Economics 101
Fall 2018
Answers to Homework #3
Due Thursday, November 8, 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

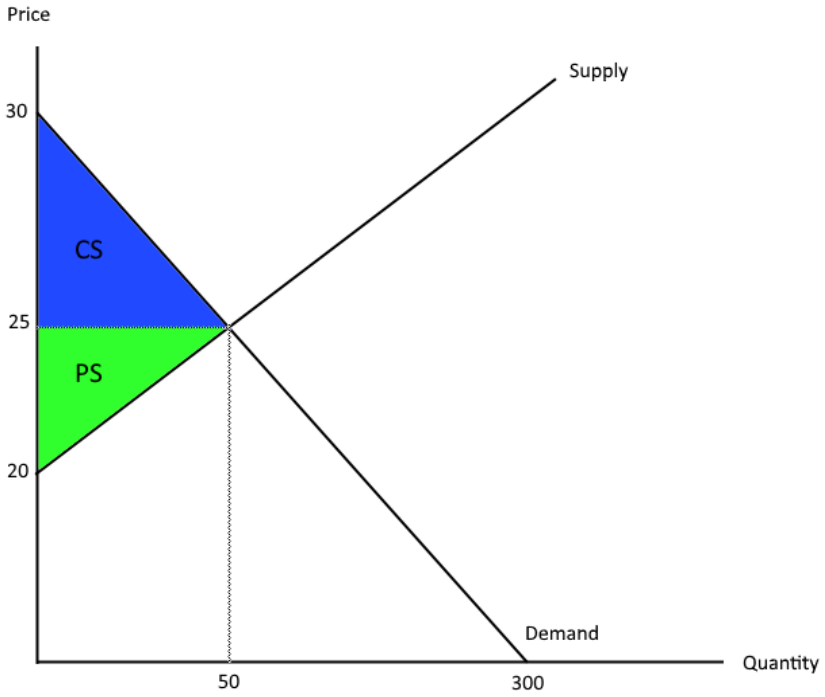
1) Assume that in the market for LCD screens, demand and supply are described by the following equations where Q is the quantity of LCD screens and P is the price per screen:

Demand: $Q_d = 300 - 10P$
Supply: $Q_s = 10P - 200$

With this information, solve the problems below:

a. Given the above information, find the market equilibrium price and quantity. Then calculate Consumer Surplus (CS), Producer Surplus (PS) and Total Surplus (TS).

Solution:
Using the given equations, we can find the equilibrium: $300 - 10P = 10P - 200 \rightarrow 500 = 20P \rightarrow P^* = \$25\ per\ LCD\ screen, Q^* = 50\ LCD\ screens.$
At the equilibrium, $CS = \frac{1}{2} * 50 * 5 = \$125\ , PS = \frac{1}{2} * 50 * 5 = \$125, TS = CS + PS = \$250.$



b. Now assume the government imposes an excise tax of $5 per LCD screen sold. This excise tax is imposed on the producers of the LCD screens. What will be the equation that describes the new supply curve, written in x-intercept form, after the implementation of this excise tax?

Solution:
This is simply an upward shift (or shift to the left) of the supply curve (in this case, by 5 dollars per LCD screen), meaning we subtract 5 from P in the supply curve function: $Q_s = 10(P-5) - 200 = 10P - 50 - 200 = 10P - 250$. The new supply curve written in x-intercept form is: $Q_s = 10P - 250$.

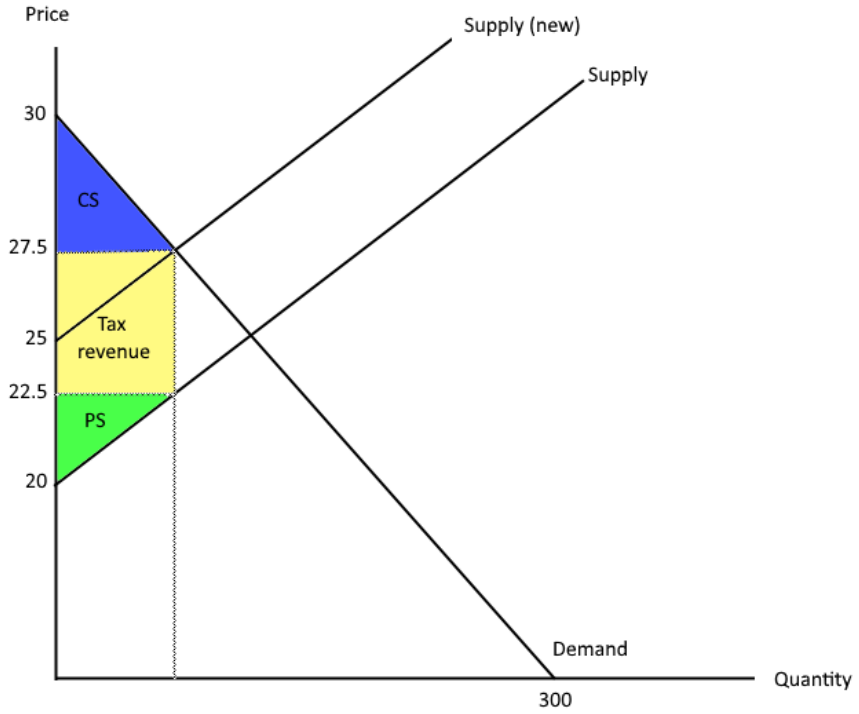
c. Given the excise tax described in (b), calculate the new equilibrium quantity, the price consumers pay with the tax, and the post-tax price producers receive once the excise tax is implemented.

