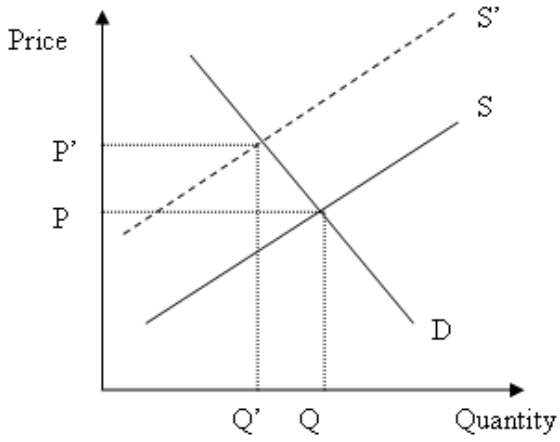
We now have to solve the system:

$$Q = 10P_J - 10$$
$$Q = 150 - 15P_J$$

Solving for P_J and Q we get that $P_J = 6.4$ and $Q = 54$. In a supply and demand graph, the supply curve shifts to the left, resulting in the higher equilibrium price and lower equilibrium quantity.



(c) (8 points) Suppose $P_A = 1$ but the price of tea drops to $P_T = 3$. Find the new equilibrium price and quantity of apple juice.

$Q = 10P_J - 5$, $Q = 130 - 15P_J \longrightarrow P_J = 5.4$, $Q = 49$.

(d) (8 points) Suppose $P_A = 1, P_T = 5$, and there is a price ceiling on apple juice of $P_J^* = 5$. What is the excess demand for apple juice as a result? Draw a graph to illustrate your answer.

Note that the price ceiling will be binding, since the equilibrium price from (a) is $P_J = 6.2$. Plugging the price ceiling level into the supply and demand equations we get that $Q_S = 45$ and $Q_D = 75$. Hence, there will be excess demand for apple juice of $Q_E = 30$. The graph in Question 1(e) shows the identical case as the one here.

Problem 3 solution courtesy of William Wheaton. Used with permission.

4. (25 points) You have been asked to analyze the market for steel. From public sources, you are able to find that last year's price for steel was \$20 per ton. At this price, 100 million tons were sold on the world market. From trade association data you are able to obtain estimates for the own-price elasticities of demand and supply on the world markets as -0.25 for demand and 0.5 for supply. **Assume that steel has linear demand and supply curves throughout**.

(a) (10 points) Solve for the equations of demand and supply in this market and sketch the demand and supply curves.

Assume that this is a competitive market and assume that demand and supply are linear. Thus, $X_d = a - bP$ and $X_s = c + dP$. We know from the equation for own-price elasticity of demand that

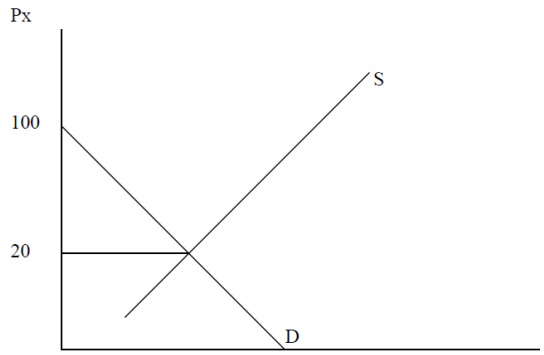
$$E_{Q_X P_X} = \frac{dX_d}{dP_X}\frac{P_X}{X_d} = -b\frac{P_X}{X_d} = -b\frac{20}{100} = -0.25$$

Solving for b, then, we have $b = 1.25$. Substituting back into the equation for demand, $X_d = a - 1.25P$ or $100 = a - 1.25(20)$. Solving for a we have $a = 125$. Hence, the equation for last year's demand is $X_d = 125 - 1.25P$.

We know that the price elasticity of supply is

$$E_{Q_X P_X} = \frac{dX_s}{dP_X}\frac{P_X}{X_s} = d\frac{20}{100} = 0.5$$

Solving for d, then, we have $d = 2.5$. Substituting back into the equation for supply, $X_s = c + 2.5P$ or $100 = c + 2.5(20)$. Solving for c, we have $c = 50$. Hence, the equation for last year's supply is $X_s = 50 + 2.5P$.



(b) (15 points) Suppose that you discover that the current price of steel is \$15 per ton and the current level of worldwide sales of steel is 150 million tons. The most recent elasticity estimates from the trade association this year are -0.125 for demand and 0.25 for supply. Describe the change in the supply and demand curves over the past year using your diagram from part (a). What sort of event(s) might explain the change?

Using the same functional forms as in the first part of the answer, with the new data we find that $X_d = a - bP$ becomes $150 = a - b(15)$. Our equation for elasticity of demand yields

$$E_{Q_X P_X} = \frac{dX_d}{dP_X}\frac{P_X}{X_d} = -b\frac{P_X}{X_d} = -b\frac{15}{150} = -0.125$$

Solving for b yields $b = 1.25$. Substituting this value for b into the equation for (linear) demand, we have $150 = a - 1.25(15)$ or $a = 168.75$. Hence, $X_d = 168.75 - 1.25P$.

For supply, we have $X_s = c + dP$ or $150 = c + d(15)$. The equation for elasticity yields

$$E_{Q_X P_X} = \frac{dX_s}{dP_X}\frac{P_X}{X_s} = d\frac{15}{150} = 0.25$$

Solving for d yields $d = 2.5$. Substituting this value for d into the equation for linear supply, we have $150 = c + 2.5(15)$ or $c = 112.5$. Thus, $X_s = 112.5 + 2.5P$.

The demand and supply have kept the same slope as last year, but the intercepts have changed for both curves: demand and supply have shifted out. The demand shift could occur with any number of factors that increase the willingness to pay for steel at any given price, such as an increase in income, an increase in the price of other (substitute) materials, or the increase in demand for a good that requires steel as an input, like cars. The supply shift could occur with any of a number of factors that increase the willingness to produce steel for the markets at a given price, such as an increase in the number of firms that sell steel, or a decrease in the prices of inputs required to produce steel (such as steel workers' wages).

Problem 4 solution courtesy of Luke Stein. Used with permission.