Economics 101
Spring 2018
Answers to Homework #3
Due Thursday, March 15, 2018

Directions:

- The homework will be collected in a box **before** the lecture.
- Please place **your name, TA name, and section number** on top of the homework (legibly). Make sure you write your name as it appears on your ID so that you can receive the correct grade.
- Late homework will **not** be accepted so make plans ahead of time.
- **Show your work**. Good luck!

Please realize that you are essentially creating "your brand" when you submit this homework. Do you want your homework to convey that you are competent, careful, and professional? Or, do you want to convey the image that you are careless, sloppy, and less than professional? For the rest of your life you will be creating your brand: please think about what you are saying about yourself when you submit any work for someone else.

Part I: Excise Taxes

1) Recently, McDonald's re-introduced its Szechuan dipping sauce as an option at its restaurants located across the United States. Suppose that the U.S. government considers the Szechuan sauce market as a potential source of government revenue and that the government decides to levy an excise tax on Szechuan dipping sauce of $.80 per unit of sauce. The market clearing price before the excise tax is levied is $1.20 and the equilibrium quantity is 1500 units of Szechuan dipping sauce. After the excise tax is levied the consumer will pay $1.80 and the equilibrium quantity in the market will drop to 1200 units of Szechuan dipping sauce.

a. Given the above information, derive the equations for the supply curve and the demand curve in Szechuan sauce market.

Solution:
Before the implementation of the excise tax, we know that the quantity supplied equals the quantity demanded at the market clearing price. So, when P = $1.20, Qs = Qd = 1500 units of Szechuan dipping sauce.
After the implementation of the excise tax, Pt = the price the consumer pays for a unit of Szechuan dipping sauce = $1.80, Pnet = the price the producer gets to keep after they pay the excise tax to the government = Pt - tax = 1.80 – 0.80 = $1. Thus, we know when P = $1.80, Qd = 1200 units of Szechuan dipping sauce; P= $1, Qs =1200units of Szechuan dipping sauce.
Let P = a*Qs + b denote the initial supply curve,
Slope of the supply curve = a = (1.20 – 1) / (1500 – 1200) = 1/1500

P- intercept for the supply curve = b = 1.20 – (1500/1500) = 0.20
Initial Supply curve: P = (1/1500)*Qs + 0.20
Similarly, we can find the equation for the demand curve:
Slope of the demand curve = (1.20 – 1.80) / (1500 – 1200) = –1/500
P- intercept for the demand curve = 1.20 – (–1500) /500) = 4.20
Demand curve: P = (–1/500) *Qs + 4.20

b. Consider this market prior to the implementation of the excise tax. Calculate the values of Consumer Surplus (CS), Producer Surplus (PS) and Total Surplus (TS) when this market is initially at equilibrium.

Solution:
Consumer surplus is the area of the triangle above the price consumers pay, and below the demand curve. The height of the triangle is the P - intercept of the demand curve minus the equilibrium price ($4.20 – $1.20 = $3). The base of the triangle is the quantity purchased (Q = 1500). Thus,
CS = (1/2) *3*1500 = $2,250

Producer surplus is the area of the triangle below the price producers receive and above the supply curve. The height of the triangle is the price minus the P - intercept of the supply curve ($1.20 – $0.20 = $1). The base is as before.
PS = (1/2) *1*1500 = $750

Total surplus equals the sum of consumer surplus and producer surplus. Thus,
TS = CS + PS = 2,250 + 750 = $3,000

c. Now, consider this market after the implementation of the excise tax. Calculate the value of Consumer Surplus with the excise tax (CSt), Producer Surplus with the excise tax (PSt), the tax revenue the government receives from implementing the tax (Tax Revenue), Total Surplus in this market after the excise tax is implemented (TSt) and the Deadweight Loss (DWL) due to the implementation of this excise tax.