Solution:
To find the new equilibrium quantity, use the new supply function, find its inverse (the y-intercept form of the equation), and equate it with the y-intercept form of the given demand function: $\frac{Q}{10} + 25 = 30 - \frac{Q}{10} \rightarrow \frac{Q}{5} = 5 \rightarrow Q^*_{new} = 25\ LCD\ screens$. Now just plug in this quantity into the original demand function to find the consumer price: $P^*_{new} = 30 - \frac{25}{10} = \$27.50\ per\ LCD\ screen$. However, producers will only get $P_t = P^*_{new} - tax = 27.50 - 5 = \$22.50\ per\ LCD\ screen.$

d. Find the consumer surplus, producer surplus, and the government's tax revenue given this excise tax. Illustrate these areas on a clearly labeled graph.

Solution:

$CS\ with\ the\ tax = \frac{1}{2} * 25 * (30 - 27.5) = \$31.25$, $PS\ with\ the\ tax = \frac{1}{2} * 25 * (22.5 - 20) = \$31.25$, tax revenue$= 25 * (27.5 - 22.5) = \$125$.



e. Suppose you are told that the excise tax described in (b) has been implemented. You are also told that there has been a shift in the demand equation such that the new equilibrium quantity with the tax and this demand shift is now equal to the original equilibrium quantity. Given this information and holding everything else constant, write the equation for the new demand curve in x-intercept form. Assume that the new demand curve's slope is the same as the original demand curve's slope.

Solution:

From our previous work we know that the supply curve with the excise tax is given by the equation $Q_s = 10P - 250$. We also know that the new equilibrium quantity with the demand curve shift is the same as our original equilibrium quantity prior to the implementation of the excise tax: thus, Q = 50 LCD screens. When Q = 50 LCD screens, our new supply curve gives us a price of P = \$30 per LCD screen. The new demand curve has the same slope as the original demand curve (m = -1/10) and must contain the point (Q, P) = (50, \$30). Given this information we can write the y-intercept form of the equation for the new demand curve as P = (-1/10) Q + b

and then plug in our known point. Thus, 30 = (-1/10)(50) + b or b = 35. The new demand curve in y-intercept form is P = 35 – (1/10) Q and in x-intercept form is Q = 350 – 10P.

Part II: International Trade

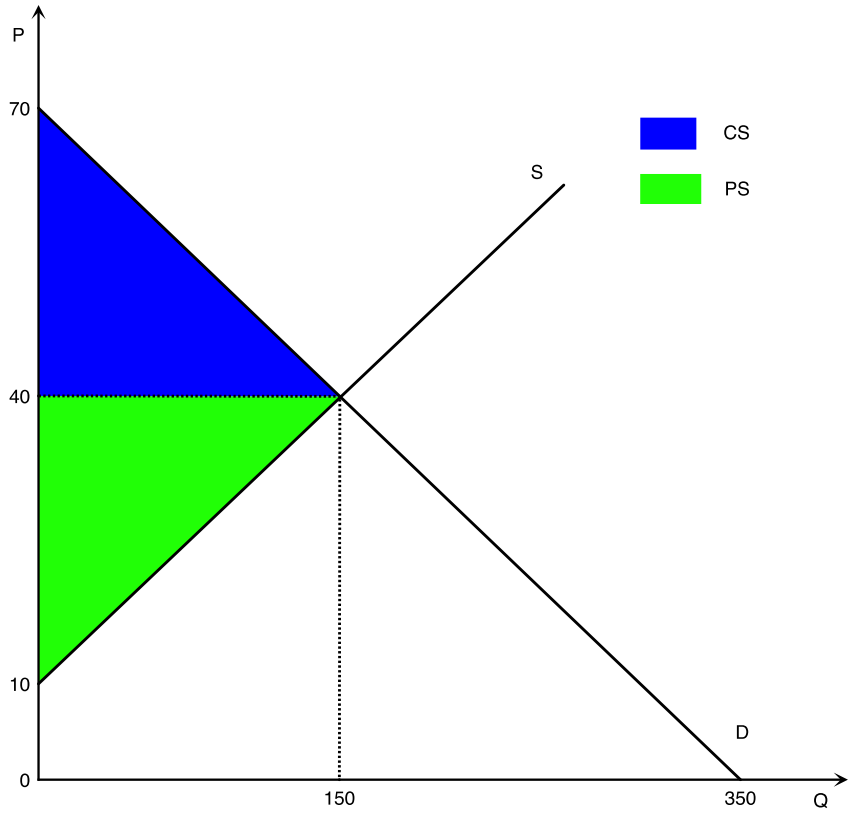
2) China and the United States are locked in an ongoing trade war as each country has introduced tariffs on goods traded with the other country. US President Donald Trump had promised in his campaign to fix China's "longtime abuse of the broken international system and unfair practices". Starting in January 2018 the U.S imposed a tariff on solar panel imports, most of which are manufactured in China. Suppose the domestic demand and supply for solar panels in the US are given by the following equations where Q is the quantity of solar panels and P is the price in dollars per unit of solar panels:

Domestic Demand: $P = 70 - \frac{1}{5}Q$

Domestic Supply: $P = 10 + \frac{1}{5}Q$

a. Calculate the equilibrium price, quantity, Consumer Surplus (CS), Producer Surplus (PS) and Total Surplus (TS) in the domestic market for solar panels when the US is in autarky (i.e. the market is closed to trade). Illustrate your answer graphically in a clearly and completely labeled graph.

Solution:
To find the equilibrium point, follow the usual method: set supply equal to demand.
70 – (1/5) Q = 10 + (1/5) Q
We find Q = 150 solar panels. Plugging this back into either the supply or demand equations, we find P = $40 per solar panel.
Consumer surplus is the triangle below the demand curve but above the equilibrium price. The P - intercept of demand is $70 and the equilibrium price is $40, so the height of the triangle is $30 per solar panel. The base length is simply the equilibrium quantity. Thus,
CS = (1/2) *30*150 = $2250
To find producer surplus, we can follow a similar method to find the area of the triangle below equilibrium price but above the supply curve. The P - intercept of supply is $10 and the equilibrium price is $40, so the height of the triangle is $30 per solar panel. The base length is simply the equilibrium quantity. Thus,
PS = (1/2) *30*150 = $2250
Total surplus is merely the sum of the two areas so,
TS = CS + PS = 2250 + 2250 = $4500



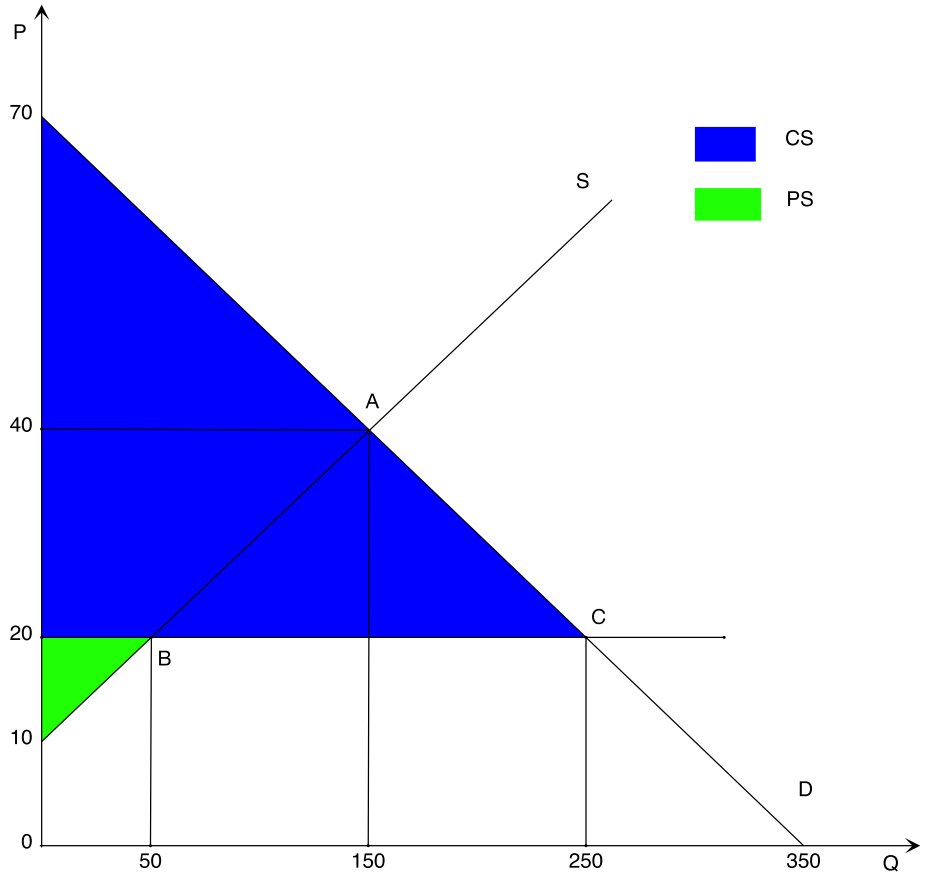
b. Suppose the US now opens it solar panel market to international trade and the world price for solar panels is $20 per solar panel. Furthermore, suppose the market for solar panels in the US is small relative to the global market for solar panels. Given this information, what is the new market price in the US? How many solar panels will be consumed domestically in the US market? How many solar panels will be imported/exported? Calculate the new Consumer Surplus, Producer Surplus and Total Surplus when the market for solar panels opens in the US. Illustrate your answers graphically in a clearly and completely labeled graph. Given your calculations determine the amount of deadweight loss in this market if the US decides to have a closed market rather than an open market. Explain how you found this deadweight loss value.

