AGEC321, Fall 2011

Take-home Practice Problems: Solutions

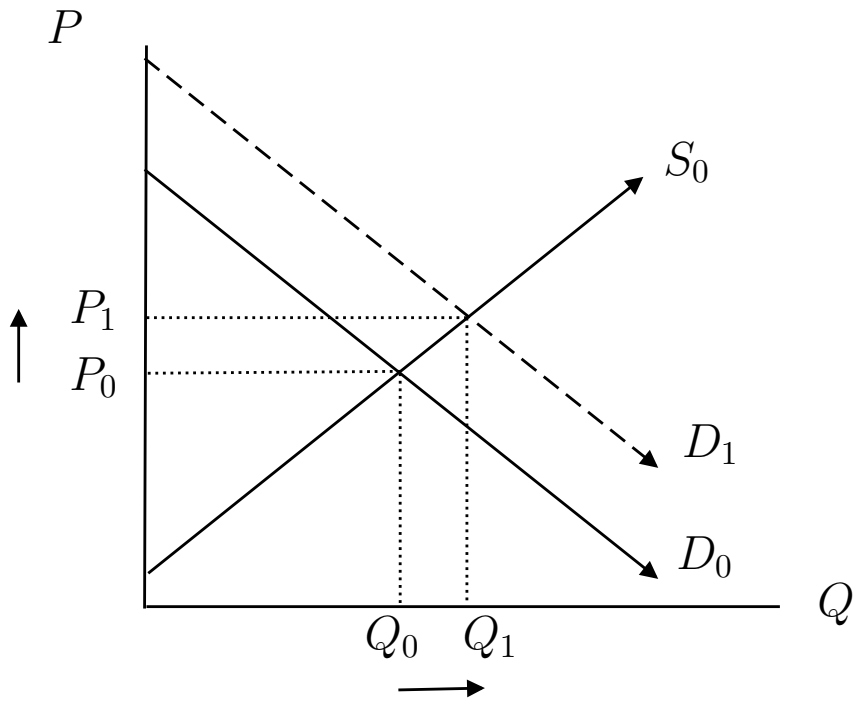
Due date: September 20, 2010, 5:00 p.m.

1. Read the article titled "College organic, sustainability programs growing" on the next page. Then, using basic supply and demand intuition, do the following:

   - Write a paragraph that describes what has occurred in the organic product market. I want to see that you are able to describe the logic behind the changes in the organic market during the past 10-20 years. Make sure to describe the changes in the supply, demand, quantity supplied, quantity demanded, and prices in the organic product market. (5 points)
   - Using a supply and demand diagrams, illustrate what has happened in the organic product market. Clearly label all of the components of the diagram, so that it is clear what component of the market changed and in which direction. (6 points)
   - How will the increasing number of college organic programs affect the organic product market? Why? (5 points)

Consumers of organic goods has been steadily increasing. This change in preferences has shifted the demand curve outward, increasing the quantity demanded at the existing price, P_0. As farmers see that consumers are willing to pay a higher price for the organic products, there is an increase in the quantity of organic products that are available in the market. However, there are still not enough of organic goods available to the consumers, such that there is still an excess demand. In response, agricultural departments are beginning to create programs that train young agricultural producers to grow organic products. As this continues, the organic market will eventually return to an equilibrium, at which there will be a higher price and higher quantities consumed and produced of organic foods.

