Economics 101
Fall 2016
Answers to Homework #3
Due November 3, 2016

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 do any work for someone else!

Part I: Excise tax

1. Norway has a sugar tax that is a tax paid on chocolate and sugar products that are either imported into Norway or produced in Norway. In 2016 the tax was around 20 Norwegian knorer (NOK) per kg.

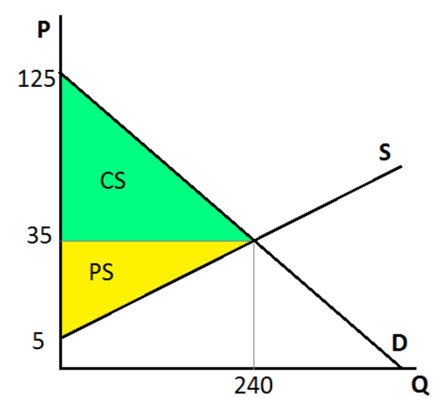
Consider the market for candies in Norway before the introduction of this sugar tax. Market demand and market supply curves are given by the following equation below where P is the price in NOK per kg of candies and Q is the quantity in kg of candies:

Market Demand: P = 125 – (3/8)Q

Market Supply: P = 5 + (1/8)Q

a) Given the above information, find the equilibrium price and quantity in this market.

Solve for the market equilibrium price and quantity:
125 – (3/8)Q = 5 + (1/8)Q
120 = (1/2)Q
Q = 240 kg of candies
P = 5 + 240/8 = 35 NOK per kg of candies
So the equilibrium price and equilibrium quantity are P = 35 NOK per candy, Q = 240 kg of candies.



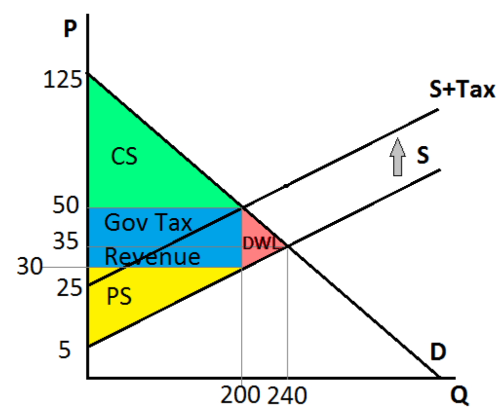
b) Calculate the values of consumer surplus and producer surplus before the imposition of the tax. Show them graphically in a well-labeled graph.

Producer surplus is (1/2)(240 - 0)(35 - 5) = 3,600 NOK
Consumer surplus is (1/2)(240 - 0)(125 - 35) = 10,800 NOK

c) Given this excise tax of 20 Norwegian knorer, find the new price consumers will pay for each kg of candies, the new price producers will receive for each kg of candies after they pay the excise tax, and the new equilibrium quantity of kg of candies that will be sold in the market. Show the impact of this excise tax in a well-labeled graph.

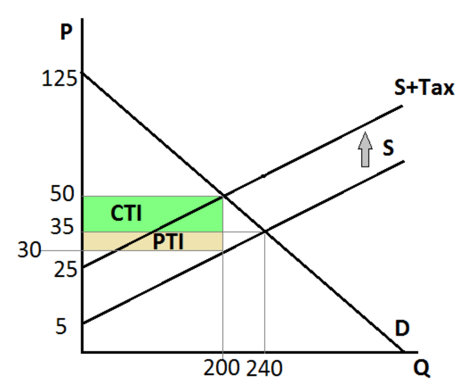
With this excise tax the supply curve shifts up by the amount of the tax per unit, because at each quantity sellers' costs increase by the amount of the tax, i.e. 20 NOK.
The new equation for the supply curve with the tax: P=5+(1/8)Q+20.
Solve for the new market equilibrium price and quantity:
125 – (3/8)Q = 25 + (1/8)Q
100 = (1/2)Q
Q with the tax = 200 kg of candies
P with the tax = 125 – (3/8)*200 = 50 NOK per kg of candies. It is the price that consumers will pay.
After tax producers will receive 50 – 20 = 30 NOK per kg of candies. This is the net price with the tax.
So the equilibrium quantity with the excise tax is Q = 200 kg of candies, the price consumers pay with the tax is P = 50 NOK per kg of candies, and the price producers receive after paying the excise tax to the government is 30 NOK per kg of candies

d) Given this excise tax, calculate the value of consumer surplus with the tax, producer surplus with the tax, tax revenue the government receives from implementing the tax, and the deadweight loss due to the implementation of this excise tax. Show these areas in a well-labeled graph.



Producer surplus is (1/2)(200 - 0)(30 - 5) = 2,500 NOK
Consumer surplus is (1/2)(200 - 0)(125 - 50) = 7,500 NOK
Government Tax Revenues is 20*200 = 4,000 NOK
DWL is (1/2)(240 - 200)(50 - 30) = 400 NOK

e) Given this excise tax, calculate consumer tax incidence and producer tax incidence. Show them graphically in a well-labeled graph. Who bears the greater economic burden from this excise tax?