Solution: (A graph of the solution follows the explanation)
Consumer surplus with the implementation of the excise tax is the area of the triangle above the price consumers pay for a unit of Szechuan sauce, and below their demand curve. The height of the triangle is the P - intercept of demand minus the new equilibrium price ($4.20 – $1.80 = $2.40). The base is the quantity purchased (Q = 1200). Thus,
CSt = (1/2) *2.40*1200 = $1,440

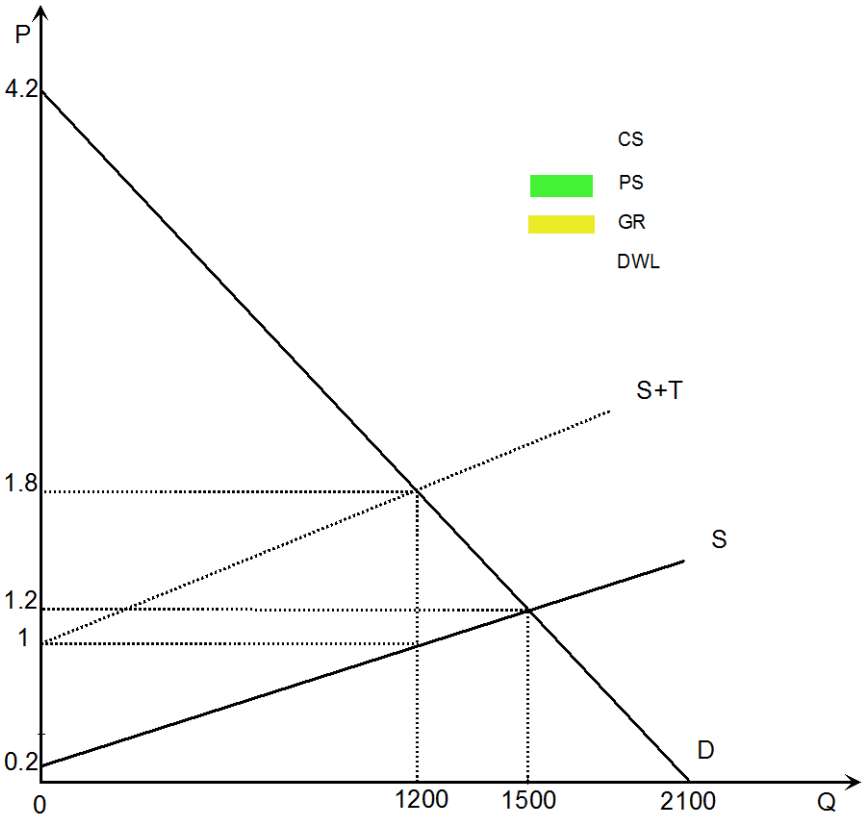
Producer surplus with the implementation of the excise tax is the area of the triangle below the price producers receive when they sell a unit of sauce and above their supply curve. The height

of the triangle is the price the producers receive minus the P - intercept of supply ($1 – $0.20 = $0.80). The base is as before. So
PSt = (1/2) *0.8*1200 = $480

Government's tax revenue is equal to the excise tax per unit of Szechuan sauce times the new equilibrium quantity. Thus:
Tax Revenue = ($0.80) *(1200) = $960

Total surplus is the sum of CSt, PSt and government excise tax revenue, so
TS = CS + PS + Tax Revenue = 1440+ 480 + 960 = $2,880

Deadweight Loss is the difference between the TS without the excise tax and Total Surplus with the excise tax. Thus:
DWL = 3000 – 2880 = $120



d. Consider this market after the implementation of the excise tax. Calculate the Consumer Tax Incidence(CTI) and Producer Tax Incidence(PTI) of this excise tax. Which one is larger? If the demand curve became more elastic (eg: if the new demand curve was "flatter" but went through the initial equilibrium point before the excise tax was levied), would consumers pay a higher or

lower share of the total taxes collected? What conclusion can you make about the relationship between elasticity and tax incidence?

Solution:
CTI = (Pt – Pe) * Qt = (1.80 – 1.20) * 1200 = $720
PTI = (Pe – Pnet) * Qt = (1.20 – 1) * 1200 = $240

As the demand curve becomes more elastic, the consumers' share of the total taxes becomes smaller. To summarize our conclusions:

The tax incidence will depend on the price elasticities of the supply and demand curves.

When the value of the price elasticity of demand is higher than the price elasticity of supply in absolute value terms, the economic incidence of an excise tax will fall mainly on the producers in the market.
When the value of the price elasticity of supply is higher than the price elasticity of demand in absolute value terms, the economic incidence of an excise tax will fall mainly on the consumers in the market.