Solution:
From part (a) we know the market price without trade is $40 per solar panel, which is above the world price, thus the price in the US with trade will be the world price of $20 per solar panel.
Plugging this into the supply and demand curves we find
20 = 70 – 1/5 Qd, so Qd = Quantity demanded domestically in the US = 250 solar panels;
20 = 10 + 1/5 Qs, so Qs = Quantity supplied domestically in the US = 50 solar panels.
Since the domestic quantity demanded is 250 solar panels, and the domestic quantity supplied is only 50 solar panels, the difference must be made up by imports. Thus
Imports = 200 solar panels

Consumer Surplus is the triangle above the world price and below the demand curve, so
CS = (1/2) *50*250 = $6250

Producer Surplus is the area below the world price and above the supply curve, so
PS = (1/2) *10*50 = $250
TS = CS + PS = $6500

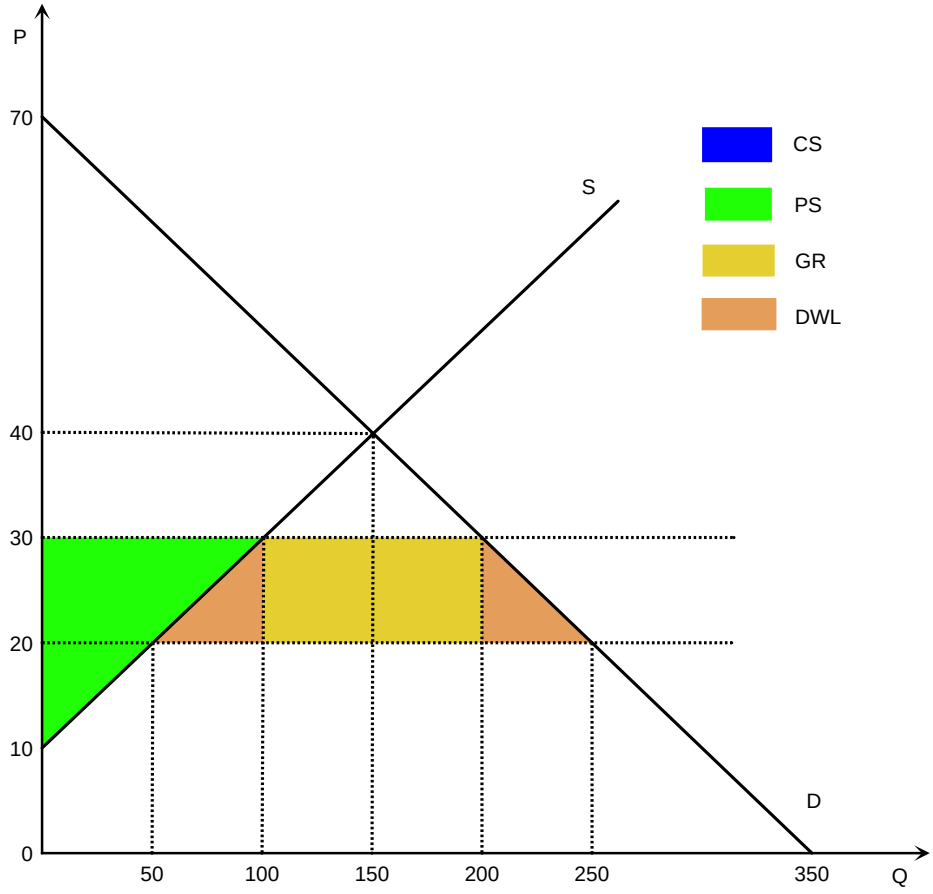
In the closed market in (a) we found that Total Surplus was equal to $4500 and in the open market in (b) we found that Total Surplus was equal to $6500. The difference, of $2000, is the deadweight loss that occurs if this market is closed rather than open to trade. In the graph drawn below this deadweight loss area if the market was closed to trade would be equal to the area of the triangle ABC.



c. Suppose now the US government imposes a tariff in the solar panel market. With the imposition of this tariff you are told that the quantity of solar panels now supplied by the domestic producers is equal to the quantity of solar panels that are imported with the tariff. Given this information and holding everything else constant, determine the size of this tariff. Given this tariff what is the new price for a solar panel 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 in a clearly and completely labeled graph.