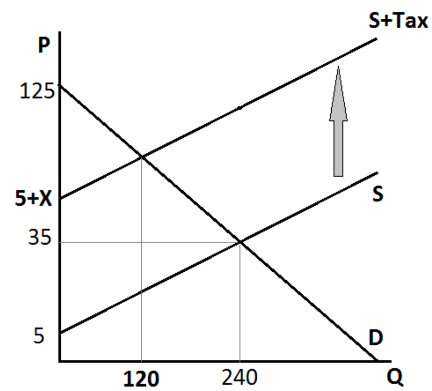


Consumer Tax Incidence is (50 - 35)(200 - 0) = 3,000 NOK
Producer Tax Incidence is (35 - 30)(200 - 0) = 1,000 NOK

Check that CTI + PTI = Government Tax Revenues
Note that it does not matter who officially or legally pays the tax. In this problem both consumers and producers bear some of the economic burden of the excise tax.

f) Suppose that the number of people with diabetes starts to increase. To try to prevent the spread of diabetes the government decides to implement an excise tax in this market so that consumption of candies falls to 120 kg. Calculate the size of the excise tax (assume that you are measuring the size of this excise tax relative to there being no excise tax in the market) that would be needed for the government to accomplish this goal.

Assume that government imposes an excise tax equal to X NOK. Hence, with this excise tax the supply curve will shift up by the amount of the tax per unit, i.e. X NOK.
The new equation for supply with this excise tax will be: P = 5 + (1/8)Q + X.
Solve for the new market equilibrium price and quantity:
125 – (3/8)Q = 5 + X + (1/8)Q
120 – X = (1/2)Q
We know that new equilibrium quantity Q = 120 kg of candies, so 120 – X = 120/2 = 60. Thus, X = 60 NOK.
So to accomplish the goal government should impose an excise tax of 60 NOK per kg of candies.



g) Suppose that the government increases its expenditures on diabetes treatment research by 2,200 NOK and wants to finance these expenditures by using tax revenue generated from implementing an excise tax in the candy market. Calculate the size of the excise tax that would be needed for the government to accomplish this goal. Assume that there is no excise tax initially when doing your calculations.

Assume that the government imposes an excise tax equal to Y NOK. Hence, with this excise tax the Supply curve shifts up by the amount of the tax per unit, i.e. Y NOK.
The new equation for supply with the excise tax: P=5 + (1/8)Q + Y.
Solve for the new market equilibrium price and quantity:
125 – (3/8)Q = 5 + Y + (1/8)Q
120 – Y = (1/2)Q
So the new equilibrium quantity is Q = 240 – 2Y
Government tax revenues are Y*Q = Y(240 – 2Y) = $-2Y^2$ + 240Y = 2,200 NOK
This is a quadratic equation! So, we need to solve this equation: $2Y^2$ – 240Y + 2200 = 0, we could divide both sides of the equation by 2.
Y^2 – 120Y + 1100 = 0
(Y – 10)(Y – 110) = 0
Y = 10 or Y = 110 as possible answers. So if the excise tax is 10 NOK per unit, the government tax revenue is calculated as follows:
Q = 240 – 2(10) = 220 kg of candy

Government tax revenue = (tax per unit)(number of units with the tax)
Government tax revenue = (10 NOK per unit)(220 units) = 2200 NOK
If the excise tax is 110 NOK per unit, the government tax revenue is calculated as follows:
Q = 240 – 2(110) = 20 kg of candy
Government tax revenue = (tax per unit)(number of units with the tax)
Government tax revenue = (110 NOK per unit)(20 units) = 2200 NOK

h) As the size of the excise tax increases, what happens to the level of tax revenue? Provide a verbal explanation. (Hint: Based on this example, you might think about what the tax revenue is when the excise tax is 0 NOK per kg of candies and what the tax revenue is when the excise tax is 120 NOK per kg of candies. Then, think about what must occur at excise taxes that are set between these two values of the excise tax).

When the excise tax is set at 0 NOK per kg of candies, the tax revenue the government receives is 0 NOK. When the excise tax is set at 120 NOK per kg of candies in this example, the tax revenue the government receives is 0 NOK since at this level of excise tax consumers will purchase 0 kg of candies. We know that an excise tax has the capacity to generate tax revenue, so it must be the case that tax revenue rises as the excise tax increases, then at some point tax revenue decreases as the excise tax continues to increase. In our example, we see that an excise tax of 10 NOK per kg results in tax revenue of 2,200 NOK, while an excise tax of 20 NOK per kg results in tax revenue of 4,000 NOK. So there is an increase in government tax revenue as an excise tax per kg increases. Also we know that an excise tax of 110 NOK per kg results in tax revenue of 2,200 NOK. So for a high enough level of excise tax per kg the tax revenue falls.

