Economics 101
Spring 2017
Answers to Homework #3
Due Thursday, March 16, 2017

Directions:

- The homework will be collected in a box **before** the large 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. **Please 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 do any work for someone else!

Part I: Excise Taxes

1. Suppose the demand and supply curves for goose-down winter jackets in 2014 were as given below:

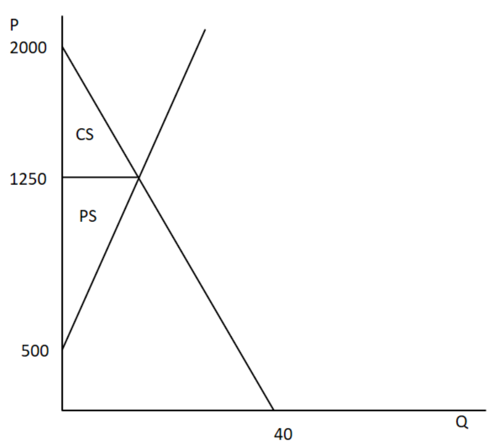
Demand: P = 2000 - 50Q
Supply: P = 500 + 50Q

a. Find the equilibrium price and the equilibrium quantity in 2014.

In equilibrium, the quantity demanded is equal to quantity supplied.
2000 – 50Q = 500 + 50Q
Q* = 15 goose-down jackets; P* = 500 + 50 * 15 = $1250 per down jacket

b. Calculate the consumer surplus and producer surplus in 2014. Provide a graph of this market and show these areas on the graph.

CS = (2000-1250) * 15 * 0.5 = $5625
PS = (1250-500) * 15 * 0.5 = $5625



c. Compute the price elasticity of demand and supply at the equilibrium price. Use the point elasticity formula for the computation. At the equilibrium point, is demand elastic, unit elastic, or inelastic? Explain your answer.

Point elasticity of demand = ε = [-1/slope][P/Q]
P = \$1250 per goose-down jacket, Q = 15 goose-down jackets, and slope is -50.
Point elasticity of demand = (1/50)*(1250/15) = 25/15 = 5/3
Since the value for the point elasticity of demand at the equilibrium point is greater than one, the demand curve at that point is elastic.

d. Find the range of prices where the demand is elastic, unit-elastic and inelastic.

Demand is elastic if the price elasticity of demand is greater than 1, inelastic if the price elasticity of demand is less than 1, and unit elastic if the price elasticity of demand is exactly 1.
First, let's find the price at which the demand is unit-elastic.
$1 = (1/50) * (P / Q)$ where $Q = (2000 - P) / 50$.
$1 = P / (2000 - P)$
$2000 - P = P$
$P = 1000$
Hence, at P = 1000, demand is unit elastic.
Second, the demand is elastic when:
$1 \geq (1/50) * (P / Q)$ where $Q = (2000 - P) / 50$.
$1 \geq P / (2000 - P)$
$2000 - P \geq P$
$1000 \geq P$
Lastly, the demand is inelastic when:
$1 \leq (1/50) * (P / Q)$ where $Q = (2000 - P) / 50$.
$1 \leq P / (2000 - P)$
$2000 - P \leq P$
$1000 \leq P$

e. Given the above demand curve, what would be the price at which the total revenue (price * quantity demanded) is maximized? What would the total revenue equal at that price?

The total revenue is maximized at that quantity and price where the demand is unit-elastic. Hence, at P = 1000, the total revenue is maximized. The size of the total revenue is determined by the relative size of the two effects namely a price effect and a quantity effect. The price effect refers to the impact of a change in price: after a price increase, each unit sold sells at a higher price than before and this adds to revenue. The quantity effect refers to the impact of a change in quantity: after a price increase, fewer units are sold at this higher price than the initial price and this reduces revenue. Total revenue increases when demand is inelastic since the price effect dominates the quantity effect. Total revenue reaches its maximum when the quantity effect and the price effect exactly offset each other: i.e., when demand is unit-elastic. Then total revenue starts decreasing when demand become elastic because the quantity effect is stronger than the price effect.

Because of an extremely cold winter in 2015, the demand for goose-down winter jackets increased greatly. The result of this increase in the popularity of goose-down winter jackets is that at every quantity consumers are now willing to pay $500 more per jacket. The supply of goose-down winter jackets did not change.

f. Without doing any calculations, please explain in words what would happen to the equilibrium price and the equilibrium quantity in 2015 compared to those values in 2014?

