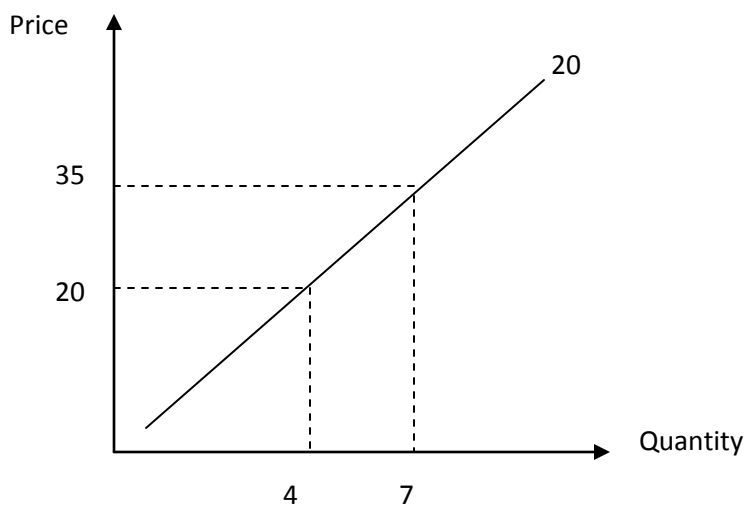
\$15 of profit would be a $(\$15/\$200)*100 = 7.5\%$ return. Is that a high enough return to take on the risk involved in mowing lawns? If not, supply will drop and the price will rise. If it is, then supply will rise and the price will fall.

d) How would your production decision change if the price fell to \$20 per lawn?

At a \$20 price, only 4 lawns would be supplied.

e) Sketch out your supply curve for lawns.

Price	Lawns Supplied
5	1
10	2
15	3
20	4
25	5
30	6
35	7
40	8
45	9
50	10



- 4) Suppose that we have the following information about wheat production (assume that each producer will operate at full capacity as long as it is strictly profitable):

Producer	Capacity (in Bushels)	Cost per bushel
1	100	\$3
2	200	\$4
3	200	\$5
4	400	\$6

Further, we also have some consumer information (Reservation price refers to the maximum price each consumer would pay). Assume that consumers will make their full purchase as long as the price is below their reservation price.

Consumer	Reservation Price	Wheat Purchases (in Bushels)
1	\$2	150
2	\$3	170
3	\$4	100
4	\$5	130
5	\$6	200
6	\$7	90

