Economics 101
Fall 2011
Homework #4
Due 11/8/11

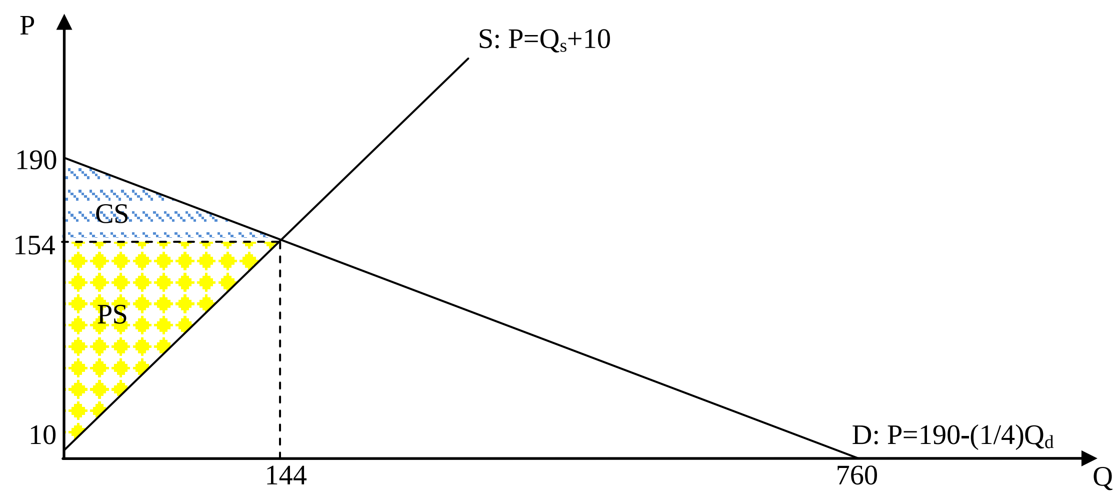
Directions: The homework will be collected in a box before the lecture. Please place your name, TA name and section number on top of the homework (legibly). Make sure you write your name as it appears on your ID so that you can receive the correct grade. Please remember the section number for the section you are registered, because you will need that number when you submit exams and homework. 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, 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!

1. Excise Taxes

Hipsteria is a town made up of only hipsters. The people of Hipsteria consume many vinyl records according to the demand curve: $P = 190 – (1/4)Q_d$. Records are supplied by Hipster-Phonics, the local record label, according to: $P = 10 + Q_s$.

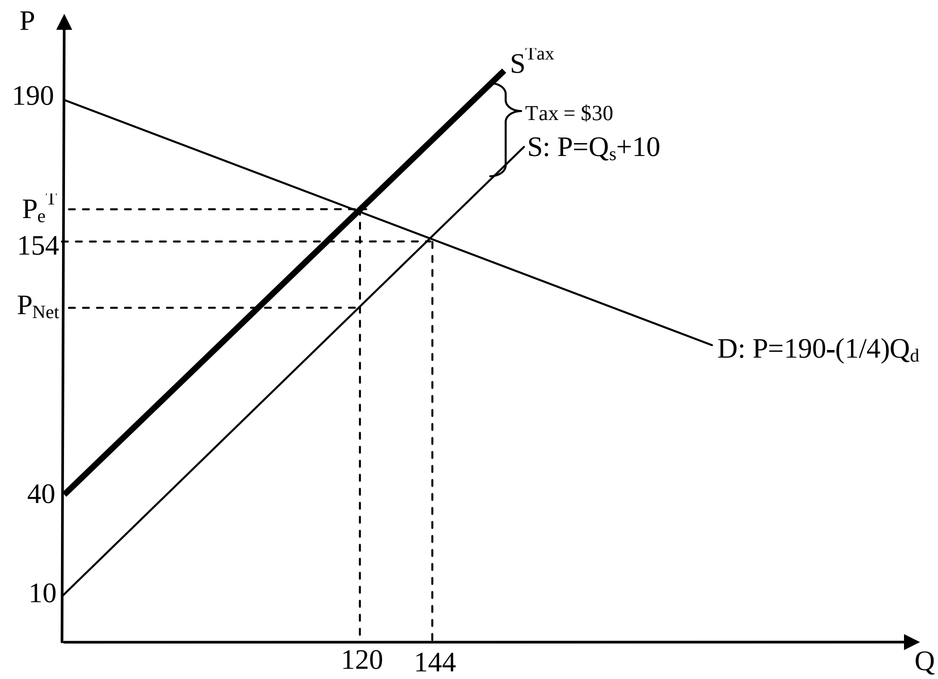
a. What are the equilibrium price and quantity of records in Hipsteria?
   Setting demand equal to supply, we find that:
   $190 – (1/4)Q = 10 + Q \rightarrow 180 = (5/4)Q \rightarrow Q_e = 144$, $P_e = 10 + (144) = \$154$
   $(Q_e, P_e) = (144, \$154)$
b. Calculate the value of consumer surplus (CS) and producer surplus (PS) in the market for vinyl records in Hipsteria.
   Consumer surplus is area between the demand curve and the price that consumers pay:
   CS = (1/2)*(144 – 0)*(190 – 154) = (1/2)*(1144)*(36) = \$2592
   PS = (1/2)*(144 – 0)*(154 – 10) = (1/2)*(144)*(144) = \$10,368