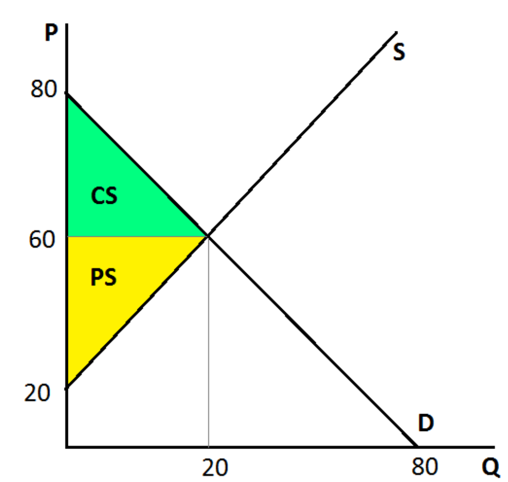
<u>Part II: International Trade</u>

2. Consider the market for space fuel on our planet Earth. Market demand and market supply curves for Earth residents are given by the following equations where P is the price per gallon of space fuel and Q is the quantity in millions of gallons of fuel:

Earth's Market Demand: P = 80 - Q

Earth's Market Supply: P = 20 + 2Q

a) Given the above information, find the equilibrium price and quantity in this market if the only producers and consumers are from Earth.



Solve for the market equilibrium price and quantity:
80 – Q = 20 + 2Q
60 = 3Q
Q = 20 million gallons of fuel

P = 80 – 20 = \$60 per gallon of fuel
So the equilibrium price and equilibrium quantity are P = \$60 per gallon of fuel, Q = 20 million gallons of fuel.

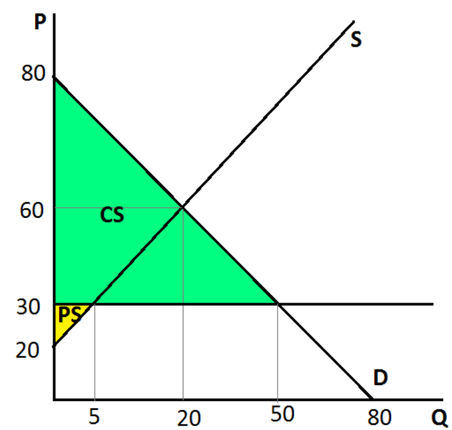
b) Calculate the value of consumer surplus and producer surplus. Show them on a well-labeled graph.

Producer surplus is (1/2)(20 - 0)(60 - 20) = \$400 million
Consumer surplus is (1/2)(20 - 0)(80 - 60) = \$200 million

Suppose that humans now discover that we are not alone in the universe. This means that humans can now trade of the global interplanet market for space fuel and in this market the current price of one gallon of space fuel is \$30.

c) Given the free trade in the interplanet market, find the quantity of space fuel that is sold by domestic producers and the quantity of space fuel that is imported from other planets. Calculate the new values of consumer surplus and producer surplus. Show them graphically in a well-labeled graph.

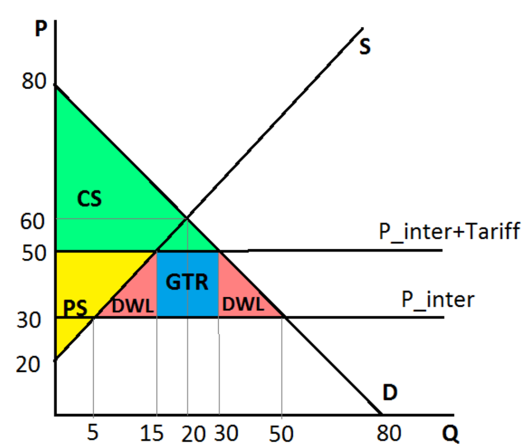
As Earth enters the interplanet market, it becomes a price taker for space fuel and has to accept \$30 per gallon of space fuel as its domestic price. If we plug in P = 30 into the demand equation P = 80 – Q. You get Q = 50 million gallons, which is the quantity demanded by humans. Plug in P = 30 into the supply equation P = 20 + 2Q, and you get Q = 5 million gallons, which is the quantity supplied by Earth producers. The difference between them is the quantity imported, which is 50 - 5 = 45 million gallons of space fuel.



Producer surplus is (1/2)(5 - 0)(30 - 20) = \$25 million
Consumer surplus is (1/2)(50 - 0)(80 - 30) = \$1,250 million

d) Suppose that leaders of the countries on Earth decide to protect domestic producers of space fuel by imposing a tariff of \$20 on each gallon of imported space fuel. Find the quantity that is sold by domestic producers and the quantity that is imported from other planets given this tariff. Calculate the new values of consumer surplus and producer surplus with the tariff. Calculate the revenue the earth gets from the tariff, and the deadweight loss due to the implementation of this tariff. Show these areas in a well-labeled graph.

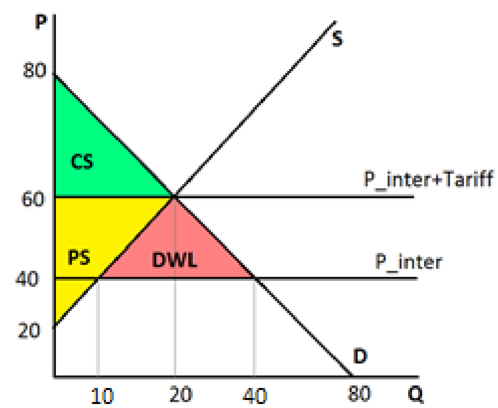
Now Earth has to accept 30 + 20 = 50 as its domestic price.
If we plug in P = 50 into the demand equation P = 80 – Q. You get Q = 30 million gallons, which is the quantity demanded by humans. Plug in P = 50 into the supply equation P = 20 + 2Q, and you get Q = 15 million gallons, which is the quantity supplied by Earth producers. The difference between



them is the quantity imported, which is 30 - 15 = 15 million gallons of space fuel.
Producer surplus is (1/2)(15 - 0)(50 - 20) = \$225 million
Consumer surplus is (1/2)(30 - 0)(80 - 50) = \$450 million
Tariff Revenue Earth gets = (30 - 15)(50 - 30) = \$300 million
DWL = (1/2)(15 - 5)(50 - 30) + (1/2)(50 - 30)(50 - 30) = 100 + 200 = \$300 million