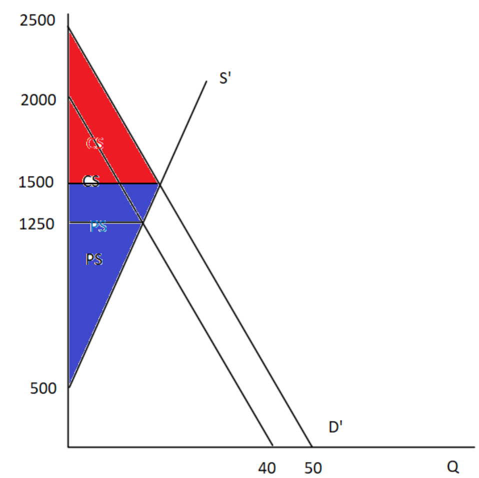
Since the demand for goose-down winter jackets increased, the equilibrium price should go up and the equilibrium quantity as well. At the old equilibrium price, there is excess demand, which drives the equilibrium price up. This would cause a movement along the supply curve, leading to a higher equilibrium quantity.

g. What is the equation for the demand curve in 2015? What is the new equilibrium price and the equilibrium quantity?

The demand curve has shifted up by 500 dollars. The new demand curve is:
P = 2500 – 50Q
2500 – 50Q = 500 + 50Q
100Q = 2000
Q** = 20 goose-down jackets
P** = 2500 – 50*20 = $1500 per goose-down jacket

h. Calculate the consumer surplus and producer surplus in 2015. Provide a new graph that illustrates these two areas.

The new CS is the red shaded area:
(2500 – 1500) * 20 * 0.5 = $10,000
The new PS is the blue shaded area:
(1500 – 500) * 20 * 0.5 = $10,000



i. Is there any deadweight loss? If yes, calculate the size of the deadweight loss. If no, please explain your answer.

There is no distortion in the market. There is no deadweight loss.

Now, the government is worried that an increased demand for goose-down jackets would endanger the goose population. This sentiment led to **a legislation of an excise tax** on the producers of goose-down jackets.

j. Suppose that the government wants to implement an excise tax in this market so that consumers purchase the same number of jackets as they did in 2014. What would the size of the excise tax need to be in order for the government to successfully reach this goal? Provide the equation for the new supply curve with this excise tax. Then, calculate the new equilibrium price once this excise tax is imposed.

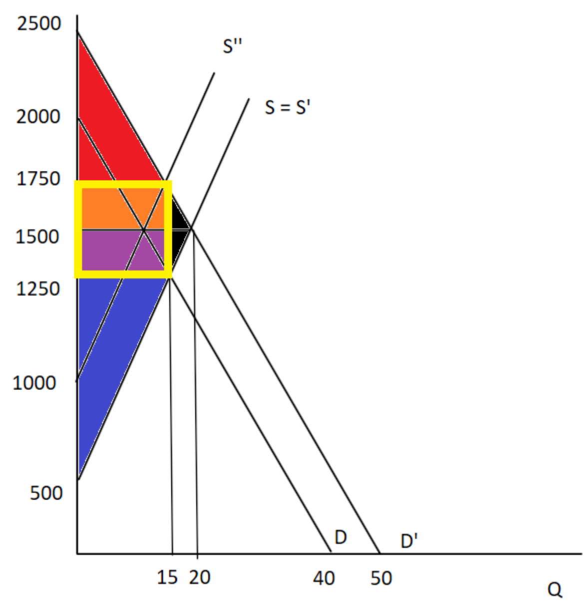
The government wants to restore the equilibrium quantity in the market to the 2014 level which was 15 goose-down jackets. First, since we need to decrease the equilibrium quantity, we need to shift the supply curve left. Say the excise tax is equal to t*. The supply curve becomes P = 500 + t* + 50Q. The demand curve is P = 2500 – 50Q. So, the new equilibrium quantity is 500 + t* + 50Q = 2500 – 50Q which gives 100Q = 2000 – t*. Since the government wants the new equilibrium Q to be 15, t* should be $500 per goose-down jacket to achieve the objective.
Hence, the supply curve after the legislation would be:
P = 1000 + 50Q
Equilibrium price: P* = $1750 per goose-down jacket
Equilibrium quantity: Q* = 15 goose-down jackets

k. Calculate the consumer surplus, the producer surplus, the government tax revenue and the deadweight loss (if any) after the legislation of the tax you calculated in (j). Provide a graph that illustrates these areas. Make sure it is well labeled.

The new CS is the red shaded area:
(2500 – 1750) * 15 * 0.5 = $5625
The new PS is the blue shaded area:
(1250 – 500) * 15 * 0.5 = $5625

The government tax revenue is the yellow rectangle area:
(1750-1250) * 15 = 500 * 15 = $7500

The deadweight loss is the black shaded area:
500 * 5 * 0.5 = $1250



l. What are the consumers' tax incidence and the producers' tax incidence after the legislation of the tax in (j)?