Part II: International Trade

2) As a Mexican-style dish, Nachos are loved by many people around the world. The domestic demand and supply for Nachos in Kazakhstan are given by the following equations where Q is the quantity of Nachos and P is the price in dollars per unit of Nachos:

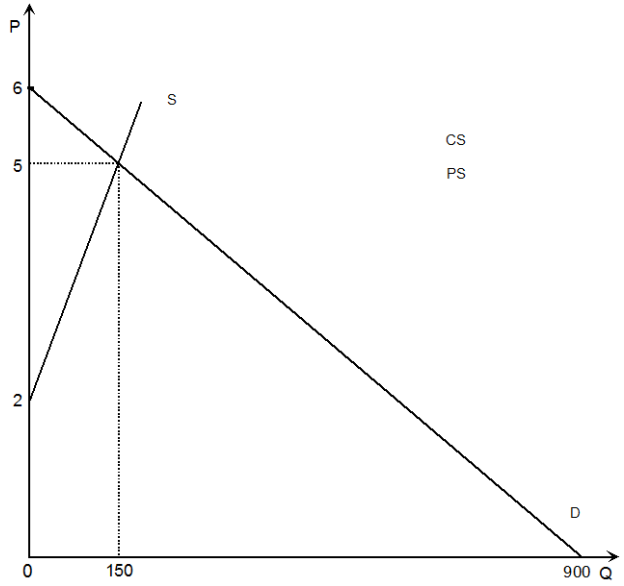
Domestic Demand: $P = 6 - \frac{1}{150}Q$

Domestic Supply: $P = 2 + \frac{1}{50}Q$

a. Calculate the equilibrium price, quantity, Consumer Surplus (CS), Producer Surplus (PS) and Total Surplus (TS) for the domestic market of Nachos when Kazakhstan is in autarky (i.e. the market is closed to trade). Illustrate your answer graphically.

Solution:
To find the equilibrium point, follow the usual method: set the supply curve equal to the demand curve.
6 – (1/150) Q = 2 + (1/50) Q
We find Q = 150 Nachos. Plugging this back into either the supply or demand curves, we find P = $5 per unit of Nachos.
Consumer surplus is the area of the triangle below the demand curve but above the equilibrium price. The P - intercept of demand is $6 and the equilibrium price is $5, so the height of the triangle is $1. The base length is simply the equilibrium quantity. Thus,
CS = (1/2) *1*150 = $75

To find producer surplus, we can follow a similar method to find the area of the triangle below the equilibrium price but above the supply curve. The P - intercept of supply is $2 and the equilibrium price is $5, so the height of the triangle is $3. The base length is simply the equilibrium quantity. Thus, PS = (1/2) *3*150 = $225
Total surplus is merely the sum of the two areas (TS = CS + PS) so,
TS = 75 + 225 = $300



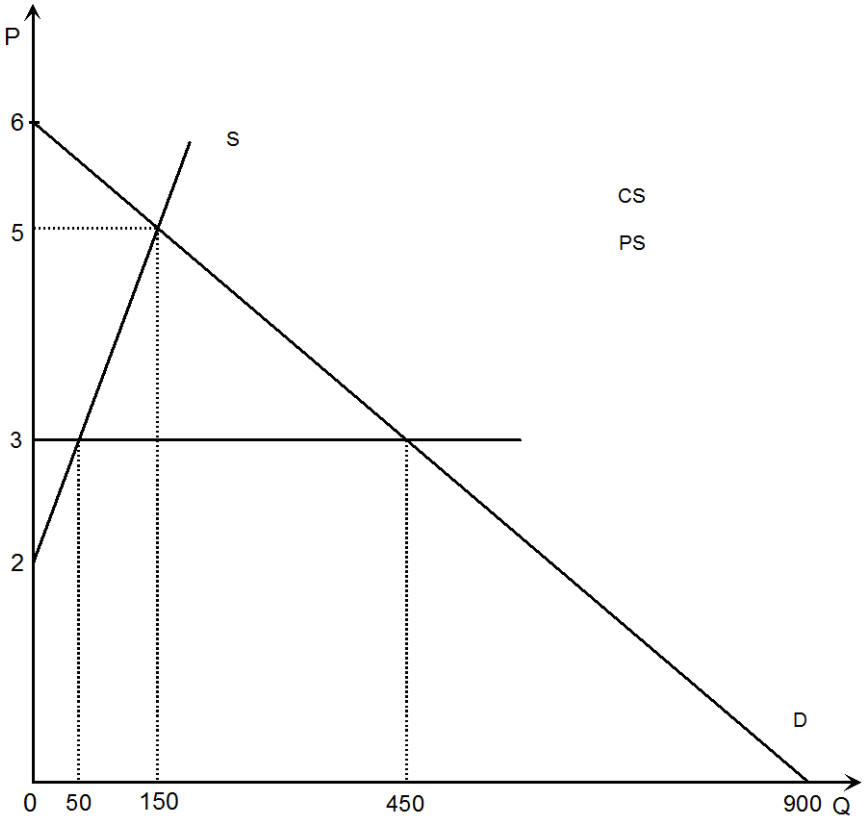
b. Suppose Kazakhstan now opens it Nachos market to international trade and the world price for Nachos is $3 per unit of Nachos. Furthermore, suppose the market for Nachos in Kazakhstan is small relative to the global market. Given this information, what is the new market price in Kazakhstan? How many units of Nachos will be consumed domestically in the Kazakhstan market? How many units of Nachos will be imported/exported? Calculate the new Consumer Surplus, Producer Surplus and Total Surplus when the market for Nachos opens in Kazakhstan. Illustrate your answers graphically.