Solution:
We know that the quantity of solar panels supplied by the domestic producer is equal to the quantity of solar panels imported. This implies that the quantity demanded domestically is twice as large as the quantity supplied domestically at the new price: or 2(Quantity supplied domestically) = (Quantity demanded domestically).
We can find the quantity domestically demanded at price p is: (Quantity demanded domestically) = 5(70 – p).
We can find the quantity domestically supplied at price p is: (Quantity supplied domestically) = 5(p – 10).
Then setting 5(70 – p) = 2* 5(p – 10) we find Pnew = $30 per solar panel.
The tariff = Pnew – Pworld = 30 – 20 = $10 per solar panel.
Then the quantity demanded domestically is 5(70 – Pnew) = 5* (70 – 30) = 200 solar panels.
This implies that the number of imported solar panels is equal to 100 solar panels.

We can calculate Consumer Surplus and Producer Surplus in the usual manner, finding
CS = (1/2) *40*200 = $4000
PS = (1/2) *20*100= $1000
Since the tariff is $10 per solar panel imported, and 100 solar panels are imported we know Tariff Revenue must be:
Tariff Revenue = 10*100 = $1000
Total Surplus is CS + PS + Tariff Revenue, so
TS = 4000 + 1000 + 1000 = $6000
Deadweight Loss is the difference between the TS without the tariff and with the tariff, thus
DWL = 6500 – 6000 = $500
Alternatively, you can calculate DWL as the area of the two brown triangles in the graph.



d. Now suppose instead of the tariff described in (c), the government decides to set an import quota of 150 solar panels; i.e. only 150 solar panels may be imported into the US market. What is the new equilibrium price, quantity, surpluses (CS, PS and TS), license holder revenue and deadweight loss due to the imposition of this import quota? Illustrate your answers graphically in a clearly and completely labeled graph.

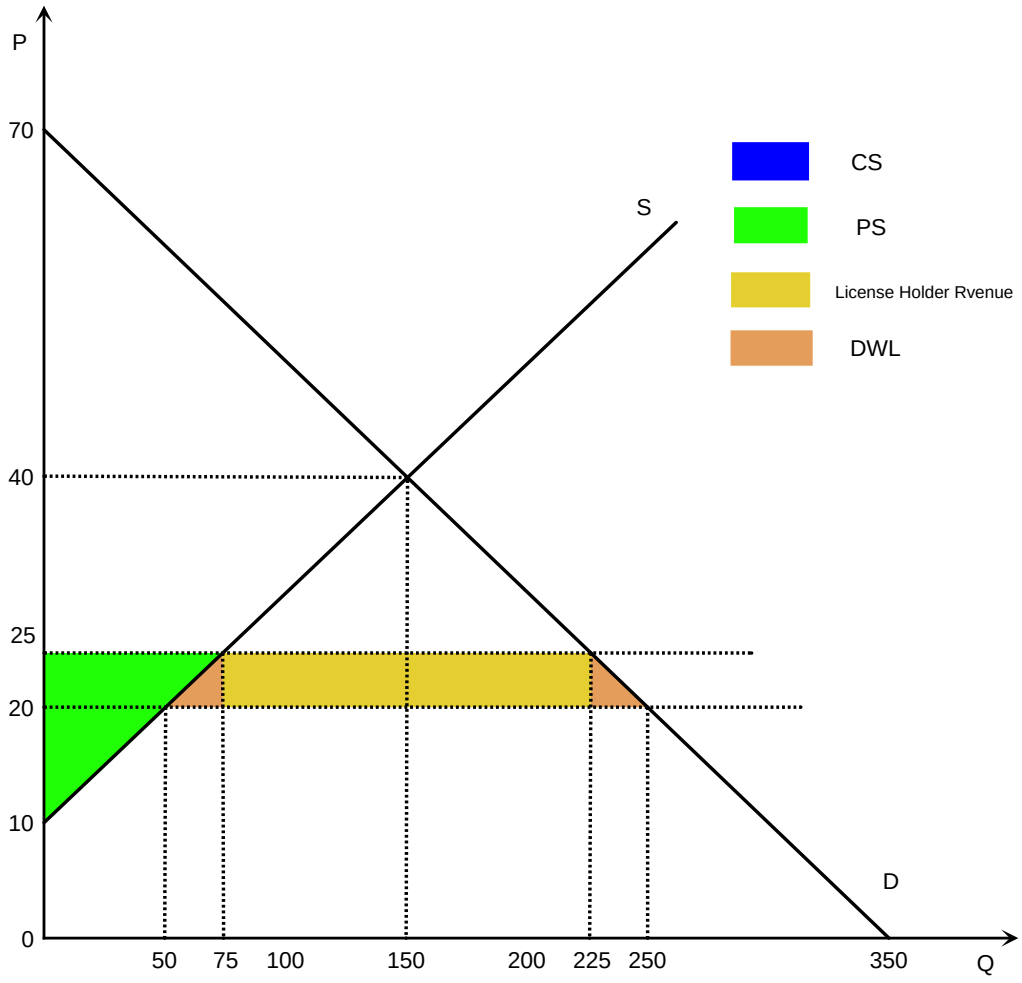
Solution:
First, we find the equilibrium price with the quota noting the fact that, at the equilibrium price
Qd = Qs + Quota
5(70 – P) = 5(P – 10) + 150
350 – 5P = 5P + 100
Solving for P we find P = $25 per solar panel.
By plugging 50 into the demand curve, we find the quantity consumed domestically is 225 solar panels. 150 solar panels are imported (imports are equal to the import quota of 150 solar panels), so the domestically supplied quantity of solar panels is 75 solar panels.