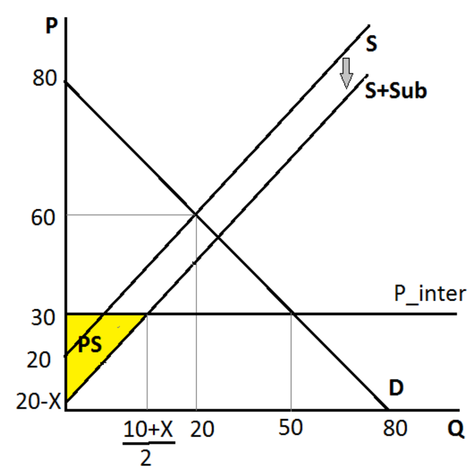
e) Suppose that due to the galactic energy crisis price of space fuel increases to \$40 per gallon of space fuel. Earth leaders are still imposing the tariff of \$20 per gallon of imported space fuel. Find the quantity that is sold by domestic producers and the quantity that is imported from other planets given this increase in the intergalactic price of space fuel and the tariff imposed by the earthlings. Calculate the new values of consumer surplus and producer surplus. Calculate the amount of tariff revenue the earth gets from implementing this tariff, and the deadweight loss due to the implementation of this tariff. Show all your results in a well-labeled graph.

Now Earth has to accept 40 + 20 = 60 as its domestic price.
If we plug in P = 60 into the demand equation P = 80 – Q. You get Q = 20, which is the quantity demanded by humans. Plug in P = 60 into the supply equation P = 20 + 2Q, and you get Q = 20, which is the quantity supplied by Earth producers. The difference between them is the quantity imported, which is 20 - 20 = 0 million gallons of space fuel. So the earth economy is no longer importing space fuel.
Producer surplus is (1/2)(20 - 0)(60 - 20) = \$400 million
Consumer surplus is (1/2)(20 - 0)(80 - 60) = \$200 million
Tariff Revenue for Earth = (0)(60 - 40) = \$0
DWL = (1/2)(40 - 10)(60 – 40) = \$300 million



f) Suppose that situation normalizes and the price for a gallon of space fuel returns to \$30. During one of the Earth summits, the leader of country W suggests implementation of a per unit subsidy to domestic producers instead of a tariff that would result in the same value of producer surplus as in (d). What is the amount of this subsidy per gallon of space fuel? Calculate the total cost to Earth of this expenditures on this subsidy program.

Producer surplus in point (d) was \$225 million.
Assume that Earth provides domestic producers with a per unit subsidy equal to X. Hence, with this subsidy the Supply curve shifts down by the amount of the per unit subsidy, i.e. X.
The new equation for the supply curve with the subsidy: P = 20 + 2Q -X.
Earth has to accept 30 as its domestic price. Plug P = 30 into the new supply curve: 30 = 20 + 2Q - X. Solve for Q = (10 + X)/2.
So producer surplus is (1/2)((10 + X)/2 - 0)(30 - (20 - X)) = (1/2)((10 + X)/2)(10 + X) = (1/4)(10 + X)^2= 225



$(10 + X)^2 = 225*4 = 900$
$10 + X = 30$ or $10 + X = -30$
$X = 20$ or $X = -40$
A negative subsidy is no longer a subsidy, but a tax, because the negative number implies that the ruling authority (Earth) is now taking away $40 per gallon instead of providing a positive subsidy to domestic producers of the product. Hence, the subsidy should be $20 gallon of space fuel. The quantity supplied domestically with this subsidy is (10 + 20)/2=15 million gallons.
Earth's expenditures on this subsidy is 20*15 = $300 million.

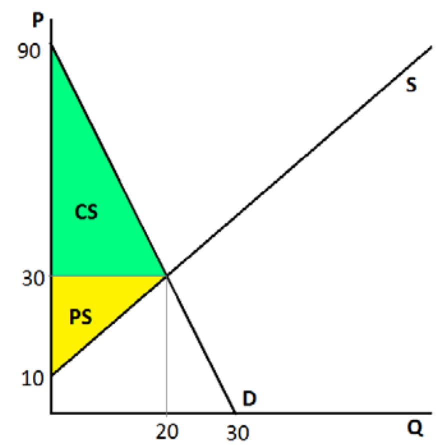
3. Consider the market for chicken in Mexico. The domestic market demand and market supply curves are given by the following equations where P is the price in pesos per pound of chicken and Q is the quantity in millions of pounds of chicken:

Domestic Market Demand: P = 90 - 3Q

Domestic Market Supply: P = 10 + Q

a) Given the above information, find the equilibrium price and quantity in this market if this market is closed to international trade.