Solution:
From part (a) we know the market price without trade is $5, which is above the world price, thus the price in Kazakhstan with trade will be the world price of $3.
Plugging this into the supply and demand curves we find:
3 = 6 – (1/150)*Qd, so Qd = Quantity demanded domestically in Kazakhstan = 450 units of Nachos
3 = 2 + (1/50)*Qs, so Qs = Quantity supplied domestically in Kazakhstan = 50 units of Nachos

Since the domestic quantity demanded is 450 units of Nachos, and the domestic quantity supplied is only 50 units of Nachos, the difference must be made up by imports. Thus
Imports = 400 units of Nachos.

Consumer Surplus with trade is area of the triangle above the world price and below the demand curve, so

CS = (1/2) *3*450 = $675
Producer Surplus with trade is the area below the world price and above the supply curve, so
PS = (1/2) *1*50= $25
TS with trade = CS with trade + PS with trade = $700



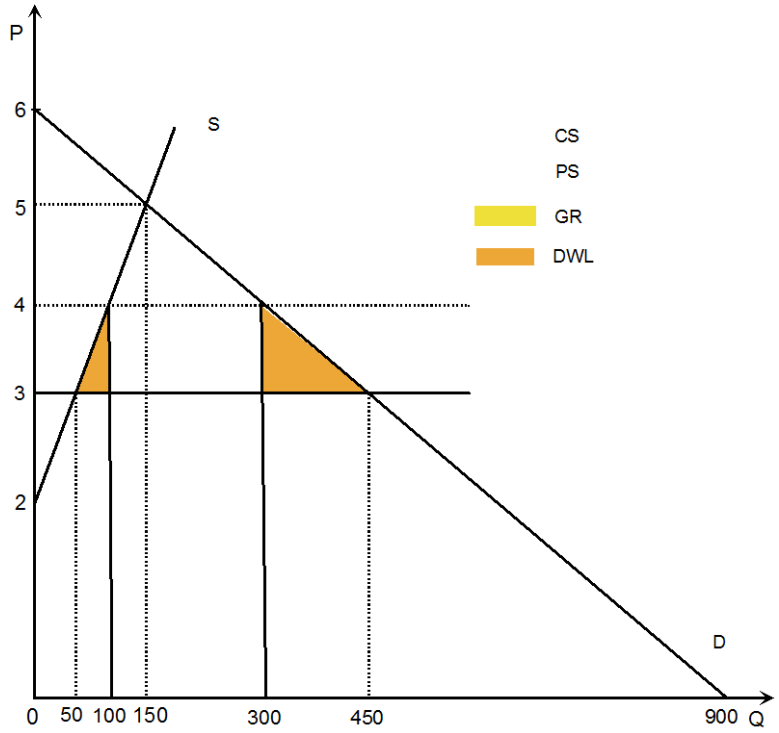
c. Suppose Kazakhstan government, fearing that the domestic Nachos suppliers are unduly suffering from the influx of cheap foreign Nachos, decides to implement a $1 per unit tariff on imports. With the implementation of this tariff, what is the new price for a unit of Nachos in the domestic market, the quantity consumed, the quantity imported, the Consumer Surplus, Producer Surplus, Government Tariff Revenue, Total Surplus and Deadweight Loss? Illustrate your answers graphically.