Now, suppose that the government of Hipsteria decides that Hipsters are listening to too much music, and thus decide to impose an excise tax of $30 per record.

c. Graph the market for records in Hipsteria with the excise tax and solve for the new equilibrium price and quantity, P_e^T and Q^T.

(Note: the rest of the graphs are "zoomed in" to better show details of the tax)



To solve for the new equilibrium price and quantity with the excise tax, first solve for the supply curve with the tax: from the graph you can see that the excise tax shifted the price-intercept of the supply curve up by the distance of the tax. So, the new supply curve is:

S^{Tax}: $P = Q_s + 40$

The new equilibrium price and quantity are:

$190 - (1/4)Q = 40 + Q \rightarrow 150 = (5/4)Q \rightarrow Q^T = 120$, $P_e^T = 40 + (120) = \$160$

$(Q^T, P_e^T) = (120, \$160)$

d. What is the price that buyers pay once the excise tax is implemented? What is the price that sellers receive once the excise tax is implemented?

Buyers pay the price we solved for in part (c): $P_e^T = \$160$

Sellers receive what buyers pay minus the amount of the tax: $P_{Net} = \$160 - \$30 = \$130$

e. Draw a new graph of the market with the excise tax. On that graph, label each of the following and calculate the corresponding values.

(i) Consumer surplus with the tax (CS^{Tax})

$CS^{Tax} = (1/2)*(120)*(190-160) = (1/2)*(120)*(30) = \$1800$

(ii) Producer surplus with the tax (PS^{Tax})

PS^{Tax} = (1/2)*(120)*(130-10) = (1/2)*(120)*(120) = \$7200

(iii) Consumer tax incidence (CTI)

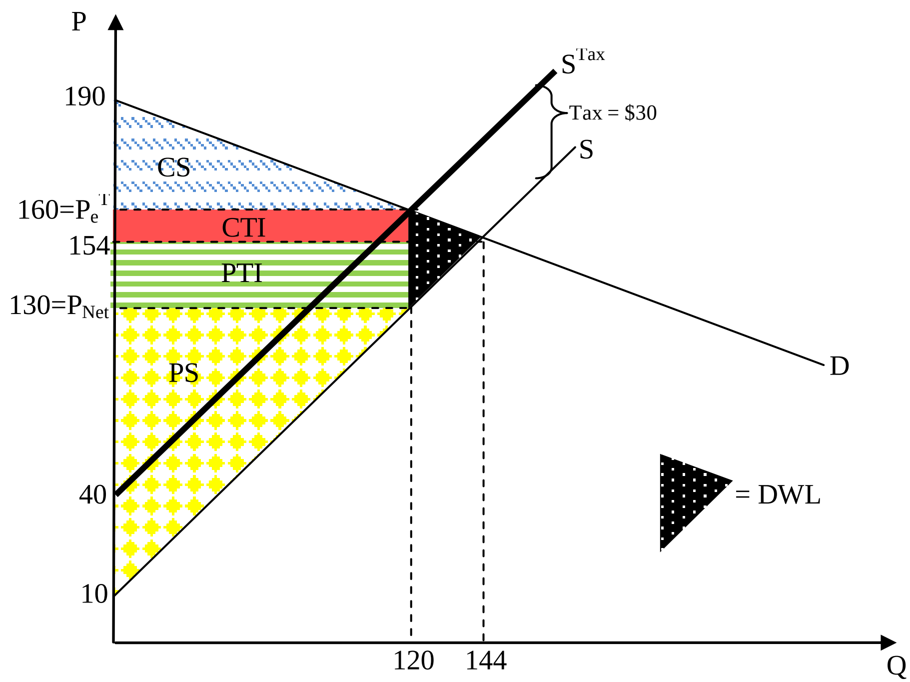
CTI = (120)*(160 - 154) = \$720

(iv) Producer tax incidence (PTI)

PTI = (120)*(154 - 130) = \$2880

(v) Deadweight loss from the tax (DWL)

DWL = (1/2)*(144 - 120)*(160 - 130) = (1/2)*(24)*(30) = \$360



f. Calculate the government revenue from the tax.