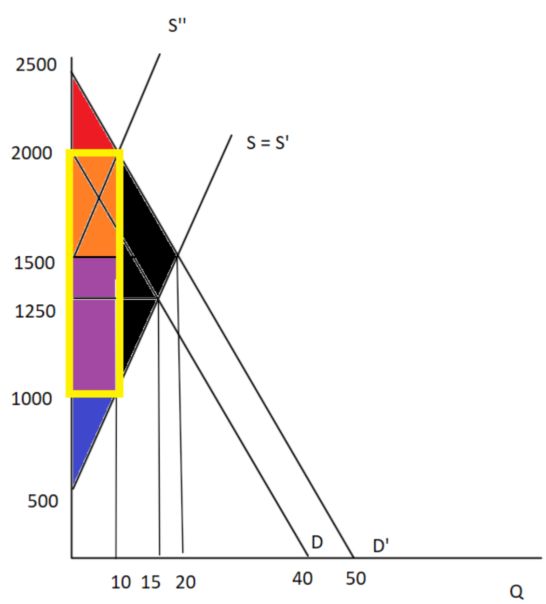
The incidence of tax paid by consumers is: (1750-1500) * 15 = $3750 (orange rectangle)
The incidence of tax paid by producers is: (1500-1250) *15 = $3750 (purple rectangle)

m. Now assume that the government is aiming to **maximize its tax revenue <u>not</u> aiming to restore the 2014 equilibrium quantity**. What would be the amount of the excise tax that the government should charge to the producers to reach this goal? ***You are not allowed to use any calculus here***. (Hint: The government revenue would be a quadratic equation of the size of the excise tax.)

Say the size of excise tax is T.
The supply equation would become as aforementioned:
P = 500 + T + 50Q
Hence, the equilibrium quantity would be:
500 + T + 50Q = 2500 – 50Q
100Q = 2000 – T
Q = 20 – T/100
The government revenue is Q * T = $(20 - \frac{T}{100})$*T = $-\frac{1}{100}(T^2 - 2000T) = -\frac{1}{100}(T-1000)^2 + 10000$
Since this is a quadratic equation and we are looking for maximum, it is maximized at T = 1000. (at the "vertex" of the curve)
At T = 1000, tax revenue is $10,000. At T greater than 1000, the first term is going to be negative and result in tax revenue that is less than $10,000. At T less than 1000, the first term is going to still be negative because you are squaring a negative number and therefore the tax revenue will be less than $10,000.

n. Calculate the consumer surplus and the producer surplus and the deadweight loss (if any) after the legislation of the tax you calculated in part m. Compare your answers with that in part (k).

The size of the excise tax is $1000 per goose-down jacket. The new supply curve is P = 1500 + 50Q and the demand curve is P = 2500 – 50Q. The equilibrium quantity is 1500 + 50Q = 2500 – 50Q which gives you 100Q = 1000 so Q = 10 goose-down jackets. P = $2000 per goose-down jacket.
The consumer surplus is (2500 – 2000) * 10 * 0.5 = $2500 (red shaded area)
The producer surplus is (1000 – 500) * 10 * 0.5 = $2500 (blue shaded area)
Both consumer surplus and producer surplus decrease a lot compared to that in part (k).
The deadweight loss is the black shaded area: 1000 * 10 * 0.5 = $ 5000, which is greater than that in part (k), consistent with what we have expected.



o. What is the total tax revenue? What are the consumers' tax incidence and the producers' tax incidence after the legislation of the tax in part (m)? Compare yours answers with that in part (l). Provide a well labeled graph depicting CS, PS, DWL, CTI, PTI and tax revenue.

The tax revenue would be 1000 * 10 = $10,000.
The consumers' tax incidence is: (2000 – 1500) * 10 = $5000 (orange rectangle in part (n))
The producers' tax incidence is: (1500 – 1000) * 10 = $5000 (purple rectangle in part (n))
This is higher than the values in part (l) since the government is maximizing its tax revenue here.

2. Draw **four different sets of graphs** of the excise tax T imposed on either consumers or producers (it does not matter which side of the market the excise tax is imposed on), where:
(1) demand is elastic in the first graph for a given supply curve;
(2) demand is inelastic in the second graph for a given supply curve (that is the same as in (1);
(3) supply is elastic in the third graph for a given demand curve;
(4) supply is inelastic in the fourth graph for a given demand curve (that is the same as in (3).
Show graphically and then describe verbally how the incidence of the excise tax depends on the elasticity of demand/supply. In each graph have the excise tax be the same amount.

