Take-home Practice Problems

1. You are analyzing the market for shrimp. The demand for shrimp is dependent on the price of shrimp and the prices of crab, lobster, and mussels. The demand function for shrimp is:

$$Q_D^{shrimp} = 2000 - 4P^{shrimp} + 5P^{crab} + 10P^{lobster} - 2P^{mussel}$$

You know that $P^{shrimp} = \$100$, $P^{crab} = \$250$, $P^{lobster} = \$500$, $P^{mussel} = \$50$.

Respond to the following:

(a) Quantity of shrimp.

(b) Own-price demand elasticity of shrimp.

(c) Cross price elasticities of shrimp and (i) crab, (ii) lobster, and (iii) mussels.

$$Q^{shrimp} = 7750$$

$$\varepsilon_{s,s} = \frac{\Delta Q^s}{\Delta P^s}\frac{P^s}{Q^s} = -4 \cdot \frac{100}{7750} = -0.05$$

$$\varepsilon_{s,c} = \frac{\Delta Q^s}{\Delta P^c}\frac{P^c}{Q^s} = 5 \cdot \frac{250}{7750} = 0.16$$

$$\varepsilon_{s,l} = \frac{\Delta Q^s}{\Delta P^l}\frac{P^l}{Q^s} = 10 \cdot \frac{500}{7750} = 0.65$$

$$\varepsilon_{s,m} = \frac{\Delta Q^s}{\Delta P^m}\frac{P^m}{Q^s} = -2 \cdot \frac{50}{7750} = -0.01$$

2. You are a farmer who can produce canola and camelina on the same land. Suppose that the supply of canola follows the function:

$$Q_S^{canola} = 500 + 3P^{canola} + 2 \cdot Rain - 4P^{camelina} - 8P^{wheat}$$

You know that $P^{canola} = \$2.00$, $Rain = 10\ in.$, $P^{camelina} = \$1.50$, $P^{wheat} = \$8$.

Respond to the following:

(a) How much more canola will you sell if the market price of canola increases by 1%?

$$Q^{canola} = 456$$

$$\varepsilon_{c,c} = \frac{\Delta Q^c}{\Delta P^c}\frac{P^c}{Q^c} = 3 \cdot \frac{2}{456} = 0.01$$

A 1% increase in market prices will increase quantity supplied by 0.01%.

i. How will producers respond in the short run?

There will be a slight increase in the quantity supplied of wheat, because farmers are trying to respond to higher prices by selling their stored commodity.

ii. How will producers respond in the long run?

If prices remain higher, then farmers will reallocate land to produce more wheat.

(b) If the price of camelina increases by 20%, will you plant more or less canola? How much quantity of canola will you change?

$$\varepsilon_{c,ca} = \frac{\Delta Q^c}{\Delta P^c a}\frac{P^c a}{Q^c} = -4 \cdot \frac{1.50}{456} = -0.01$$

For a 20% increase in camelina prices, canola production will decrease by 0.2%.

(c) Suppose that rain fall is 2 inches greater. What is the percentage by which the production of canola change?

A 2 inch increase in rain is a 20% increase in rain over the initial 10 inch amount. Now, $\varepsilon_{c,r} = 0.04$*, so a 20% increase in rain would lead to an 0.8% increase in canola production.*

3. Consider the market for watermelons. The demand for watermelons is a function of watermelon price, the prices of honeydew melons and sweet corn, and consumer income. This demand is characterized by the following equation:

$$Q_D^{wm} = 50 - 3P^{wm} - 20P^{hd} + 10P^{sc} + 0.001 \cdot Income$$

Prices are: $P^{wm} = \$4.00$, $P^{hd} = \$3.00$, $P^{sc} = \$2.00$, $Income = \$40,000$.

Furthermore, the supply of watermelons is characterized by the following:

$$Q_S^{wm} = 22 + 4P^{wm}$$

(a) In your own words, describe the steps necessary to analyze a 5% demand shock in the watermelon market. Be very specific and make sure that you fully understand the underlying mechanism.

(b) What is the quantitative effect of a 5% demand shock in the watermelon market? Determine the effect on price, quantity demanded, and quantity supplied of watermelon.

(c) Now consider a simultaneous supply shock in the watermelon market of –10% due to an extreme drought. This supply shock occurs at the same time as the 5% demand shock. Determine the effect on price, quantity demanded, and quantity supplied of watermelon.