Government Revenue = (Amount of Tax)*(Quantity Sold with Tax) = (\$30)*(120) = \$3,600
or, Government Revenue = CTI + PTI = \$720 + \$2880 = \$3,600

g. Who pays more of the tax? Why is this true?

Producers pay more of the tax. This is because demand is relatively more elastic than supply. So, consumers are more sensitive to price changes than are producers which means that producers are the ones who bear more of the burden of the tax.

2. Elasticity

Suppose that the city of Hewletton consumes only two goods, computers and pumpkins. Demand for computers is given by: $Q_C = 205 - 2P_C + P_P - (1/4)M$, where P_C and P_P are the prices of computers and pumpkins, respectively, and M is income.

Currently, citizens of Hewletton are purchasing computers and pumpkins at P_C = \$10 and P_P = \$15. Income in Hewletton is equal to \$400.

a. What is the quantity of computers currently being consumed?
Plug in all the information we know into the equation for demand:
$Q_C = 205 – 2P_C + P_P – (1/4)M$
$Q_C = 205 – 2(10) + (15) – (1/4)(400) = 100$

b. At the current amount of computers being purchased, use the point elasticity formula to calculate the price elasticity of demand for computers, ε_D, at the quantity you determined in part (a). (Hint: plug in all the information given EXCEPT for the price of computers. After doing so, the problem should look more familiar since you will now have an equation with two variables, Q_c and P_c.)
Plugging all the given information other than the price of computers into the demand equation, we have:
$Q_C = 205 – 2P_C + P_P – (1/4)M$
$Q_C = 205 – 2P_C + (15) – (1/4)(400) = 120 – 2P_C$
Now, using the slope equation for elasticity of demand:

$$\varepsilon_D = \left|\frac{\%\Delta Q^D}{\%\Delta P}\right| = -\left(\frac{1}{slope}\right) * \frac{P}{Q^D}$$

Remember, since the "slope" in the equation for demand is the slope of the line *when it is solved for PRICE*, so before plugging in to the equation, we must solve the equation of the line for P_C. We then get: $P_C = 60 – (1/2)Q_C$. So,

$$\varepsilon_D = -\left(\frac{1}{slope}\right) * \frac{P}{Q^D} = -\frac{1}{(-1/2)} * \frac{10}{100} = 1/5$$

c. Given the above price elasticity of demand, are suppliers maximizing their revenue? If not, should they increase or decrease the price to increase their revenue?
No they are not. Currently, demand is relatively inelastic, which means that by increasing the price, the producers of computers could increase their revenue.

d. At what price and quantity is total revenue maximized? (Hint: to find where total revenue is maximized, use the same method of plugging in information as in part (b).)
To maximize total revenue, they should produce at the midpoint of the demand curve.
Using the demand curve we solved for in (b), $Q_C = 120 – 2P_C$, solve for the quantity-intercept and price-intercept of the demand curves.
If $P_C = 0$, $Q_C = 120 – 0 = 120$
If $Q_C = 0$, $0 = 120 – 2P_C \rightarrow P_C = \$60$
Thus, the midpoint of quantity is: $Q_C = 120/2 = 60$
The midpoint of price is: $P_C = \$60/2 = \$30$.
Therefore, we know that revenue will be maximized at $(Q_C, P_C) = (60, \$30)$

e. At the current prices and income, it can be shown that the income elasticity of demand will be equal to $\varepsilon_M = (-1/4)*(400/100) = -1$. What does $\varepsilon_M = -1$ say about computers?
Computers are an inferior good in this example. Given the equation provided for the demand for computers we can see by inspection that income is inversely related to the quantity of computers demanded: that is, when income increases, Qc decreases. This inverse relationship is consistent with a negative income elasticity: a negative income elasticity tells you that for a given increase

in income, there will be a decrease in the quantity of computers that you demand, which is the definition of an inferior good.

f. At the current prices and income, it can be shown that the cross-price elasticity of demand will be equal to ε_{CP} = (1)*(15/100) = 3/20 = 0.15. What does ε_{CP} = 0.15 say about computers and pumpkins?
This says that computers and pumpkins are substitutes in this example. Given the equation provided for the demand for computers we can see by inspection that the price of pumpkins is positively related to the quantity of computers demanded: that is, when Pp increases, Qc increases. This positive relationship is consistent with a positive cross price elasticity. Intuitively, this makes sense because if there is an increase in the price of pumpkins, then the change in demand for computers is positive. This is the definition of substitutes.