Solve for the market equilibrium price and quantity:
$90 – 3Q = 10 + Q$
$80 = 4Q$
Q = 20 million pounds of chicken
P = 10 + 20 = 30 pesos per pound of chicken
So the equilibrium price and equilibrium quantity are P = 30 pesos per pound of chicken, Q = 20 million pounds of chicken.



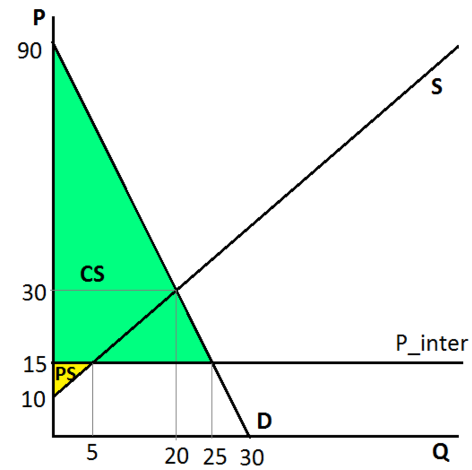
b) Calculate the value of consumer surplus and producer surplus. Show these areas in a well-labeled graph.

Producer surplus is (1/2)(20 - 0)(90 - 30) = 600 million pesos
Consumer surplus is (1/2)(20 - 0)(30 - 10) = 200 million pesos

Suppose that now Mexico enters the international market of chicken, where a pound of chicken costs 15 pesos.

c) Given the free trade in the international market, find the quantity that is sold by domestic producers and the quantity that is imported or exported in the Mexican market for chicken. Calculate the new values of consumer surplus and producer surplus. Show them graphically.

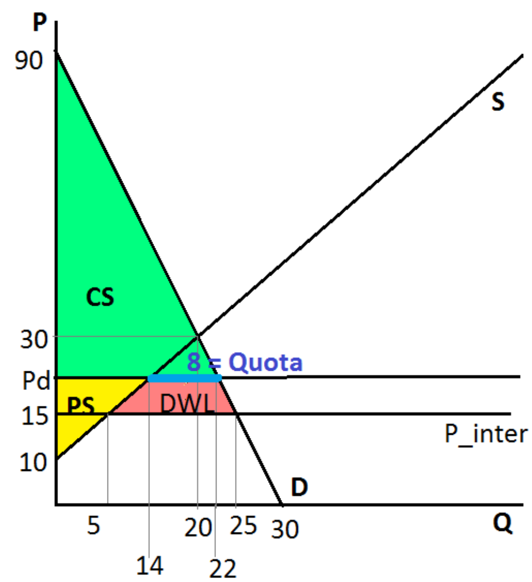
As Mexico enters the international market, it becomes a price taker for chicken and has to accept 15 pesos per pound of chicken as its domestic price. If we plug in P = 15 into the demand equation P = 90–3Q. You get Q = 25, which is the quantity demanded by Mexican consumers. Plug in P = 15 into the supply equation P = 10 + Q, and you get Q = 5, which is the quantity supplied by Mexican producers. The difference between them is the quantity imported, which is 25 - 5 = 20 million pounds of chicken.



Producer surplus is (1/2)(5 - 0)(15 - 10) = 12.5 million pesos
Consumer surplus is (1/2)(25 - 0)(90 - 15) = 937.5 million pesos

d) Suppose that Mexican poultry farmers are unhappy with the results of opening this market to trade. They lobby for imposing an import quota equal to 8 million pounds of chicken. Find the market price, the quantity that is sold by domestic producers and the quantity that is imported given the implementation of this import quota. Calculate the new values of consumer surplus and producer surplus. Calculate the deadweight loss due to the implementation of this quota. Show them graphically.

After the quota is imposed, Mexican consumers can only import 8 million of pounds of foreign chicken. This means that the domestic price for chicken in Mexico must rise, such that the difference between the quantity demanded and the quantity supplied is reduced to 8 million pounds of chicken.
Suppose that the domestic price is Pd. Solving for Q in the demand equation, we have quantity demanded Qd= 30 – (Pd/3). Solving for Q in the supply equation, we have quantity supplied Qs = Pd - 10. So the difference of 8 million pounds of imported chicken must equal: 8 = 30 – (Pd/3) - (Pd - 10). Solving for Pd we get 24 pesos per pound of chicken. At this price the Quantity demanded is 30 – (24/3) = 22 million pounds of chicken, and the quantity supplied by domestic suppliers is 24 - 10 = 14 million pounds of chicken. The difference between the quantity demanded domestically and the quantity supplied domestically is the amount of the imports: in this case, the imports are 8 million pounds of chicken.



Producer surplus is (1/2)(14 - 0)(24 - 10) = 98 million pesos
Consumer surplus is (1/2)(22 - 0)(90 - 24) = 726 million pesos
DWL is (1/2)(8 + 20)(24 - 15) = 126 million pesos

e) Suppose that government does not like the idea of an import quota and decides to implement instead a tariff that results in the same producer surplus as an import quota of 8 million pounds of chicken. What is the amount of this tariff per pound? Find the quantity that is sold by domestic producers and the quantity that is imported when this proposed tariff is implemented. Calculate the new values of consumer surplus. Calculate tax revenue the government receives from implementing the tariff, and the deadweight loss due to the implementation of this tariff. Show these areas in a well-labeled graph.