Consumer Surplus is the usual triangle (see graph) so
CS = (1/2) *(70 – 25) *225 = $5062.5
Similarly, for Producer Surplus

PS = (1/2) *(25 – 10) *75 = $562.5

License holder revenue is the number of imported units (the quota) times the difference between the domestic price and the world price (the importer buys solar panels at the world price and sells them at the domestic price, netting the difference).
License Holder Rev = 5*150 = $750

Total surplus is the sum of CS, PS, and License - Holder Revenue so
TS = 5062.5 + 562.5 + 750 = $6375
Recalling that TS before the quota was $6500, we see that the DWL must be $125.
Alternatively, you could calculate the area of the DWL triangles from the graph.



e. Suppose the US government decides to sell a single license to an importer granting the right to import and sell all the imported solar panels up to the import quota of 150 solar panels. At most how much would a seller be willing to pay in order to purchase the license to sell these solar panels? Explain your answer.

An importer would be willing to pay no more than the revenue gained from selling the imported solar panels, that is, $5 per solar panel imported with the import quota or a total of $750.

3) Assume that in the country of Turkmenistan, a mineral called potassium is a popular consumer good. Its domestic demand and supply are given by the following equations where Q is the quantity of units of potassium and P is the price per unit of potassium:

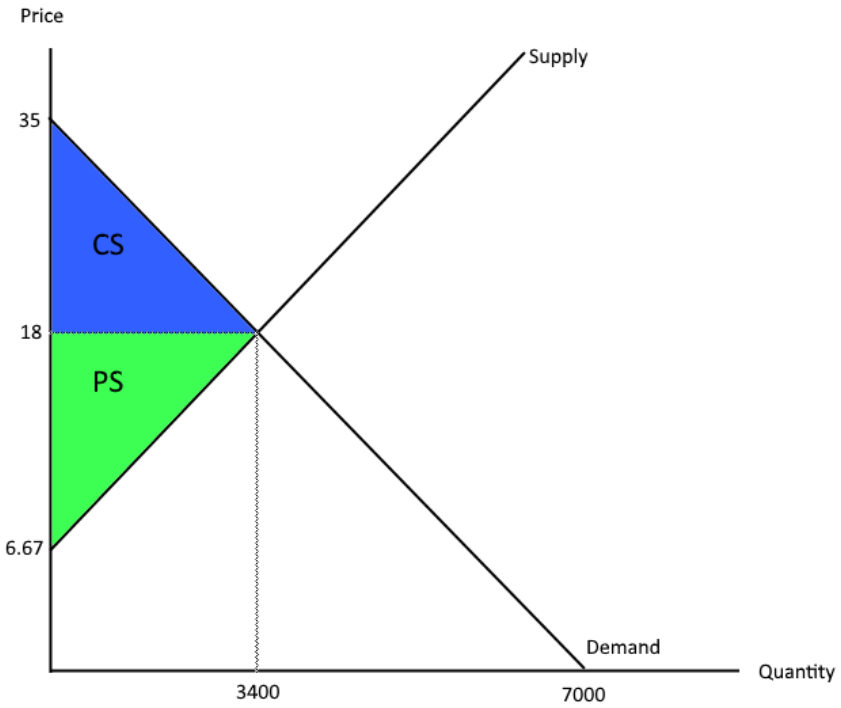
Domestic Demand: $Q = 7000 - 200P$
Domestic Supply: $Q = 300P - 2000$

a. Given this information find the equilibrium quantity and price in this market. Then calculate the consumer surplus and producer surplus. Draw a clearly and completely labeled graph to illustrate your answer. Hint: your numbers are likely to be a bit "messy" here: if you want to use a calculator you can, but we expect you to do the calculations!

Solution:

Using the given equations, we can find the equilibrium: $7000 - 200P = 300P - 2000 \rightarrow 9000 = 500P \rightarrow P^* = \$18, Q^* = 3400\ units.$

At the equilibrium, $CS = \frac{1}{2} * (35 - 18) * 3400 = \$28{,}900$, $PS = \frac{1}{2} * \left(18 - \frac{20}{3}\right) * 3400 \approx \$19{,}267.$



b. Now suppose the government decides to open the country to trade, and the price of potassium in the rest of the world is $20 per unit. If we assume that Turkmenistan is relatively small and thus has no influence on the world market, what will be the price of potassium in the country? How much potassium will the domestic consumers demand, and how much of it will be exported or imported?