Figure 1: Shift outward of the demand curve



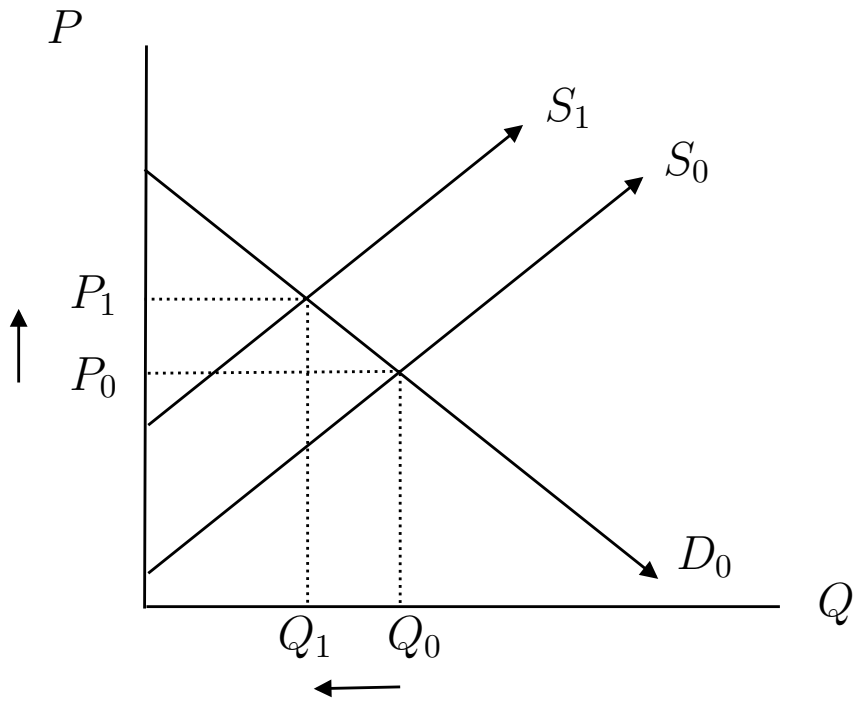
2. Read the article title "NC governor: Storm damage tops $400 million" on the next page. Then, Then, using basic supply and demand intuition, do the following:

   - Write a paragraph that describes what has occurred in North Carolina's agricultural market. I want to see that you are able to describe the logic behind the changes in the agricultural market. Make sure to describe the changes in the supply, demand, quantity supplied, quantity demanded, and prices. (5 points)
   - Using a supply and demand diagrams, illustrate what has happened in North Carolina's agricultural market. Clearly label all of the components of the diagram, so that it is clear what component of the market changed and in which direction. (6 points)
   - What might be the long-term effects of the losses of machinery and equipment due to the storm? Why? (5 points)

The damage caused by the weather event hurricane Irene resulted in an inward shift of the supply curve for many agricultural goods in North Carolina. This inward shift caused a shortage in the supply of these commodities at the existing price, P_0. As consumers begin to adjust to the supply shortage, some will be willing to pay a higher price to obtain the remaining quantity supplied of agricultural goods. As this occurs, producers will supply a higher quantity than if the price remained at P_0. These two dynamics will result in a movement along the demand and supply curves to the new equilibrium at the higher price and at a lower quantities supplied and demanded.

Because there was substantial damage to agricultural machinery and storage facilities, the inward shift of the supply curve may persist for a longer time period. Consequently, this will keep prices for agricultural products in North Carolina higher, until the machinery and storage facilities can be repaired or replaced.

Figure 2: Shift inward of the supply curve



3. Suppose that you are producer of hay from alfalfa. You know that the demand for hay is $Q^D_{hay} = 450 - P_{hay}$. In order to produce the hay, you'll need to seed and fertilize your fields and have a custom operator cut and bale the hay. The cost of seeding and fertilizing is \$60/ton of produced hay. Custom workers have a labor function $Q^L = 210 + P$

   Solve for the following:

   (a) Equilibrium quantity of hay. (6 points)

   (b) Equilibrium price of hay. (1 points)

   (c) Equilibrium quantity of labor. (1 points)

   (d) Equilibrium price of labor. (2 points)

   Additionally, illustrate the equilibrium values of hay and labor on a single supply and demand diagram. (2 points)

   Follow these steps to solve:

   (a) Organize and label (very important):

   You know that you have a demand function for sugar: $D: \ Q^D_{hay} = 450 - P^D_{hay}$

   You know that you have a supply function for labor: $S: \ Q^S_L = 210 + P$

   You know the price of seeding and fertilizing: $P_{sf} = \$60$

   (b) Convert all functions to inverse demand and inverse supply (in other words, solve for price):

$$ID: \ P^D_{hay} = 450 - Q^D_{hay}$$

$$IS: \ P^S_L = -210 + Q^S_L$$

   (c) Define the production function, and the price of production. In this case, you are told that the production of hay takes seeding, fertilizing, and custom labor. In other words:

$$H = SF + L$$

Now, that you've got a production function, you need to determine how much it will cost to produce hay. If you know this cost, than you will be able to determine how much you can sell on the market. In a competitive market, a producer will set the price of the output (hay) equal to the price of the inputs (seeding, fertilizing, and custom labor). In other words:

$$IS: \ P^S_{hay} = P^S_L + P_{sf}$$

(d) *Now, in step 1 you wrote out the prices of seeding/fertilizing and labor, and in step 2 you solved for the price of supplied labor. Plug these equations into the formula for* $IS: \ P^S_{hay}$*:*