The incidence of tax falls mostly on producers when the price elasticity of demand is high (elastic) and the price elasticity of supply is low (inelastic). On the other hand, when the price elasticity of demand is low and the price elasticity of supply is high, the burden of an excise tax lies mainly on consumers.

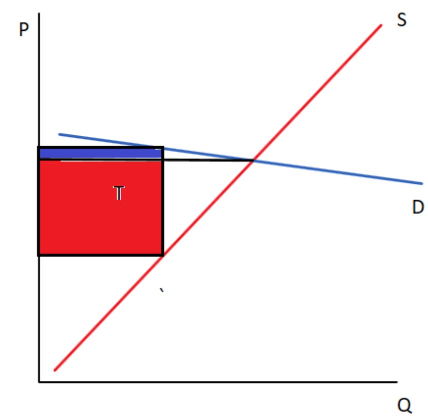
Assume that tax is levied on producers.

The imposition of the tax causes the supply curve to shift left, the equilibrium price to increase and the equilibrium quantity to fall.

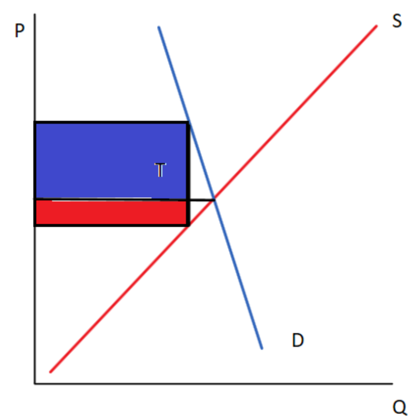
1) If the demand is elastic, given changes in quantities, the price change would be small. Hence, the burden is relatively smaller than that of producers.
2) If the demand is inelastic, given changes in quantities, the price change would be large. Hence, the burden is relatively larger than that of producers.

The same argument can apply to consumers.

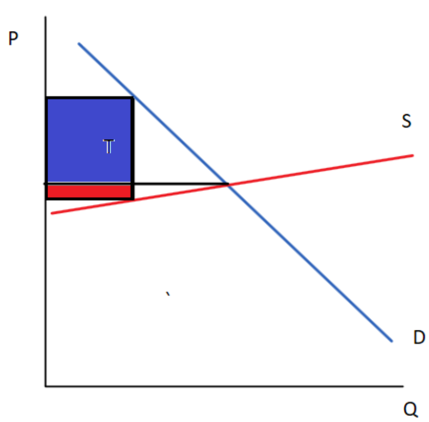
Elastic Demand



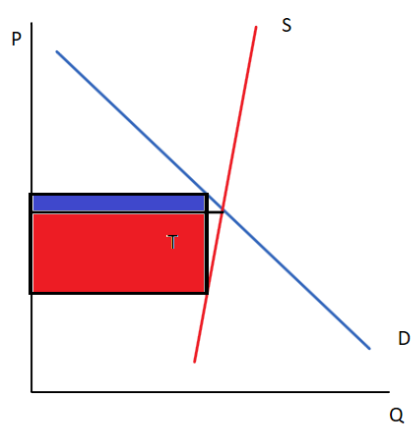
Inelastic Demand



Elastic Supply



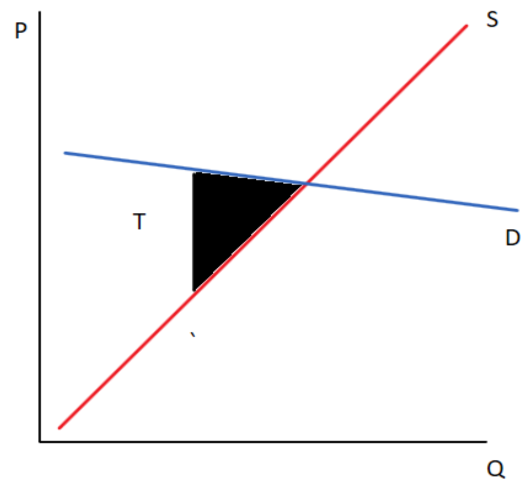
Inelastic Supply



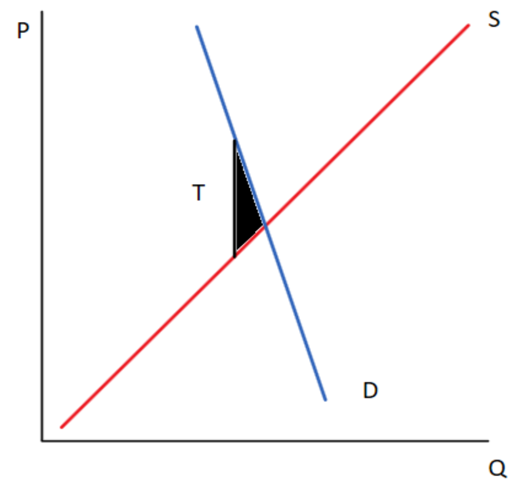
3. Repeat the same exercise as in question 2 but now analyze how the deadweight loss changes and explain how the deadweight loss depends on the elasticity of demand/supply.