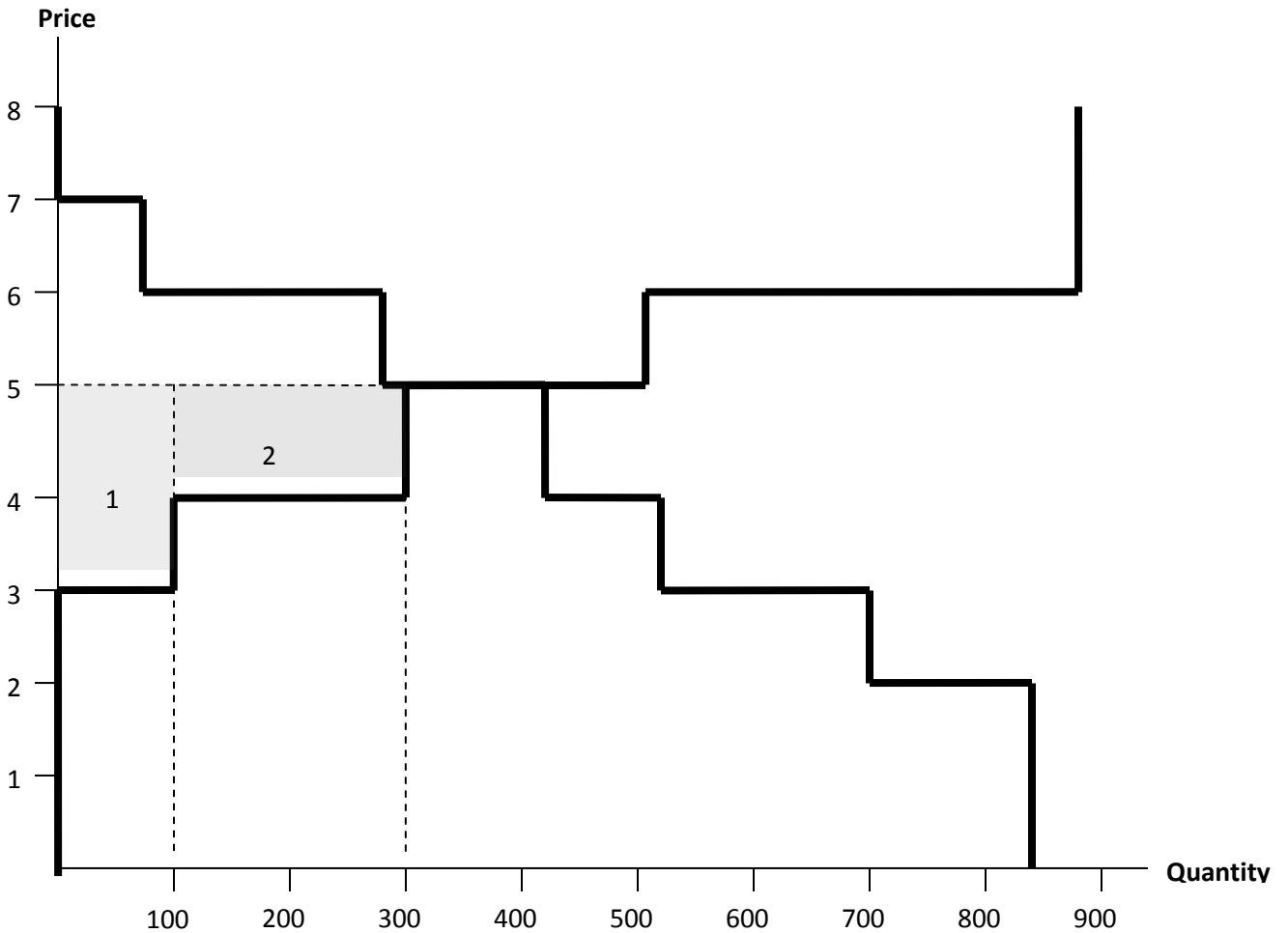
- a) What should be the market price of wheat?

To answer this question, look at each price and ask yourself how much will consumers be willing to buy (consumers will buy the full amount as long as the market price is strictly below their reservation price. If the market price equals their reservation price, they will buy anywhere from zero to their full amount). For example, if the market price is \$5, consumers five and six will buy their full amounts (for a total of 290). Consumer 4 will buy anywhere from zero to 130. Therefore the possible range for quantity demanded will be 290 -420. Next, how much will be supplied at every market price (producers will supply their full capacity if the market price is strictly above their unit cost. If the market price is equal to their unit cost, they will supply anywhere from zero to their full capacity). For example, if the market price is \$4, producer 1 will supply 100 and producer 2 will supply anywhere from zero to 200. Therefore total supply will be between 100 and 300.

If we do this for all prices, we get the following:

Price	Quantity Demanded	Quantity Supplied
1	840	0
2	690-840	0
3	520-690	0-100
4	420-520	100-300
5	290-420	300-500
6	90-290	500-900
7	0-90	900
8	0	900

Finally, in equilibrium, quantity supplied should equal quantity demanded, so look at the chart above and find where the ranges for demand and supply overlap – this happens at a market price of \$5. Below, I have put the chart in graph form. Note that the maximum consumers will buy at a \$5 price is 420.



b) Calculate the profits of the wheat producers

For each produce, profit will be quantity supplied times profit margin per sale:

Producer #1 operates at full capacity of 100 and earns a profit of \$2 per bushel for a total profit of \$200 (indicated in the graph above by shaded area 1).

Producer #2 operates at full capacity of 200 and earns a profit of \$1 per bushel for a total of \$200 (indicated by shaded area 2 above).