Solution:
Since the tariff is $1 per unit of Nachos, the domestic price will be $1 more than the world price, thus P = $4.
Plugging this price with the tariff into the demand curve, we find the quantity domestically demanded is 300 units of Nachos.
Plugging this price with the tariff into the supply curve, we find the quantity domestically supplied is 100 units of Nachos. This implies that imports are now equal to 200 units of Nachos.
We can calculate the value of Consumer Surplus with the tariff and Producer Surplus with the tariff in the usual manner, finding
CS with the tariff = (1/2) *2*300 = $300

PS with the tariff = (1/2) *2*100 = $100
Since the tariff is $1 per unit of Nachos, and 200 units of Nachos are imported we know the Tariff Revenue must be:
Tariff Revenue = 1*200= $200

Total Surplus is CS with the tariff + PS with the tariff + Tariff Revenue, so
TS = 300 + 100 + 200 = $600

Deadweight Loss is the difference between the TS without the tariff (the open economy) and TS with the tariff, thus
DWL = 700 – 600 = $100
Alternatively, you can calculate DWL as the area of the two brown triangles in the graph.



d. Now, suppose the government only cares about its revenue. Suppose the government is willing to close the market to trade provided domestic suppliers of Nachos compensate the government by paying them an amount equal to the tariff revenue the government earned in the previous question. Will domestic suppliers accept this deal and ask the government to implement it?

Solution:
When Kazakhstan is in autarky (closed economy), the producer surplus in this market is $225. When this market is open to trade and there is a $1 tariff per unit imposed on Nachos, the producer surplus with this tariff is equal to $100.
The increase in producer surplus is $125 if the market for Nachos is closed to trade. Since the program requires that the domestic suppliers compensate the government an amount equal to the

tariff revenue of $200, the domestic producers will conclude that it is not a good idea to support this new program.

e. Continue our discussion in part (d). What is the tariff that maximizes the government's tariff revenue? Find the revenue-maximizing tariff.

Solution:
Government tariff revenue equals the tariff times the quantity of Nachos imported. When the government sets the tariff to be $x dollar per unit, the domestic price will be the world price plus the tariff, thus:
P = 3 + x
Plugging this into the demand and supply curves, we find
3 + x = 6 – 1/150 Qd, so Qd = 450 – 150x;
3 + x = 2 + 1/50 Qs, so Qs = 50 + 50x.
Then we have Imports = Qd – Qs = 450 – 150x – (50 + 50x) = 400 – 200x;

So now if we think of this like a linear demand curve, we know revenue will be maximized when the price elasticity of demand (or really a "tariff elasticity of imports" in this case) is equal to 1.
Then we could have just used the fact that the unit elastic point is the middle point of the curve and get the revenue-maximizing tariff should be $1, which coincides with the tariff that government imposed in part (c).

3) Granola bars are often served as a quick on-the-go meal and are popular among students especially when they are busy doing their homework. Suppose that the domestic supply and demand for granola bars in a small economy are given as follows:

Domestic Demand: $Q = 240 - 5P$
Domestic Supply: $Q = 10P - 60$

where Q is the quantity of granola bars and P is the price per granola bar.

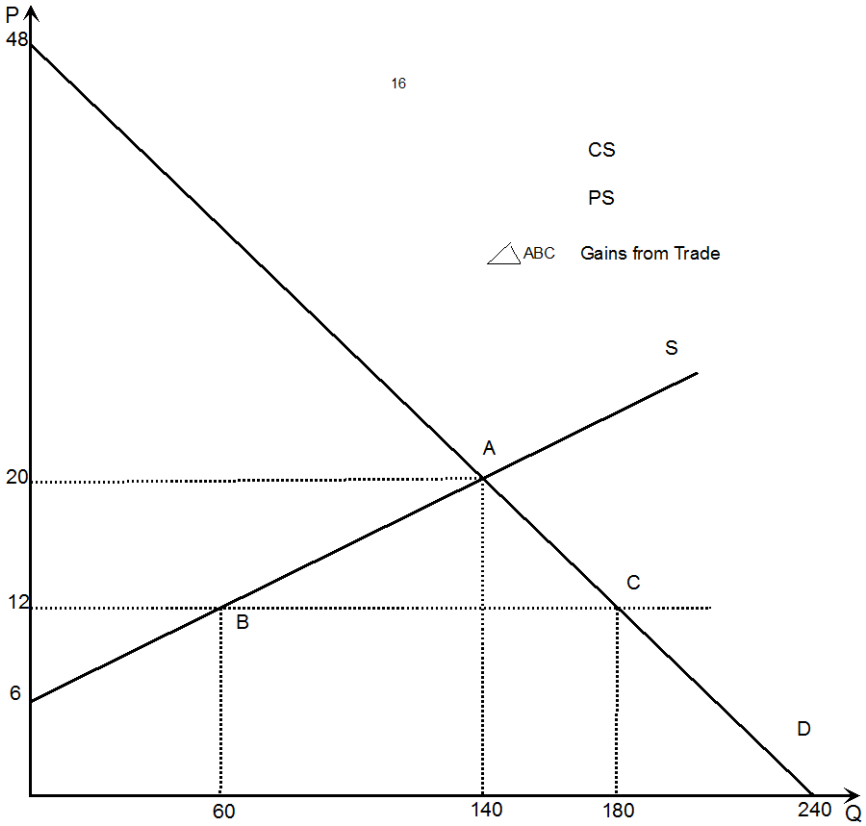
a. What is the equilibrium price and quantity in autarky (remember "autarky" is the term used to describe a closed market)? Also calculate the value of Consumer, Producer, and Total Surplus.