The deadweight loss is smaller when the demand/supply is inelastic. It is because the lower the price elasticity of demand or supply, the smaller the tax-induced fall in the quantity transacted and hence the smaller deadweight loss.

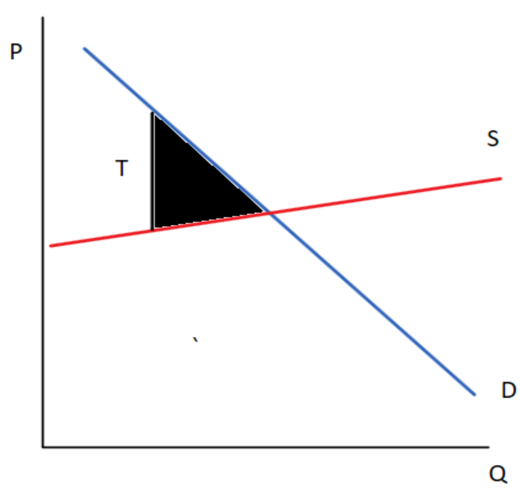
Elastic Demand



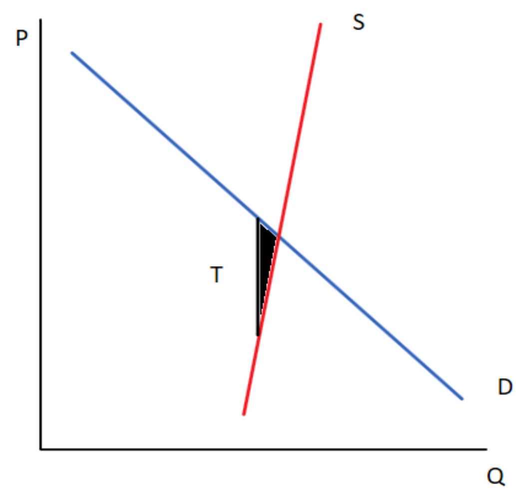
Inelastic Demand



Elastic Supply



Inelastic Supply



Part II: International Trade (Tariffs and Quotas)

4. Suppose Country A is a small economy. The domestic demand for computers in Country A and the domestic supply of computers are given by the following equations where P is the price per computer in dollars and Q is the quantity of computers.

   Domestic Demand for Computers: $P = 1000 – 10\,Q$
   Domestic Supply of Computers: $P = 100 + 50\,Q$

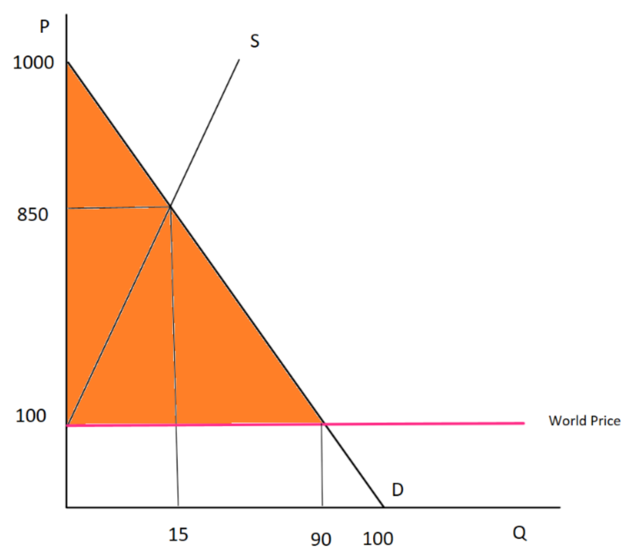
   a. Calculate the equilibrium price, quantity, consumer surplus and producer surplus for the domestic market for computers when the Country A is in autarky (i.e. the market is closed to trade). Calculate total surplus. Illustrate your answer graphically.