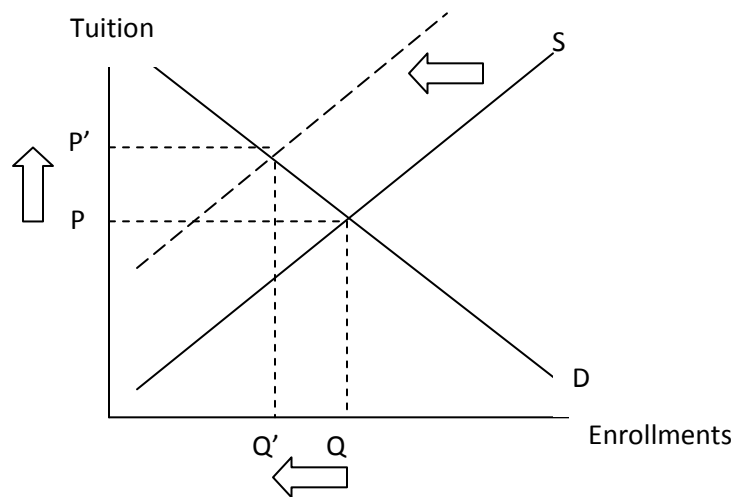
Producer #3 operates at limited capacity (produces 120) and earns a profit of zero (the market price is equal to unit cost).

- 5) Explain how each of the following events would affect the supply curve for education (by colleges), the demand curve for education (by potential students), total enrollments, and tuition rates.

(Note: There is not necessarily one correct answer for these questions. What I am interested in is that you can recognize how a change in supply or demand influences market price and market sales)

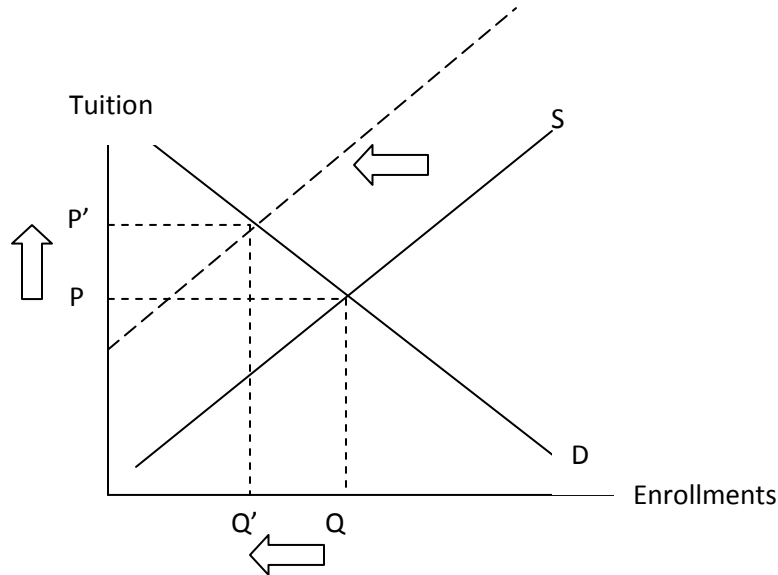
- a) University professors unionize and use their increased bargaining power to increase their salaries by 20%.

The main question here is: "Can we say that an increase in professor salaries affects the universities at the margin, or will this simply represent an increase in a fixed cost". If costs are affected at the margin, then the increase in costs lowers supply, raises price, and lowers enrollments.



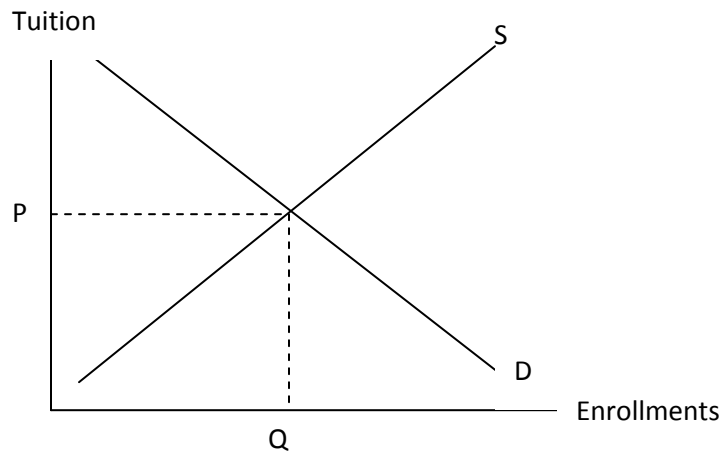
- b) Legislation is passed raising the minimum wage.