Solution:
Follow the usual procedure. Set the supply curve equal to the demand curve:
240 – 5P = 10P – 60
So, P = 20 per granola bar. Plugging this back into supply or demand, we find Q = 140 Granola bars.
We can calculate the value of Consumer Surplus and Producer Surplus in the usual manner, finding:
CS = (1/2) *(48 – 20) *140 = $1960

PS = (1/2) * (20 – 6) *140= $980
And TS = CS + PS = 1960 + 980 = $2940

b. The small economy now decides to enter the international market for granola bars. Once the market clears, we find that the quantity of imports is twice as large as the quantity produced by the domestic producers. Given this fact, what is the world price for a granola bar? What is the new consumer, producer, and total surplus in the open market for granola bars? And what is the value of the gains from trade that this economy experiences when it opens its granola bar market to trade? Illustrate your answers graphically.

Solution:
We know the number of imports is twice as large as the domestic supply. This implies that the domestic quantity demanded, Qd, is three times larger than the domestic quantity supplied, Qs, i.e.,
Qd = 3Qs
we get
(240 – 5P) = 3(10P – 60)
Simplifying we get
35P = 420
Thus, the world price must be P = $12. And we can find
Qd = 240 – 5*12 = 180 Granola bars, Qs = 10*12 – 60 = 60 Granola bars.
To find Consumer and Producer surpluses, we proceed as before, but now CS is a much larger triangle and PS a smaller one (see graph below).
CS = (1/2) *(48 – 12) *180 = $3240
PS = (1/2) * (12 – 6) * 60 = $180
TS = 3240 + 180 = $3420
Gains from trade is the difference between TS with trade and TS without trade (in autarky), thus
Gains from Trade = 3420 – 2940 = $480
Notice, without international trade, total surplus would be the triangle to the left of the domestic equilibrium, above $6 and below $48. Thus, from the graph, we can see that the gains from trade can be represented by the triangle that is located below the domestic equilibrium point and above the world price and between the supply and demand curves.



c. Now suppose the government decides to set an import quota of 60 granola bars; i.e. only 60 granola bars may be imported. What are the new equilibrium price, quantity, surpluses (CS, PS and TS) with the import quota, license holder revenue and deadweight loss due to the imposition of this import quota? Illustrate your answers graphically.

Solution:
First, we find the equilibrium price with the import quota noting the fact that, at the equilibrium price
Qd = Qs + Quota
240 – 5P = (10P – 60) + 60
240 – 5P = 10P
Solving for P we find P = $16.
By plugging 50 into the demand curve, we find the quantity consumed domestically is 160 units of Granola bars. 60 are imported (up to the import quota amount), so the domestic supply is 100 granola bars.