   To find the equilibrium price and quantity, set the domestic supply equation equal to the domestic demand equation and then solve.
   1000 – 10Q = 100 + 50Q; 60Q = 900
   Q* = 15 computers and P* = $850 per computer
   CS = (1000 – 850) * 15 * 0.5 = $1125, the orange shaded area
   PS = (850 – 100) * 15 *0.5 = $5625, the purple shaded area
   Total Surplus = 1125 + 5625 = $6750

   b. Suppose now that the Country A opens the market to international trade and that the world price of computers is $ 100 per computer. Further, suppose that Country A is small relative to the global market. Given this information, what will be the new price for computers in the Country A market? How many computers will be consumed domestically? How many computers will be supplied domestically? How many computers will be imported/exported? Calculate the new consumer and producer surplus. How does the total surplus change as Country A opens this market to international trade? Illustrate your answer graphically.

   Since the Country A market is small this means that when Country A opens this market to international trade, the new price will be the world price, which is $100 per computer. At that price the domestic suppliers will provide 0 computers and the domestic demanders will demand 90 computers. Hence, 90 computers will be imported.

   The new consumer surplus is
   (1000 – 100) * 90 * 0.5 = $40,500
   The new producer surplus is zero.
   Total welfare = $40,500
   Change in the total surplus = 40500 – 6750 = $33,750.

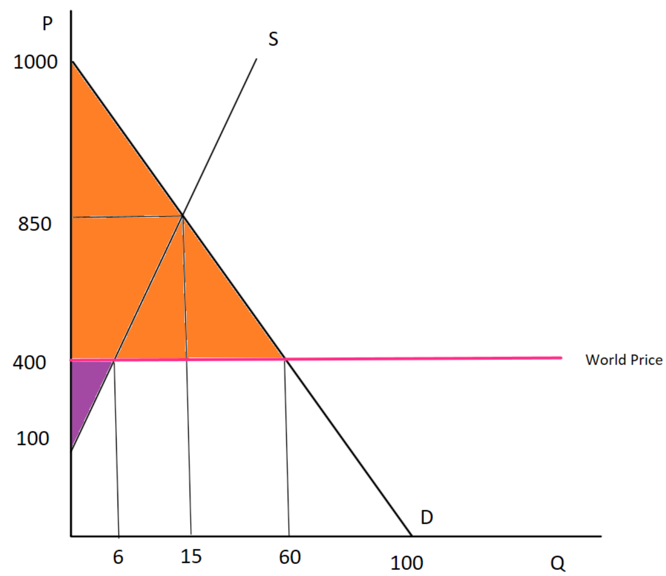


c. Suppose now that the world price of computers is $ 400 per computer and that this small economy opens its computer market to trade. What will be the price of the computer in this market? How many computers will be consumed domestically? How many computers will be supplied domestically? How many computers will be imported/exported? Calculate the new consumer and producer surplus. Illustrate your answer graphically.

The world price will be $400. At P = $400, the quantity supplied domestically would be 6 computers and the quantity demanded would be 60 computers. Hence, 60 – 6 = 54 computers would be imported.

The consumer surplus is:
(1000 – 400) * 60 * 0.5 = $18,000

The producer surplus is:
(400 – 100) * 6 * 0.5 = $900

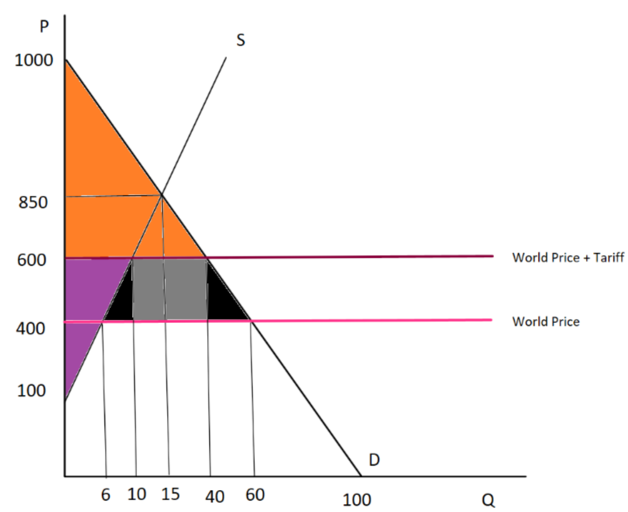


d. The government of Country A now decides to support the domestic producers of computers and plans to levy a tariff of $200 per imported computers. (The current world price of computers before the tariff is $400.) What will be the new price of computers when this tariff is implemented? How many computers will be consumed domestically? How many computers will be produced domestically? How many computers will be imported/exported given this tariff? Calculate the consumer surplus, producer surplus, government revenue and deadweight loss (if any) with this tariff. Again, illustrate your answer graphically.