The rise in minimum wage will increase costs at the margin. Supply decreases, price rises, and enrollments drop.



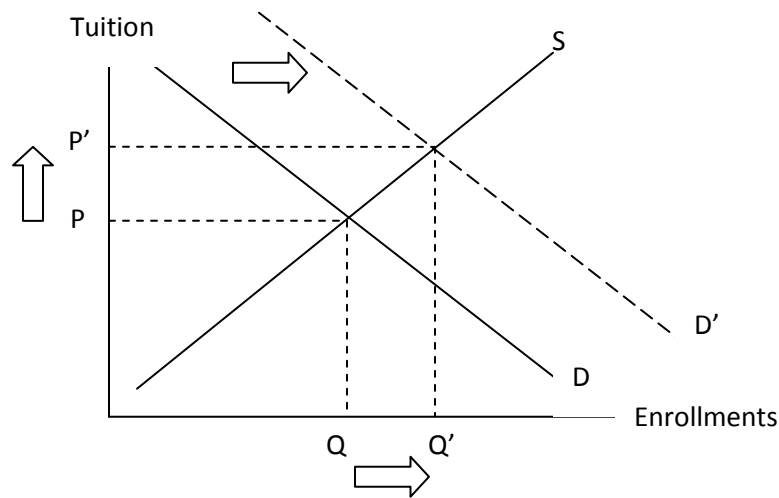
- c) Students nationwide file a class action lawsuit charging universities with unfair tuition policies. The result is that each university nationwide is fined \$200M.

In this case, the settlement represents an increase in a fixed cost. No decisions are affected.



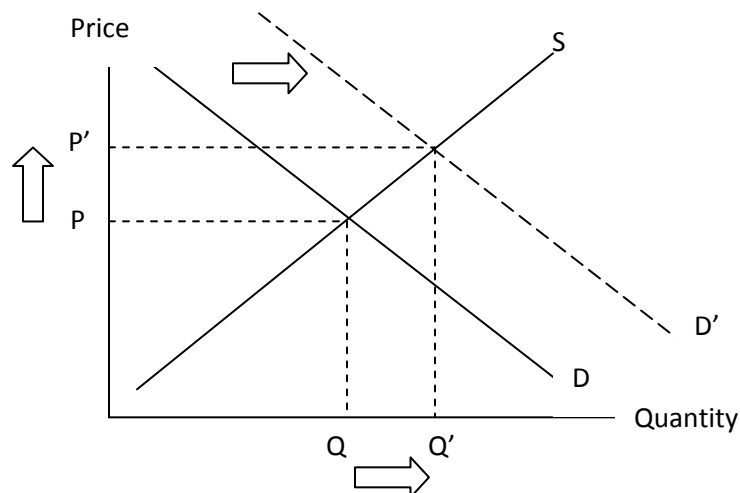
- d) Universities increase the availability of student aid.

The availability of aid raises demand. This will raise price and raise enrollments.



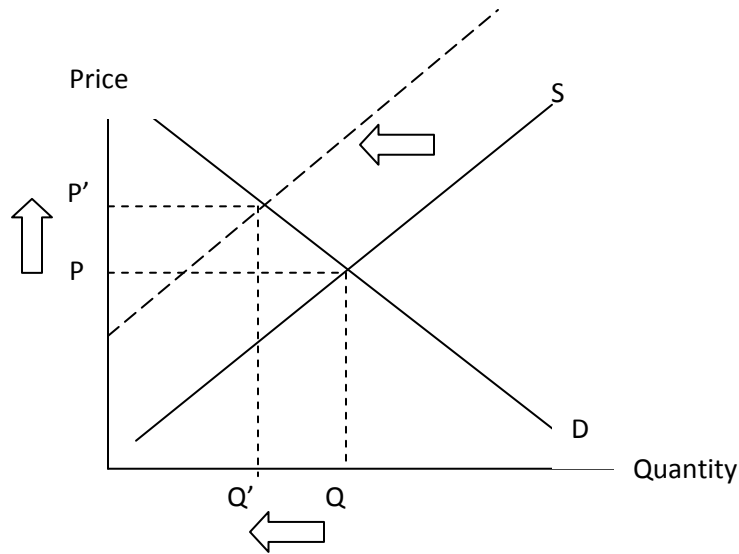
- 6) Explain how each of the following events would influence market prices/quantities
- a) The surgeon general announces that eating oranges lowers the risk of a heart attack (market for oranges)

The announcement should increase demand for oranges. This increase in demand should raise the market price and increases sales.