Producer surplus should be 98 million pesos.

Let tariff be equal to Y pesos per pound.

Now Mexico has to accept 15 + Y pesos as its domestic price.

If we plug in P = 15 + Y into the supply equation P = 10 + Q, i.e. 15 + Y = 10 + Q. Domestic producers supply 5 + Y million pounds of chicken.

Producer surplus is (1/2)(5 + Y - 0)(15 + Y - 10) = 98 million pesos

Solve quadratic equation: $(1/2)(5 + Y)^2 = 98$

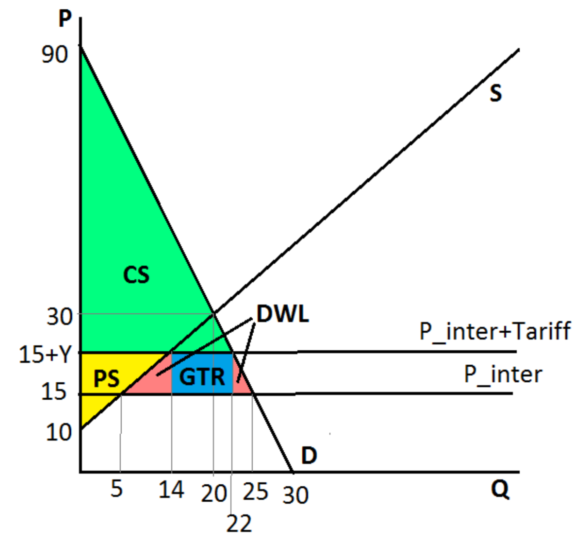
$(Y + 5)^2 = 196$

Y + 5 = 14 or Y + 5 = -14

Y = 9 or Y = -19

A negative tariff does not make sense. So the tariff should be 9 pesos per pound of chicken.

So P = 15 + 9 = 24, as in point (d).



Consumer surplus is (1/2)(22 - 0)(90 - 24) = 726 million pesos

Government Tariff Revenue is (22 - 14)*9 = 72 million pesos

DWL is (1/2)(14 - 5)(24 - 15) + (1/2)(25 - 22)(24 - 15) = 54 million pesos

f) Suppose that the government wants to receive the same amount of money that it receives from implementing the tariff in point (e) by selling the legal right to sell imported chicken to the foreigners who will import the chicken into Mexico. Suppose the Mexican government wants to sell the legal right to import chicken to 8 foreign producers. Suppose that the legal right allows each buyer of the legal right to sell 2 million pounds of foreign produced chicken in Mexico. Will foreign producers agree to buy this right?

The Mexican government wants to receive 72 million pesos. Since the Mexican government wants to sell the legal rights to 8 foreign producers, the government will charge each foreign producer 9 pesos per legal right (72/8 = 9 million pesos per legal right). With 8 foreign producers buying the legal right we would have the total quantity imported being equal to 8*2=16 million pounds of chicken.

If the number of pounds of imported chicken is 16 million pounds, we can calculate the domestic price, Pd, as follows: solving for Q in the demand equation, we have quantity demanded Qd = 30 – (Pd/3). Solving for Q in the supply equation, we have quantity supplied Qs = Pd - 10. So the difference between the quantity demanded domestically and the quantity supplied domestically is 16 million pounds of chicken or 16 = 30 – (Pd/3) - (Pd - 10). Solving for Pd, we get 18 pesos per pound of chicken. At this price Quantity demanded is 30 – (18/3) = 24 million pounds of chicken, and quantity supplied by domestic suppliers is 18 - 10 = 8 million pounds of chicken. The difference between the quantity demanded domestically and the quantity supplied domestically is the amount of the imports: in this case, the imports are 16 million.

If domestic price is 18 pesos per pound, by purchasing the legal right foreign producers will earn 18 - 15 = 3 pesos per pound. They each will only be able to sell 2 million pounds of chicken, so they will each earn 3*2 = 6 million pesos. The foreign producers will not agree to this since the cost of the legal right to import is 9 million pesos while they can only hope to earn 6 million pesos from importing the good under this proposed plan.

Hence, foreign producers would not agree to buy this legal right.

Part Ⅲ: Elasticity

4.Suppose your family runs a Greek yogurt factory which is famous in your town for its unique black Greek yogurt. After attending Econ 101 for nearly ten weeks, you really feel like helping your father to make better pricing decisions. To begin with, you search for a market survey company to find out the demand curve for your black Greek yogurt, which turns out to be:

Q = 12 - 2P + 0.1I

where Q is the quantity demanded in US (in thousands of packages), P is the price for a package of black Greek yogurt, and I is the median income in your town (in thousands of dollars).

Currently the price is set by your father at 2, and the median income is 40.

a) Using the point slope elasticity formula, what is the price elasticity of demand of black Greek yogurt at the current price and income level?