The new price would be the world price plus the tariff, or $600.
The quantity supplied domestically is 10 computeres and the quantity demanded domestically is 40 computers. Country A imports 30 computers.

CS = (1000 – 600) *40 * 0.5 = $8000
PS = (600 – 100) *10 *0.5 = $2500

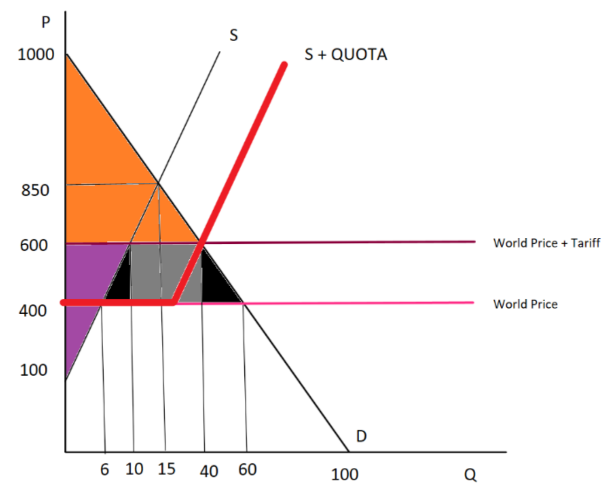
When you compare the sum of the consumer surplus and the producer surplus before the tariff and after the tariff is imposed, you see that the black + grey areas are missing. Grey area is the government revenue from the tariff. Government tariff revenue = (30 * 200) = $6000.



Black triangles are deadweight loss:
18000 + 900 – 8000 – 2500 – 6000 = $2400
(or you can just calculate the area of the black triangles)

e. Suppose instead of a tariff, Country A wants to implement an import quota which effectively gives the same result as the tariff of \$200. What would be the appropriate import quota? Calculate the consumer surplus, producer surplus, government revenue, license-holder revenue and deadweight loss (if any) from this import quota.

The quota would be 30 imported computers. All answers are the same as that from part (d), except that the government revenue is \$0. The government revenue now would be license-holder revenue, unless the government auctions off the right to import the good. With a well-run auction the government can likely "capture" most of the license-holder revenue.



f. Assume the government is trying to **maximize its tariff revenue**. The current world price of computers before the tariff is \$400. What would be the size of the tariff? ***Calculate your answer without using calculus***. (Hint: Complete the squares!) What is the maximum government tariff revenue?

Let the size of the tariff be t.
Domestic demand:
400 + t = 1000 – 10Qd
Qd = 60 – t/10
Domestic supply:
400 + t = 100 + 50Qs
Qs = 6 + t/50
Imports:
Qd – Qs = 60 – t/10 - 6 – t/50 = 54 – 6t/50
Government Revenue from Tariff:
Rev = t * (54 – 6t/50) = -6/50 $(t^2 - 450t)$ = -3/25 $(t - 225)^2 + constant$
Hence, the tariff revenue is maximized at t = 225.
The maximum revenue is:
Domestically demanded computers = Qd = 37.5 computers
Domestically supplied computers = Qs = 10.5 computers
Imported computers = 27 computers
Tariff Revenue = 27*225 = \$6075.

g. Assume the government wants to implement a tariff that will provide tariff revenue equal to \$ 6,000. Calculate the two different tariffs that can provide the government with tariff revenue of \$ 6,000. Compare the deadweight loss of these two tariff rates and determine which one gives a smaller deadweight loss. (Hint: you don't have to calculate the deadweight loss.)

As we have calculated in (f),
Tariff Revenue = t * (54 – 6t/50)
Now we want Tariff Revenue to equal \$6000. So,
Tariff Revenue = t * (54 – 6t/50)
Then, $54t - \frac{6t^2}{50} - 6000 = 0$
That is, $2700t - 6t^2 - 300000 = 0$
$t^2 - 450t + 50000 = 0$ $(t - 250)(t - 200) = 0$
t = 250 and 200. So a tariff of \$250 or a tariff of \$200 will yield government tariff revenue of \$6000.
As the size of the tariff increases, the size of the deadweight loss also increases. So the tariff of \$200 results in the smaller deadweight loss.

Part III: Elasticity

5. Below are percentage and elasticities questions.

a. Suppose the price has increased from \$125 to \$150. What is the percentage increase in prices?

% change = [(new value – old value)]/(old value)*[100%] = {(150 – 125) / 125} * 100 = 20%

b. Suppose the price has decreased from \$150 to \$125. What is the percentage decrease in prices?

% change = [(new value – old value)]/(old value)*[100%] = {(125 – 150) / 150} * 100 = -50/3 %

c. Repeat a) and b) using the midpoint method. Comment on the finding.