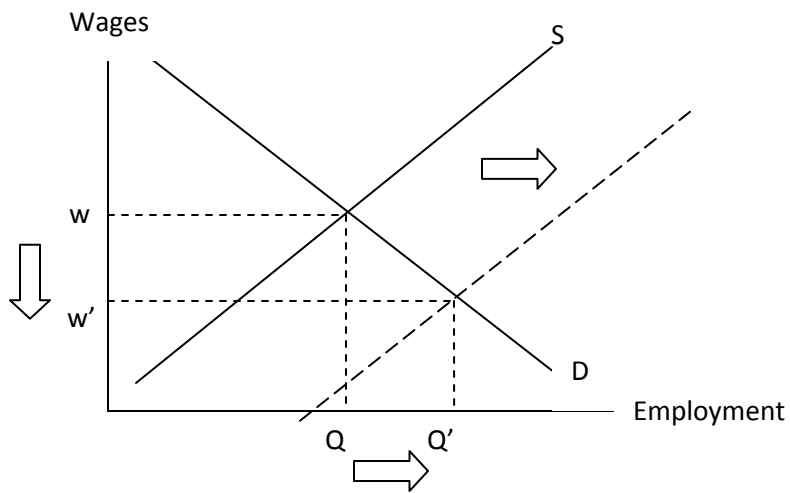
b) Terrorists destroy a major oil pipeline in Iraq (market for oil)

The drop in supply will raise price and lower sales.



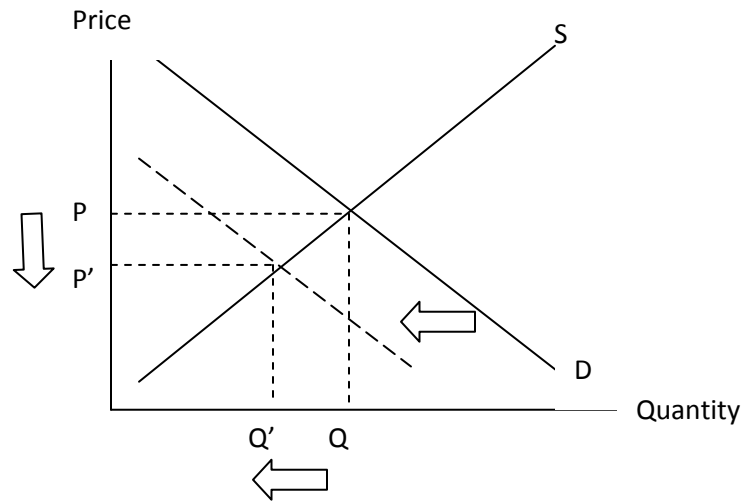
c) Immigration increases in the US by 20% (market for labor – what's the price here?)

The rise in supply should lower wages (the price of labor) and increase employment.



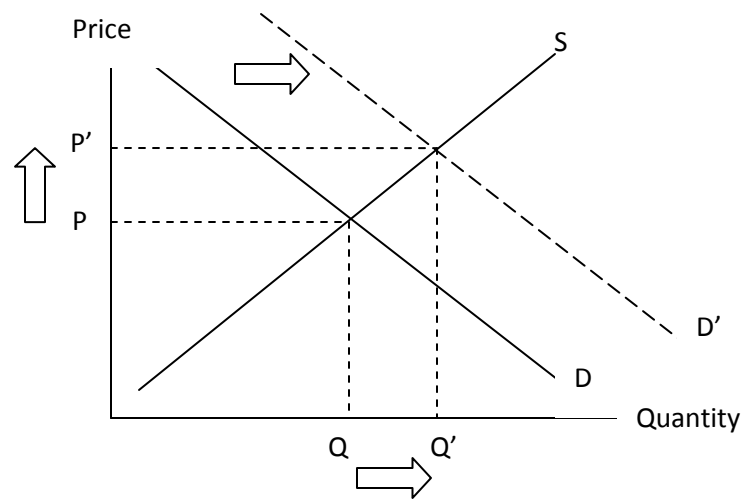
d) Consumers start getting their news from the internet (market for newspapers)

The drop in demand should lower price and lower sales.



e) Real income in the US increases (the market for BMW's)

The rise in income should increase demand for BMWs. This increase in demand should raise the market price and increases sales.