Recall that the point slope elasticity formula is $\frac{1}{|m|}\frac{P}{Q}$, where m is the slope in the inverse demand curve. At I=40, we solve for the inverse demand curve (the demand curve written in slope-intercept form): P = 8 - 0.5Q. So m = -0.5. At P = 2, we have Q = 12 - 2*2 + 0.1*40 =12. So Plug m, P and Q in the formula we have, elasticity $=\frac{1}{|0.5|}\frac{2}{12}=\frac{1}{3}$

b) Based on your result in part a), do you think you should raise or lower the price in order to increase total revenue? (Think about the price elasticity of demand, and the price and quantity effects)

To increase total revenue, you should increase the price. Because at the current price, the price elasticity of demand is $\frac{1}{3} < 1$, meaning that we are on the inelastic part of the demand curve. When demand is inelastic, it means that a given percentage change in price will cause quantity to change by a smaller percentage. Another way of saying this is that the increase in revenue from raising the price (price effect) will be larger than the decrease in revenue from the lower quantity sold (quantity effect).

So as a general rule, if demand is inelastic, Total Revenue goes up when prices go up. When demand is elastic, Total Revenue goes up when prices go down. With a linear demand curve, Total Revenue will be maximized when price elasticity of demand = 1, which is called unit elastic. This will always occur at the midpoint of a linear demand curve.

c) Now verify your answer in part b) by setting a new price which is $1 dollar higher/lower (based on your answer to part b)) than the original price of $2 and then calculate the change in total revenue.

When P = 2 + 1 = 3, Q = 12 - 2*3 + 0.1*40 = 10, so total revenue is P*Q = 30. While at P = 2, the total revenue is 2*12 = 24. So the new total revenue is higher than the original one when the price is increased, which verifies our rationale in part b).

d) Using the two-point elasticity formula (the arc elasticity formula), what is the price elasticity of demand when you go from the original price to the new price?

Recall that the two-point price elasticity formula is given by $\left|\frac{percentage\ change\ in\ Q}{percentage\ in\ P}\right| = \left|\frac{\frac{Q_2-Q_1}{Q_1}*100\%}{\frac{P_2-P_1}{P_1}*100\%}\right|$. Here the original price P_1 = 2, original quantity Q_1 = 12, new price P_2 = 3, and new quantity Q_2 = 10. Plug them in, we have price elasticity of demand equals $\left|\frac{\frac{10-12}{12}}{\frac{3-2}{2}}\right| = \frac{1}{3}$.

Suppose the following two scenarios happen when your yogurt is priced at the new price level in part c), and you hold your price unchanged during the following scenarios:

e) On the Greek yogurt market, your biggest rival is a kind of green Greek yogurt. Suppose the price of green Greek yogurt suddenly goes up from $3 to $3.5 due to an increase in the price of spinach, which is the main ingredient of the green Greek yogurt. Then, market investigation finds that this change causes the quantity demanded for your yogurt to increase by 2 units. So what is the cross-price elasticity of demand? Provide any formulas you use.

Cross-price elasticity is given by $\left|\frac{percentage\ change\ in\ Q_A}{percentage\ in\ P_B}\right|$. Here A refers to your yogurt and B refers to the green Greek yogurt. Since change in Q_A is 2, and before the change in P_B, demand for your yogurt is at 10 as in part c). So the percent change in Q_A is $\frac{2}{10} * 100\%$. Thus the cross-price elasticityof demand is $\left|\frac{\frac{2}{10}*100\%}{\frac{3-3.5}{3}*100\%}\right| = 1.2$

f) Your yogurt has an amazing effect of boosting productivity on the residents in your town, and this leads to an increase in the median income in your town: I goes from 40 to 50. Find the new quantity demanded for your yogurt and calculate the income elasticity of demand. Provide any formulas you use.

First we need to find the new Q at the new income level. Put I=50 in the demand curve, we have Q=12 - 2*3 + 0.1*50 = 11. Then we are ready to apply the income elasticity of demand formula:

$$income\ elasticity = \left|\frac{percentage\ change\ in\ Q}{percentage\ in\ I}\right| = \left|\frac{\frac{11-10}{10} * 100\%}{\frac{50-40}{40} * 100\%}\right| = 0.4$$

<u>Part IV: CPI and Real/Nominal Prices</u>

5. Suppose you find yourself unable to hold back your impulse to write a detective novel set in the 1980s. In order to make the story believable, you first decide to find out some basic economic facts in that era. (You'd better find a calculator for this exercise!)

a) You learn from Econ 101 that the CPI is a good measure of purchasing power, but you wonder what it is composed of. So you find this table showing the proportions of components in the market basket used for the CPI index:

Components of the market basket for the CPI	
Housing	41.4%
Transportation	17.8%
Food	16.2%
Energy	8.2%
Medical Care	6.4%

Apparel and Upkeep	6.1%
Other	3.9%

Suppose that in 1982, the annual average cost of these listed components are 1000, 200, 500,50,50,50,10 respectively (in dollars), then calculate the cost of the market basket in 1982.

1000*41.1% + 200*17.8% + 500*16.2% + 50*8.2% + 50*6.4% + 50*6.1% + 10*3.9% = $541.34

b) Suppose the annual average cost of the market basket is $555.63 in 1983 and $579.62 in 1984. Using the average cost of market basket over 1982-84 as the base for your CPI, calculate annual CPI for 1983 and 1984.