$$IS: \ P^S_{hay} = (-210 + Q) + 60$$

$$P^S_{hay} = -150 + Q^S_{hay}$$

(e) *At equilibrium, you know that the supply and demand curves cross. At the intersection of this cross, there is only one price. In other words, the price at which hay will sell will be the* ***same*** *as the price at which hay will be purchased:* $P^S_{hay} = P^D_{hay}$*. Similarly, the quantity of hay sold will be the same as the quantity of hay purchased:* $Q^S_{hay} = Q^D_{hay}$*. To determine the equilibrium quantity, you set the equation for* $IS: \ P^S_{hay}$ *equal to the equation* $ID: \ P^D_{hay}$*, and then solve for* Q^*_{hay}*. Remember, when you set these two equations equal to each other, you should only have* Q *as the variable to solve:*

$$-150 + Q = 450 - Q$$

$$600 = 2Q$$

$$Q^*_{hay} = 300 \ ton$$

(f) *Now that you have the equilibrium quantity of hay, you need to determine the equilibrium price. To do so, you plug in* Q^*_{hay} *into the inverse demand formula of hay,* $ID: \ P^D_{hay}$*. Then, solve for the equilibrium price of hay:*

$$P^*_{hay} = 450 - (300)$$

$$P^*_{hay} = \$150 \ per \ ton$$

(g) *Next, you need to determine the amount of labor and the price that workers will be paid in order to produce the equilibrium quantity of hay. We will start by determining the price of labor (wage). But, we were only given the supply function of labor,* $S: \ Q_L^S$.
Remember that in step 3, we solved for the price of hay: $P_{hay}^S = P_L^S + P_{sf}$. *From this equation, we can also solve for the price of labor:*

$$P_{hay}^S = P_L^S + P_{sf}$$

Solving for P_L^S*:*

$$P_L^* = P_{hay}^* - P_{sf}$$

All we need to do now is plug the values for which we solved into the equation for P_L^* *and solve:*

$$P_L^* = \$150 - \$60.00$$

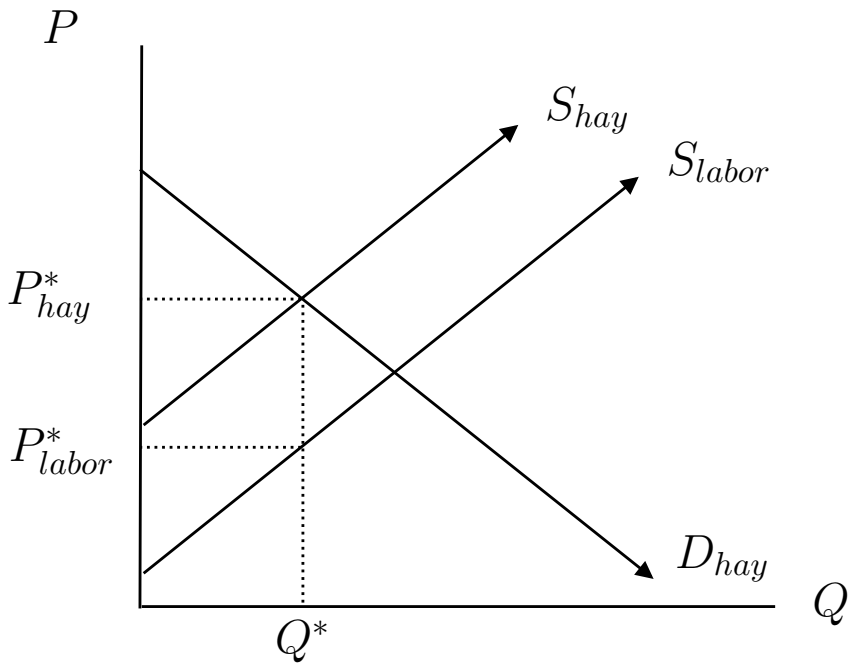
$$P_L^* = \$90$$

(h) *We now have the equilibrium price of labor. Next, we need to find minutes workers will work to produce the equilibrium quantity of hay. For this, we need a supply of function for labor. It so happens that we have it written out in step 1:* $S: \ Q_L^S = 210 + P_L^S$. *Since we already have the equilibrium price of labor, we simply plug it into the labor supply function, and solve for* $S: \ Q_L^S$*:*

$$Q_L = 210 + (\$90)$$

$$Q_L^* = 300 \ \textit{minutes}$$

Figure 3: Market for hay



4. Use the information supplied in problem (3). Assume that the price of fertilizer increased by \$30/ton of hay production.