First, you will need to calculate the elasticities of demand and supply for watermelons. These are: $\varepsilon^D_{w,w} = -0.32$ *and* $\varepsilon^S_{w,w} = 0.42$*. Next, use the following relationship to determine the effect of the shock on the watermelon market:*

$$\%\Delta P = \frac{S^D - S^S}{\varepsilon^S - \varepsilon^D} = \frac{5}{0.42 - (-0.32)} = 6.79\%$$

$$\%\Delta Q^D = \%\Delta Q^S = \varepsilon^S \cdot \%\Delta P + S^S = 0.42 \cdot 6.79 = 2.86\%$$

The same approach can be used for investigating simultaneous changes to supply and demand.

$$\%\Delta P = \frac{S^D - S^S}{\varepsilon^S - \varepsilon^D} = \frac{5 - (-10)}{0.42 - (-0.32)} = 20.36\%$$

$$\%\Delta Q^D = \%\Delta Q^S = \varepsilon^S \cdot \%\Delta P + S^S = 0.42 \cdot 20.36 + (-10) = -1.43\%$$

4. *You wish to analyze the impacts of the drought on the winter wheat market. You anticipate an 12% supply shock to the winter wheat market, in which demand is characterized by a function of hard red winter (hrw) wheat prices, live cattle (lc) prices, corn prices, and soybean prices.*

$$D^{hrw} : \; Q^{hrw}_D = -1000 - 5P^{hrw} + 4P^{corn} + 10P^{lc} + 5P^{soybean}$$

The supply of hard red winter wheat is a function of its market price, the price of spring wheat (hrs), and the price of fertilizer (f).

$$S^{hrw} : \; Q^{hrw}_S = 303 + 10P^{hrw} - 5P^{hrs} - 0.25P^f$$

Prices for these commodities and income are as follows:

$$\begin{aligned}
P^{hrw} &= \$8/bushel \\
P^{lc} &= \$120/cwt \\
P^{corn} &= \$7/bushel \\
P^{soybean} &= \$14/bushel \\
P^{hrs} &= \$10/bushel \\
P^{f} &= \$300/ton
\end{aligned}$$

(a) *First, assume that the market shock affects only the winter wheat market. Quantitatively determine the impacts on the price, quantity demanded, and quantity supplied of HRW wheat. Neatly outline the steps and logic of solving the problem.*

This is a single-market analysis, so you can use the short-cut formula for solving for the impacts of the shock. You will first, however, need to calculate wheat quantities and the elasticities of demand and supply for HRW. These are: $Q_{hrw} = 258$, $\varepsilon^D_{hrw,hrw} = -0.16$ *and* $\varepsilon^S_{hrw,hrw} = 0.31$. *Next, use the following relationship to determine the effect of the shock on the HRW market:*

$$\%\Delta P = \frac{S^D - S^S}{\varepsilon^S - \varepsilon^D} = \frac{0 - (-12)}{0.31 - (-0.16)} = 25.8\%$$

$$\%\Delta Q^S = \%\Delta Q^D = \varepsilon^D \cdot \%\Delta P + S^D = -0.16 \cdot 25.8 = -4.1\%$$

You know, however, that the shock to the HRW wheat market had an impact on the corn market. Consequently, you'll need to analyze the effect of the shock within a dynamic, two-market structure. You know the following about the corn market:

$$D^{corn} : \ Q^{corn}_D = 50 - 4P^{corn} + 2P^{hrw} + P^{lc} + 3P^{soybean}$$

$$S^{corn} : \ Q^{corn}_S = 392 + 2P^{corn} - 4P^{soybean} - 0.5P^f$$

(b) *Quantitatively determine the impacts on the price, quantity demanded, and quantity supplied of HRW wheat and corn. Neatly outline the steps and logic of solving the problem.*

i. *First, you will need to determine the own-price elasticities in the corn market and then the cross-price elasticities of demand between HRW and corn, corn and HRW, and the supply elasticity of corn. These are as follows:*

$Q_{corn} = 200$

$\varepsilon^D_{C,C} = -0.14$

$\varepsilon^D_{HRW,C} = 0.11$

$\varepsilon^D_{C,HRW} = 0.08$

$\varepsilon^S_{C,C} = 0.07$

ii. Now, use the elasticities to solve using the following setup:

$$\varepsilon^S_{HRW}\%\Delta P_{HRW} + S^S = \varepsilon^D_{HRW}\%\Delta P_{HRW} + \varepsilon^D_{HRW,C}\%\Delta P_C + S^D$$

$$\varepsilon^S_C\%\Delta P_C + S^S = \varepsilon^D_C\%\Delta P_C + \varepsilon^D_{C,HRW}\%\Delta P_{HRW} + S^D$$

$$\begin{aligned} \%\Delta P^{HRW} &= 28.3\% \\ \%\Delta Q^{HRW} &= -3.22\% \\ \%\Delta P^{C} &= 10.8\% \\ \%\Delta Q^{C} &= 0.76\% \end{aligned}$$

Lastly, assume that the corn market also had a negative supply shock of 5% and a negative demand shock of 2%.

(c) *Quantitatively determine the impacts on the price, quantity demanded, and quantity supplied of HRW wheat and corn. Neatly outline the steps and logic of solving the problem.*

$$\begin{aligned} \%\Delta P^{HRW} &= 32\% \\ \%\Delta Q^{HRW} &= -2.09\% \\ \%\Delta P^{C} &= 26.5\% \\ \%\Delta Q^{C} &= -3.15\% \end{aligned}$$