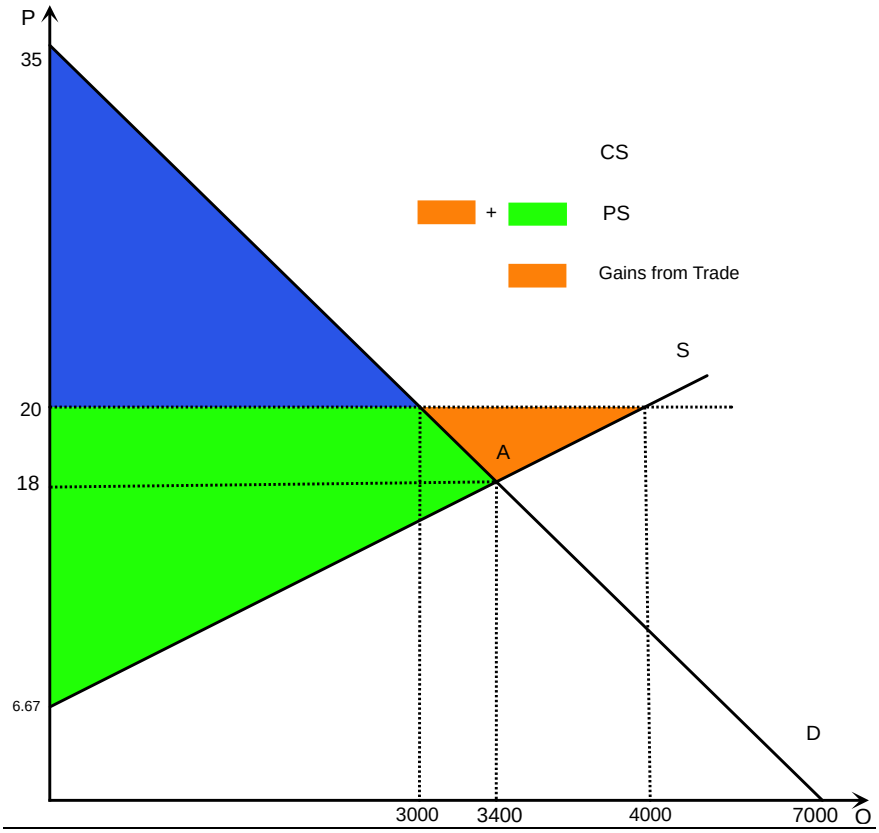
Solution:
Since the world price is higher than the domestic price, the price will now become $20 per unit of potassium. At that price, we can find the domestic demand by plugging in $20 instead of P in the demand function: $Q_d = 7000 - 200 * 20 = 3000\ units\ of\ potassium.$
First, we need to determine if the country will have to export or import potassium. In order to do that, find the quantity supplied by the domestic producers at price $20: $Q_s = 300 * 20 - 2000 = 4000\ units\ of\ potassium.$ Since the quantity supplied domestically is larger than the quantity demanded domestically, this means the country will export the good. The difference between the quantities demanded and supplied domestically will show us how much potassium is exported: $exports = Q_s - Q_d = 4000 - 3000 = 1000\ units\ of\ potassium.$

c. Find the new consumer surplus, producer surplus and gains (provide a numerical value for these gains) in surplus from opening this market to international trade. Draw a new graph that represents clearly and completely the new area of consumer surplus, the new area of producer surplus, and the gains that occur due to the opening of the market.

Solution:

$$CS = \frac{1}{2} * (35 - 20) * 3000 = \$22{,}500, PS = \frac{1}{2} * \left(20 - \frac{20}{3}\right) * 4000 \approx \$26{,}667$$

$$Gains\ form\ trade = \frac{1}{2} * (4000 - 3000) * (20 - 18) = \$1000$$



Part III: Real vs. Nominal

4) Consider the following table of *nominal* prices in a fictional version of Madison over time:

Year	**Coffee**	**T-shirts**	**Laptops**
2015	$4.00	$20.00	$660
2016	$5.00	$21.50	$680
2017	$4.75	$22.00	$620
2018	$5.55	$23.50	$600

Suppose a typical consumer basket throughout the year consists of 100 cups of coffee, 20 T-shirts, 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
2015	
2016	
2017	
2018	

Solution:
Cost of Market Basket in Year n = (Price of coffee in Year n) *(100 cups of coffee) + (Price of T-shirt in Year n) *(20 T-shirts) + (Price of laptop in Year n) *(1 laptop)

Year	Cost of Market Basket
2015	$1460
2016	$1610
2017	$1535
2018	$1625

b. Let 2015 be the base year, calculate the CPI for each year using a 100-point scale. Then, for 2016 to 2018, calculate the annual inflation rate. Round up your answers to two places past the decimal.

Year	CPI	Inflation Rate
2015		-
2016		
2017		
2018		

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 as a Percentage
2015	100	-
2016	110.27	10.27%
2017	105.14	-4.65%
2018	111.30	5.86%

c. Now, 2015 is still the base year. Calculate the real price of T-shirt in each year. Again, show your answers calculated to two places past the decimal.