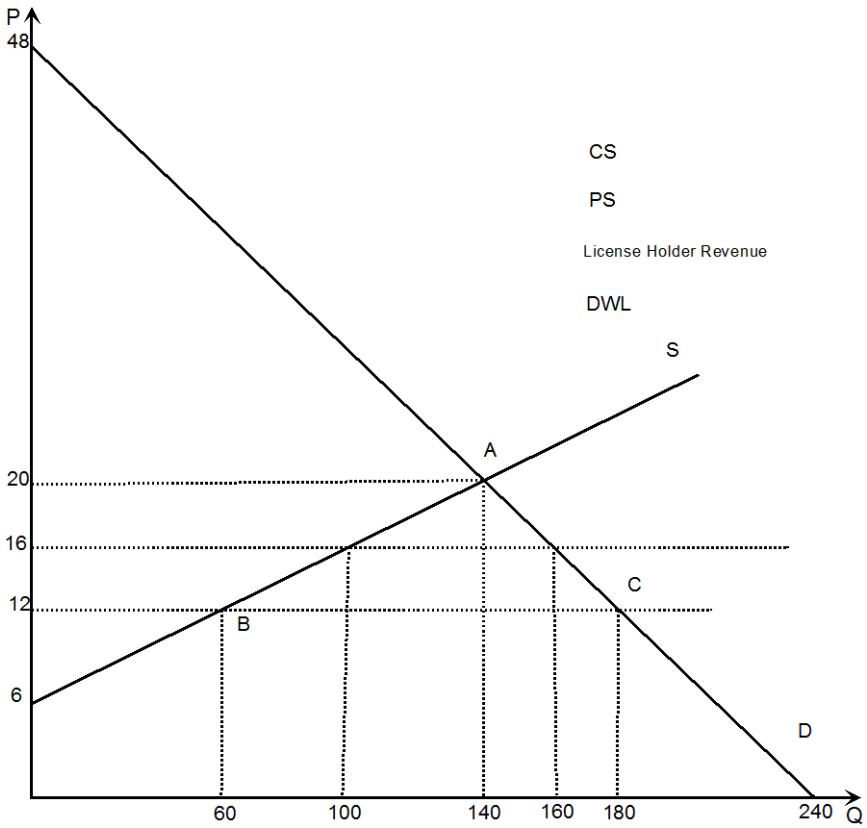
Consumer Surplus is the usual triangle (see plot) so
CS with the import quota = (1/2) *(48 –16) *160 = $2560
Similarly, for Producer Surplus with the import quota:
PS with the import quota = (1/2) *(16 – 6) *100 = $500

License holder revenue is the number of imported units (the import quota) times the difference between the domestic price with the import quota and the world price (the importer buys granola bars at the world price and sells them at the domestic price with the import quota, netting the difference).
License Holder Rev = (16 – 12) *60 = $240

Total surplus with the import quota is the sum of CS with the import quota, PS with the import quota, and License - Holder Revenue so:
TS = 2560 + 500 + 240 = $3300
Recalling that TS before the quota was $3420, we see that the DWL must be $120.
Alternatively, you could calculate the area of the DWL triangles from the graph.

d. Suppose the government in this some economy decides to sell a single license to an importer granting the right to import and sell all the imported granola bars up to the import quota of 60 granola bars. At most how much would a seller be willing to pay in order to purchase the license to sell granola bars? Explain your answer.

Solution:
An importer would be willing to pay no more than the revenue gained from selling the granola bars, that is the license holder revenue in part (c), $240.



Part III: Real vs. Nominal

4) In Merryland, there are only 3 goods: cups of coffee, movie shows, and laptops. The following table shows the *nominal* prices for these three goods from 2014 -2017:

Year	**Price per Cup of Coffee**	**Price per Movie Show**	**Price per Laptop**
2014	$5	$20	$350
2015	$5	$25	$400
2016	$6	$23	$300
2017	$5.5	$22	$375

Suppose a typical consumer basket throughout the year consists of 200 cups of coffee, 30 movie shows, and 1 laptop.

a. Using the above information to calculate the cost of the market basket for each of the years and present your calculations in the table below:

Year	**Cost of Market Basket**
2014	
2015	
2016	
2017	

Solution:
Cost of Market Basket in Year n = (Price of coffee in Year n) *(200 cups of coffee) + (Price of movie show in Year n) *(25 movie shows) + (Price of laptop in Year n) *(1 laptop)

Year	Cost of Market Basket
2014	$1950
2015	$2150
2016	$2190
2017	$2135

b. Let 2014 be the base year, calculate the CPI for each year using a 100-point scale. Then, for 2015 to 2017, calculate the annual inflation rate. Round your answers to two places past the decimal.

Year	**CPI**	**Inflation Rate**
2014		-
2015		
2016		
2017		

Solution:
CPI for year n = (Price of basket in year n / Price of basket in base year) *100
% Inflation = (CPI this year – CPI last year)/ (CPI last year)

Year	CPI	Inflation Rate
2014	100	-
2015	110.26	10.26%
2016	112.31	1.86%
2017	109.49	-2.51%

c. Now, 2014 is still the base year. Calculate the real price of a movie show in each year. Again, show your answers to the hundredths.