% change using midpoint method = {(new value – old value)/[(new value + old value)/2]}*(100%)
Both are {25 / (0.5*(150+125))} * 100 = 200/11%. The midpoint method gives you the same value whether you moved from A to B or B to A.

From now on in this question, use the midpoint method to calculate the percentage changes.

d. Write down the formula for the price elasticity of demand. The price of sparkling water has gone up from \$1.00 to \$1.50 per can, and the quantity demanded changes from 2500 to 1500 cans. What is the price elasticity of demand?

Price elasticity of demand = $\dfrac{\frac{Q2-Q1}{(Q1+Q2)/2}}{\frac{P2-P1}{(P1+P2)/2}} = \dfrac{\frac{1500-2500}{(1500+2500)/2}}{\frac{1.50-1.00}{(1.50+1.00)/2}} = 0.625$

e. Write down the formula for the income elasticity of demand. Determine the signs of the income elasticities of demand when the good is an inferior good and when the good is a normal good. Are the signs different for the two types of goods? Explain your answer.

Income elasticity of demand = $\dfrac{\frac{Q2-Q1}{(Q1+Q2)/2}}{\frac{Y2-Y1}{(Y1+Y2)/2}}$
Income elasticity of demand is positive for a normal good and negative for an inferior good.

f. Annie's income decreases from $1,300 to $1,100 per month. Consequently, the number of times Annie goes to the cinema decreases from three times to once per month. What is her income elasticity of demand for cinema visits?

Income elasticity of demand = $\dfrac{\frac{1-3}{(3+1)/2}}{\frac{1100-1300}{(1100+1300)/2}} = \dfrac{-1}{\frac{-200}{1200}} = 6$

g. Write down the formula for the cross-price elasticity of demand. Determine the signs of the cross elasticities of demand when the goods are complements and substitutes. Are they different? Explain your answer.

Cross-price elasticity of demand between good A and good B = $\dfrac{\frac{Q2-Q1}{(Q1+Q2)/2}}{\frac{P2-P1}{(P1+P2)/2}}$ where Q is quantity of good A demanded and P is the price of good B. When these two goods are substitutes, the measure of cross-price elasticity of demand will be positive and when these two goods are complements, the measure of cross-price elasticity of demand will be negative. The absolute value of cross-price elasticity of demand represents how strongly complementary/substitutable the goods are.

h. Suppose the price of a cup of tea has gone up from $2 to $3. The demand for coffee changes from one cup per day to two cups. What is the cross-price elasticity of demand for these two goods? Is it consistent with what you have explained in (g)?

Cross-price elasticity of demand between coffee and tea $= \dfrac{\frac{2-1}{(1+2)/2}}{\frac{3-2}{(3+2)/2}} = 5/3$

Since the value of the cross-price elasticity of demand is positive this tells us that coffee and tea are substitutes.

6. Demand for Good X has the equation below:

P = 100 – 3Q

a. Find the point elasticity of the demand at each price p given the demand equation. Use the formula we learned in class. Calculate the quantity demanded at the given level of price and then compute the total revenue. **Get the tightest range for the price that maximizes the total revenue given the values of the total revenue only**. Fill in the following table with your answers:

Price	Quantity Demanded	Total Revenue	Point Elasticity
10			
20			
30			
40			
50			
60			
70			
80			
90			

Point elasticity of demand = ε = [-1/slope][P/Q]

The total revenue is maximized between prices 40 and 60.

Price	Quantity Demanded	Total Revenue	Point Elasticity
10	30	300	1/3
20	80/3	1600/3	1/4
30	70/3	700	3/7
40	20	800	2/3
50	50/3	2500/3	1
60	40/3	800	1.5
70	10	700	7/3
80	20/3	1600/3	4
90	10/3	300	9

b. What price and quantity maximizes total revenue given this demand curve? What is the maximum total revenue?

The total revenue is maximized when the point elasticity is equal to one; so, the price that maximizes total revenue is \$50. At \$50, 50/3 units are demanded and total revenue is equal to \$2500/3 = \$833.33.

Part III: Time Management

In Homework 2, you were asked to track your time spent on each activity and compare them with your weekly expected number of hours for each activity. Following are some reflection questions.

a. Did you have any difficulty in tracking your time?

b. Is the difference between the actual time spent on each activity and your expectation large? Which activity has the largest difference and which has the smallest? What do you think the underlying reasons for the gap between the planned and the actual time spent?

c. What activities do you think are “time-wasting”? How many hours do you spend on these? Do you want to reduce the time on these activities? Why or why not?

d. Did you get any insight from the experiment?