7) Suppose that you estimated the following demand curve for footballs.

$$Q = 400 - 6P + .005I$$

Q Represents quantity demanded, P represents price and I represents average income.

You know that the current market price is \$50 and average income is \$20,000

a) Calculate current demand for footballs.

$$Q = 400 - 6(50) + .005(20,000) = 200$$

b) Calculate the price elasticity of demand.

There are one of two ways to do this. First, we could simply alter price by some percentage, say, 10% and then calculate the new quantity demanded:

A 10% price increase would result in a new market price of \$55.

$$Q = 400 - 6(55) + .005(20,000) = 170$$

Now, calculate the percentage drop in sales:

$$\% \Delta Q = \left(\frac{170 - 200}{200} \right) * 100 = -15\%$$

Now, calculate elasticity:

$$\varepsilon = \frac{\% \Delta Q}{\% \Delta P} = \frac{-15}{10} = -1.5$$

Alternative: We can take the definition of elasticity and move some things around:

$$\varepsilon = \frac{\% \Delta Q}{\% \Delta P} = \frac{\Delta Q / Q}{\Delta P / P} = \left(\frac{\Delta Q}{\Delta P} \right) \left(\frac{P}{Q} \right)$$

The first expression in parentheses represents the change in quantity per dollar change in price which is the interpretation of the coefficient in front of price on the demand curve. The second term is the current price and quantity. Plugging everything in, we get

$$\varepsilon = \frac{\% \Delta Q}{\% \Delta P} = \left(\frac{\Delta Q}{\Delta P} \right) \left(\frac{P}{Q} \right) = -6 \left(\frac{50}{200} \right) = -1.5$$

- c) Calculate current market expenditures. (i.e. total spending on footballs)

Total expenditures is market price times market sales:

$$\$50 * 200 = \$10,000$$

- 8) Now, suppose, we know what demand and supply look like for restaurant meals:

$$Q_d = 40 - 2P + 3I$$

$$Q_s = 20 + 2P$$

Where Q is the number of meals sold (in thousands) per month, P is the average meal price and I is average income (in thousands). Assume that average income is equal to \$20,000.

- a) Calculate the equilibrium price and quantity.

In equilibrium, supply will equal demand:

$$Q_d = Q_s$$

$$40 - 2P + 3I = 20 + 2P$$

Plug in 20 for income and solve for price:

$$40 - 2P + 3I = 20 + 2P$$

$$40 - 2P + 3(20) = 20 + 2P$$

$$100 - 2P = 20 + 2P$$

$$80 = 4P$$

$$P = 20$$

Now, plug 20 into the supply curve to get sales: $Q_s = 20 + 2(20) = 60$

- b) Calculate the elasticity of demand at the equilibrium price.

Just like in question #4:

The first expression in parentheses represents the change in quantity per dollar change in price which is the interpretation of the coefficient in front of price on

the demand curve. The second term is the current price and quantity. Plugging everything in, we get

$$\varepsilon = \frac{\% \Delta Q}{\% \Delta P} = \left(\frac{\Delta Q}{\Delta P} \right) \left(\frac{P}{Q} \right) = -2 \left(\frac{20}{60} \right) = -.67$$

- c) What effect would a 10% increase in average income have on the price of restaurant meals?