Year	Real price of T-shirt
2015	
2016	
2017	
2018	

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

Year	Real price of T-shirt
2014	$20.00
2015	$19.50
2016	$20.92
2017	$21.11

d. Suppose we do not know the nominal price of T-shirts in 2014, but we do know that a cup of coffee costs $3.25 and a laptop costs $560.00. Additionally, we know that the rate of inflation from 2014 to 2015 was 25%. What was the nominal price of a T-shirt in 2014? To answer this question, you should assume that the defined market basket has not changed and that you have access to all the data provided or calculated in the problem thus far.

Solution:
Since % Inflation = (CPI 2015 – CPI 2014)/ (CPI 2014)
We can plug % Inflation = 25%, CPI 2015 = 100 into this equation and get
CPI 2014 = 80
CPI 2014 = (Price of basket in 2014 / Price of basket in base year) *100
Then Price of basket in 2014 = 1460 *80/100 = $1168

Suppose a typical consumer basket throughout the year consists of 100 cups of coffee, 20 T-shirts, and 1 laptop.
Then the price of a T-shirt = (1168 – 3.25 *100 – 560) / 20 = $14.15

Part IV: Elasticity

5) Suppose you're running a firm that manufactures jeans. In January, your first month of operations, you were able to sell 3500 pairs of jeans at the price of $90. You know that your business is facing a downward-sloping linear demand curve, but you don't have any information about the y-intercept or the slope of this demand curve. So, you have decided to simply lower the

January price to $80 and see what happens. Not unexpectedly, after the price went down, your customers got excited and purchased 4000 pairs of jeans in February.

a. Given this information and holding everything else constant, calculate the arc price elasticity of demand using the mid-point method. Round your answer to two places past the decimal.

Solution:

Using the formula for arc elasticity, we find that the price elasticity of demand is $\varepsilon = \left|\frac{4000-3500}{80-90}\right| * \left|\frac{80+90}{4000+3500}\right| = \frac{17}{15} = 1.13$. Recall that, by convention, we take the absolute value of the price elasticity of demand: thus, the price elasticity of demand between these two points using the arc elasticity formula is 1.13.

b. From the given information reconstruct the demand equation and calculate the point elasticity for January as well as for February.

Solution:

First, construct linear equations for the two data points: $\begin{cases} 3500 = a + b * 90 \\ 4000 = a + b * 80 \end{cases}$. Solving this system yields $a = 8000, b = -50$. Now, using the formula for point elasticity, we can find that $\varepsilon^{jan} = -\frac{1}{slope} * \frac{P}{Q} = -(-50) * \frac{90}{3500} = \frac{9}{7} = 1.28,\ \varepsilon^{feb} = -(-50) * \frac{80}{4000} = 1.$

6) [1]This set of questions focus on elasticity.

a. John's demand for bananas increases from 4 bananas to 6 bananas when his hourly wage rises from $18 to $30. What is his income elasticity of demand for bananas? Use the standard formula of percentage change to calculate this income elasticity. Are bananas normal or inferior goods for John?

Solution:
Income elasticity of demand = (% change in demand / % change in income)
= ((6 – 4) / 4) / ((30 – 18) / 18)
= 3/4
Since the income elasticity of demand is a positive number this tells us that bananas are a normal good for John: when John's income increases, his demand for bananas also increases.

b. John's demand for bananas dropped from 10 bananas to 6 bananas when the price of apples decreased from $6 per apple to $5 per apple. What is his cross-price elasticity of bananas for apples? Use the arc elasticity formula for the percentage change to calculate this cross-price

[1] Modified from homework#3-Fall 2017, Problem #5.

elasticity. Based upon your value for the cross-price elasticity of demand of bananas for apples, are these two goods substitutes or complements? Explain your answer.

Solution:
The arc elasticity of demand formula is: e = [(Q2 – Q1) / (Q1 + Q2)] / [(P2 – P1) / (P1 + P2)]
Then we get:
Cross-price elasticity of demand = [(6 – 10) / (6+ 10)] / [(5 – 6) / (5 + 6)]
= (-4 /16) / (-1 / 11)
= 11/4
Since the cross-price elasticity of demand of bananas for apples is positive this tells us that these two goods are substitutes: when the price of apples falls, John substitutes away from bananas: the quantity of bananas he demands at every price decreases relative to his initial demand.

c. Suppose at $4 per banana, Ben can supply an infinite quantity of bananas, but he will supply none at a price below $4. What do you know about his supply when price rises above $4? What is Ben's price elasticity of supply?

Solution:
At any price above $4 per banana, the quantity that Ben supplies is extremely large.
Then we know Ben's price elasticity of supply equals ∞, which means he has a perfectly elastic supply curve. With a perfectly elastic supply curve even a tiny increase or reduction in the price will lead to very large changes in the quantity of the good he supplies.