The average cost of market basket over 1982-84 is (541.34 + 555.63 + 579.62)/3 = $558.86.

So CPI in 1982 is (the cost of market basket in 1982)/ base*100 = 541.34/$558.86*100 = 97.0

CPI in 1983 is (the cost of market basket in 1982)/ base*100 = 555.63/$558.86*100 = 99.4

CPI in 1984 is (the cost of market basket in 1982)/ base*100 = 579.62/$558.86*100 = 103.7

c) You want to find the actual data, and your friend gives you a website: https://fred.stlouisfed.org/series/CUUS0000SA0

Go to this website and download the Semiannual CPI data from 1984 to 1990. Then calculate the annual CPI data for 1984,1985 and 1986, rounded to one place past the decimal. (Hint: just take the average of the first half year and the second half year. Exploit Excel to do the calculation job!) Once you do your calculations, put your answers in the following table:

Year	CPI

The data is:

1984-01-01	102.900
1984-07-01	104.900
1985-01-01	106.600
1985-07-01	108.500
1986-01-01	109.100
1986-07-01	110.100

So taking the average for each year, we get CPI for 1984, 1985,1986: 103.9,107.6 and 109.6. Or putting this in a table:

Year	CPI
1984	103.9
1985	107.6
1986	109.6

d) Now using 1985 as the base year and the data you collected from the website, calculate the CPI for 1984 and 1986. Once you do your calculations put your answers in the table below:

Year	CPI with Base Year 1985

Put the base year CPI to the denominator, we have

CPI for 1984=103.9/107.6*100=96.6

CPI for 1986=109.6/107.6*100=101.9

Here is the table:

Year	CPI with Base Year 1985
1984	96.6
1985	100
1986	101.9

e) (challenging) Given the data you have gotten from the web and the work you have done answer the following question. In terms of purchasing power, how many 1986 dollars do you need to have the same purchasing power as one 1984 dollar? Round your answer to two places past the decimal.

Consider the "bundle" of goods, if it was worth $100 in 1985, then it would worth $96.6 in 1984 and $101.9 in 1986 because the CPI for 1984 and 1986 using 1985 as base is 96.6 and 101.9, respectively. So $1 in 1985 is equivalent to $101.9/96.6=$1.05 in 1986.

6. Looking back on the diary from your childhood, the prices and wages back in 2005 grab your attention. Then you compare prices of some goods in 2005 to what they are 2015. You collect the following data:

Year	CPI (using 1982-84 as the base)	Nominal Price of Doughnut	Nominal Price of Haircut	Nominal Price of Gas
2005	201.6	$1.09	$15.00	$3.25
2015	237.0	$1.29	$20.00	$4.00

a) Using 2005 as the base year, calculate the CPI for 2015 (rounded to the first decimal).
Since 2005 is the base, so CPI2015 = 237.0/201.6*100 = 117.6

b) What was the real price of doughnuts in 2015 in terms of 2005 dollars? Round your answer to two places past the decimal. What was the percentage change in the real price of doughnuts from 2005 to 2015 (in terms of 2005 dollars)?

Now we are looking at the real price of doughnuts in terms of 2005 dollars, so we can directly use the CPI we derived in part a), which is also based on 2005.

Real price in 2015 = ((nominal price in 2015) / CPI2015) * 100

= ($1.29 / 117.6) * 100 = $1.10 in 2005 dollars

Again, note that since 2005 is the new base year, our real price of doughnuts is calculated in 2005 dollars, so

Real price in 2005 = ((nominal price in 2005) / CPI2005)) * 100

= ($1.09 / 100) * 100 = $1.09 in 2005 dollars,

So the percentage change in the price of doughnuts measured in 2005 dollars is (($1.10 - $1.09) / $1.09) * 100% = 0.9%

c) What good (doughnuts, haircuts, and gas) experiences the greatest nominal increase in price? What good experiences the greatest real increase in price?

For this question, we are interested in how much the prices have increased relative to each other.

By making comparison of the nominal price changes for each of the other goods, we can see that:

Nominal doughnut prices are 1.29/1.09 = 1.18 times higher in 2015 than in 2005.

Nominal haircut prices are 20/15 = 1.33 times higher in 2015 than in 2005.

Nominal gas prices are 4/3.25 = 1.23 higher in 2015 than in 2005.

So haircut prices have had the largest nominal percentage price increases.

Since percentage change in real prices $=\frac{\text{real price in 2015}-\text{real price in 2005}}{\text{real price in 2005}} * 100\% = \left(\frac{\text{real price in 2015}}{\text{real price in 2005}} - 1\right) * 100\% = \left(\frac{\frac{\text{nominal price in 2015}}{\text{CPI2015}}}{\frac{\text{nominal price in2005}}{\text{CPI2005}}} - 1\right) * 100\% = \left(\frac{\text{nominal price in 2015}}{\text{nominal price in 2005}} * \frac{\text{CPI2005}}{\text{CPI2015}} - 1\right) * 100\%$

So we can see that the kind of good that experiences the largest nominal percentage price changes also have the largest real price change.