Year	**Real price of movie shows**
2014	
2015	
2016	
2017	

Solution:
Real price in year n = (Nominal Price in year n / CPI in year n) * 100

Year	Real price of movie shows
2014	$20.00
2015	$22.67
2016	$20.48
2017	$20.09

Part IV: Elasticity

5) Suppose the residents on a small island consume only two goods, fish and kelp. The demand curve for fish (f) is given by:

$$Q_f = 160 - 2P_f + P_k - \frac{1}{4}I$$

where P_f and P_k are the prices of fish and kelp, respectively, and I is income.
Currently, residents are purchasing fish and kelp at P_f = \$25 and P_k = \$10. Income of the residents is equal to \$400.

a. What is the quantity of fish currently being consumed?

Solution:
Plug Pf= 20, Pk= 10 and I = 400 into the demand equation for fish, we can get
Qf = 160 – 2*25 + 10 – (1/4) *400 = 20 fish.

b. At the current amount of fish being purchased that you calculated in part (a), use the point elasticity formula to calculate the price elasticity of demand for fish. (Hint: plug in all the information given EXCEPT for the price of fish. After doing so, the problem should look more familiar since you will now have an equation with two variables, Qf and Pf.)

Solution:
Plugging all the given information other than the price of fish into the demand equation, we have:
Qf = 160– 2Pf + Pk – (1/4) I
Qf = 160– 2Pf + 10 – (1/4) (400) = 70 – 2Pf
Now, using the point elasticity formula to calculate the price elasticity of demand:
e = – (1 / slope) * (P / Q)
Remember, since the slope in this equation is the slope of the demand curve when it is written in slope-intercept form (that is, when the demand curve is solved for PRICE). So, before plugging into the equation, we must solve the equation of the demand curve for Pf. We then get:
Pf = 35 – (1/2) *Qf
And,
e = – (1 / (– 1/2)) * (25 / 20) = 2.5

c. Given the price elasticity of demand you found in part (b), are suppliers of fish maximizing their revenue? If not, should they increase or decrease the price they charge for fish to increase their revenue? Find the price and quantity of fish at which total revenue is maximized.

Solution:
With a linear demand curve, we know that total revenue is maximized at the midpoint (the unit elastic point).

Given the price elasticity we found in (b), e = 2.5 > 1, suppliers of fish should decrease the price of fish in order to increase their revenue.
And given the demand curve we found in (b), $P_f = 35 – (1/2) *Q_f$, the midpoint is at (Q, P) = (35, 17.5) and their maximum total revenue is $612.5.

d. Holding everything else constant, suppose residents' income decrease to $200. Find the residents' demand for fish and use the standard (or regular) percentage formula to calculate the income elasticity of demand for fish. Are fish a normal or inferior good?

Solution:
From part (a) we know, when I = 400, Qf = 20;
Now plug Pf = 25, Pk = 10 and I = 200 into the demand equation for fish. With the new lower income we find that:
Qf = 160 – 2*25 + 10 – (1/4) *200 = 70.
Pause for a moment and interpret this: as income fell, the quantity of fish consumed increased holding everything else constant. This implies that fish are an inferior good and we should anticipate that the income elasticity of demand will be a negative number since the negative indicates that income and the quantity demanded are inversely related to one another for this good.

Using the regular percentage change formula, we can find:
Income elasticity of demand = (% change in quantity demanded / % change in income)
= ((70 – 20) / 20) / ((200 – 400) / 400)
= – 5
Since the income elasticity of demand for fish is negative, this tells us that fish is an inferior good.

e. Return to the initial situation. If the price of kelp increases by $10, find the residents' new demand for fish. What is the cross-price elasticity of fish for kelp? Use the arc elasticity formula concept when calculating this cross-price elasticity. Based upon your value for the cross-price elasticity of demand of fish for kelp, are these two goods substitutes or complements? Explain your answer.

Solution:
From part (a) we know, when I = 400, Qf = 20.
Using the new value for the price of kelp (Pk = 20) and Pf = 25 and I = 400 into the demand equation for fish, we can get:
Qf = 160 – 2*25 + 20 – (1/4) *400 = 30.

The arc elasticity of demand formula is: e = [(Q2 – Q1) / (Q1 + Q2)] / [(P2 – P1) / (P1 + P2)]
Then we get:
Cross-price elasticity of demand = [(30 – 20) / (30+ 20)] / [(20 – 10) / (10 + 20)]
= (1 / 5) / (1 / 3)

= 3 / 5

Since the cross-price elasticity of demand of fish for kelp is positive this tells us that these two goods are substitutes: when the price of kelp increases, residents substitute away from kelp and toward fish: the quantity of fish residents demand at every price increases relative to their initial demand.