Repeat part (a) with Income = 22

$$40 - 2P + 3I = 20 + 2P$$

$$40 - 2P + 3(22) = 20 + 2P$$

$$106 - 2P = 20 + 2P$$

$$86 = 4P$$

$$P = 21.50$$

Now, plug 20 into the supply curve to get sales: $Q_s = 20 + 2(21.50) = 63$

- 9) Suppose that it costs \$40,000/yr to get an MBA degree and that non MBAs expect to earn \$60,000/yr while MBAs earn \$80,000/yr. Assuming an MBA takes two years to finish and that all other costs are negligible, are wages and tuitions in equilibrium (i.e. would your average person strictly prefer one activity (getting an MBA) over another activity (not getting an MBA?). If not, how will markets adjust?

If we were to calculate the opportunity of getting an MBA, we would include two years worth of tuition as well as two years of lost wages. If we assume that the value of your time is \$60,000 per year (Non MBA salary), your total opportunity cost would be \$200,000. Therefore, the \$20,000 per year extra that an MBA earns would be a 10% return. If that makes a MBA strictly preferred, everyone would go back to school. With a shortage of Non-MBAs. The non-MBA salaries would rise, when the new MBAs hit the market, MBA salaries should fall and with higher demand for business school, tuitions should rise. This would lower the return to an MBA.

More difficult...attempt if you dare!

10) Suppose that you are concerned about teenage smoking in the US. You are interested in what the impact would be if a \$1 federal tax was added to each pack of cigarettes sold. You have the following data available:

- Elasticity of Demand (General Public): $-.45$
- Elasticity of Demand (Teenagers): $-.7$
- Elasticity of Supply: 7.0
- Current Market Price of Cigarettes: $\$5.51$
- Current Cigarette Sales: $17.4B$

a) First, we need to estimate the model. We are using a simply supply/demand framework:

$$Q_d = a - bP$$

$$Q_s = c + dP$$

Use the data above (use elasticity for the general population) to find the parameters a,b,c, and d.

From the notes, we have:

$$b = \varepsilon_d \left(\frac{Q}{P} \right) = -.45 \left(\frac{17.4}{5.51} \right) = -1.42$$

$$a = Q + bP = 17.4 + 1.42(5.51) = 25.2$$

$$d = \varepsilon_s \left(\frac{Q}{P} \right) = 7 \left(\frac{17.4}{5.51} \right) = 22.1$$

$$c = Q - dP = 17.4 - 22.1(5.51) = -104.4$$

b) Using your estimated model, solve for the equilibrium price and quantity. We already know this, but you should double check to make sure you did part (a) right.

So the model we have is:

$$Q_d = 25.2 - 1.42P$$

$$Q_s = -104.4 + 22.1P$$

Set demand equal to supply and solve for price:

$$25.2 - 1.42P = -104.4 + 22.1P$$

$$129.6 = 23.52P$$

$$P = 5.51$$

$$Q = 25.2 - 1.42(5.51) = 17.4$$

Good. We got what we should!

c) To put in the effect of the tax, we need to do the following:

- We have $Q_s = c + dP$. Now, solve this for price: $P = \left(\frac{1}{d}\right)Q_s - \left(\frac{c}{d}\right)$

- Now, add in the tax: $P = \left(\frac{1}{d}\right)Q_s - \left(\frac{c}{d}\right) + \1

- Now, Take the above and solve for Quantity: $Q_s = (c - d) + dP$

Therefore, our new supply curve is:

$$Q_s = -126.5 + 22.1P$$

d) Now, use your new supply curve and solve for the new equilibrium price and quantity. By what percentage do cigarette sales fall?

Now, resolve the model for price and quantity:

$$Q_d = 25.2 - 1.42P$$

$$Q_s = -126.5 + 22.1P$$

$$25.2 - 1.42P = -126.5 + 22.1P$$

$$151.7 = 23.52P$$

$$P = 6.45$$

$$Q = 25.2 - 1.42(6.45) = 16.04$$

Note that the price does not rise by the full dollar. Cigarette suppliers absorb some of the tax by dropping their price a little.

Cigarette sales fall by 6% from 17.4B to 16.04B

e) Given the price increase, by what percentage should teenage smoking fall?

Given a 16% rise in price from \$5.51 to \$6.45 and an elasticity of demand for teenagers of -0.7 , teenage sales fall by $-0.7 * 16\% = -11\%$

f) How much would you raise in taxes revenues?

\$1 per pack on 16.04B sales = \$16.04B