   Solve for / answer the following:

   (a) Equilibrium quantity of hay. (6 points)
   (b) Equilibrium price of hay. (1 points)
   (c) Equilibrium quantity of labor. (1 points)
   (d) Equilibrium price of labor. (2 points)
   (e) Who benefited? Who is worse of? (3 points)

   Follow these steps to solve:

   (a) Organize and label (very important):

   You know that you have a demand function for sugar: $D: \ Q^D_{hay} = 450 - P^D_{hay}$

   You know that you have a supply function for labor: $S: \ Q^S_L = 210 + P$

   You know the price of seeding and fertilizing: $P_{sf} = \$90$

   (b) Convert all functions to inverse demand and inverse supply (in other words, solve for price):

$$ID: \ P^D_{hay} = 450 - Q^D_{hay}$$

$$IS: \ P^S_L = -210 + Q^S_L$$

   (c) Define the production function, and the price of production. In this case, you are told that the production of hay takes seeding, fertilizing, and custom labor. In other words:

$$H = SF + L$$

   Now, that you've got a production function, you need to determine how much it will cost to produce hay. If you know this cost, than you will be able to determine how much you can sell on the market. In a competitive market, a producer will set the price of the output (hay) equal to the price of the inputs (seeding, fertilizing, and custom labor). In other words:

$$IS: \ P^S_{hay} = P^S_L + P_{sf}$$

(d) *Now, in step 1 you wrote out the prices of seeding/fertilizing and labor, and in step 2 you solved for the price of supplied labor. Plug these equations into the formula for* $IS: \ P^S_{hay}$*:*

$$IS: \ P^S_{hay} = (-210 + Q) + 90$$

$$P^S_{hay} = -120 + Q^S_{hay}$$

(e) *At equilibrium, you know that the supply and demand curves cross. At the intersection of this cross, there is only one price. In other words, the price at which hay will sell will be the* ***same*** *as the price at which hay will be purchased:* $P^S_{hay} = P^D_{hay}$*. Similarly, the quantity of hay sold will be the same as the quantity of hay purchased:* $Q^S_{hay} = Q^D_{hay}$*. To determine the equilibrium quantity, you set the equation for* $IS: \ P^S_{hay}$ *equal to the equation* $ID: \ P^D_{hay}$*, and then solve for* Q^*_{hay}*. Remember, when you set these two equations equal to each other, you should only have* Q *as the variable to solve:*

$$-120 + Q = 450 - Q$$

$$570 = 2Q$$

$$Q^*_{hay} = 285 \ ton$$

(f) *Now that you have the equilibrium quantity of hay, you need to determine the equilibrium price. To do so, you plug in* Q^*_{hay} *into the inverse demand formula of hay,* $ID: \ P^D_{hay}$*. Then, solve for the equilibrium price of hay:*

$$P^*_{hay} = 450 - (285)$$

$$P^*_{hay} = \$165 \ per \ ton$$

(g) *Next, you need to determine the amount of labor and the price that workers will be paid in order to produce the equilibrium quantity of hay. We will start by determining the price of labor (wage). But, we were only given the supply function of labor,* $S: \ Q^S_L$*.*
Remember that in step 3, we solved for the price of hay: $P^S_{hay} = P^S_L + P_{sf}$*. From this equation, we can also solve for the price of labor:*

$$P^S_{hay} = P^S_L + P_{sf}$$

Solving for P^S_L*:*

$$P^*_L = P^*_{hay} - P_{sf}$$

All we need to do now is plug the values for which we solved into the equation for P^*_L *and solve:*

$$P^*_L = \$165 - \$90.00$$

$$P^*_L = \$75$$

(h) *We now have the equilibrium price of labor. Next, we need to find minutes workers will work to produce the equilibrium quantity of hay. For this, we need a supply of function for labor. It so happens that we have it written out in step 1:* $S: \ Q^S_L = 210 + P^S_L$*. Since we already have the equilibrium price of labor, we simply plug it into the labor supply function, and solve for* $S: \ Q^S_L$*:*

$$Q_L = 210 + (\$75)$$

$$Q^*_L = 285 \ \textit{minutes}$$