3. Real vs. Nominal

Your elderly neighbor, Lou, tends to be a bit long-winded when it comes to stories of what things were like when he was a child. Lou's favorite story to tell is that of how much going to the movies cost him. Back in 1940, a movie was only $0.50, and popcorn and two drinks were only $0.50. Lou could take a girl out for $1.00! His sweetheart, Betty, lived pretty far away, he tells you. Lou would have to drive his dad's car 10 miles to pick Betty up for a date. Lou's dad demanded that he replace any gas that he used, which meant that the 10 gallons of gas he had to use between driving to pick Betty up, going to the movie, and then dropping her off came out of his own pocket. Gas was cheap in 1940 at just $0.50/gallon.

You are taking economics 101 and you get a little bit curious about how the prices back in 1940 *really* compare to today. Lou seems caught up on the *nominal* price differences in the past 70 years, but you know better than to ignore the *real* price changes. After doing a little research, you create the following table of information:

Year	CPI (Base Year 1984)	Movie Ticket	Popcorn and Drinks	Gasoline
1940 (Nominal)	15	$0.50	$0.50	$0.50/gallon
1940 (Real)				
2011 (Nominal)	225	$7.50	$12.50	$4.00/gallon
2011 (Real)				

You make some calculations in order to compare the prices:

a. Calculate the overall inflation from 1940 and 2011.
Percentage change in the CPI = $(CPI^{2011} – CPI^{1940})/(CPI^{1940})*100$
= (225 – 15)/(15)*100
= 1,400%

b. What was the average annual inflation over the time window?
Average inflation = 1,400/(2011-1940) = 19.72% per year

c. Calculate the real price of each of the following in 1940 and 2011 using 1984 the base year.
(i) A movie ticket in 1940 in terms of 2011 dollars

Real 1940 P_{MT} = (Nom 1940 P_{MT})/(CPI^{1940})*100
Real 1940 P_{MT} = ($0.50)/(15)*100 = $3.33
Real 2011 P_{MT} = (Nom 2011 P_{MT})/(CPI^{2011})*100
Real 2011 P_{MT} = ($7.50)/(225)*100 = $3.33

(ii) Popcorn and drinks in 1940 in terms of 2011 dollars
Real 1940 P_{PD} = (Nom 1940 P_{PD})/(CPI^{1940})*100
Real 1940 P_{PD} = ($0.50)/(15)*100 = $3.33
Real 2011 P_{PD} = (Nom 2011 P_{PD})/(CPI^{2011})*100
Real 2011 P_{PD} = ($12.50)/(225)*100 = $5.56

(iii) Gasoline in 1940 in terms of 2011 dollars
Real 1940 P_{Gas} = (Nom 1940 P_{Gas})/(CPI^{1940})*100
Real 1940 P_{Gas} = ($0.50)/(15)*100 = $3.33
Real 2011 P_{Gas} = (Nom 2011 P_{Gas})/(CPI^{2011})*100
Real 2011 P_{Gas} = ($4.00)/(225)*100 = $1.78

d. Calculate the overall percentage change in the real price of each of the following, using the values you calculated in part (c).

(i) Movie tickets
Percentage change in Real P_{MT} = ($P_{MT}{}^{2011}$ – $P_{MT}{}^{1940}$)/($P_{MT}{}^{1940}$)*100
= (3.33 – 3.33)/(3.33)*100 = 0% change

(ii) Popcorn and drinks
Percentage change in Real P_{PD} = ($P_{PD}{}^{2011}$ – $P_{PD}{}^{1940}$)/($P_{PD}{}^{1940}$)*100
= (5.56 – 3.33)/(3.33)*100 = 66.7% change

(iii) Gasoline
Percentage change in Real P_{Gas} = ($P_{Gas}{}^{2011}$ – $P_{Gas}{}^{1940}$)/($P_{Gas}{}^{1940}$)*100
= (1.78 – 3.33)/(3.33)*100 = -46.7% change

e. What would the nominal price of popcorn and drinks have to have been in 1940 for the real price of popcorn and drinks to be unchanged between 1940 and today?
P&D Today: Real 2011 P_{PD} = ($12.50)/(225)*100 = $5.56
Solving for the nominal price in 1940 to get the same price level:
Nom 1940 P_{PD} =[(Real 1940 P_{PD})(Inflation Index for 1940)]/(Scale Factor) = $5.56(15)/100
Nom 1940 P_{PD} = $83.40/100 = $0.83

f. What would the nominal price of gasoline have to have been in 1940 for the price of gasoline in 1940 and the price of gasoline today to have the same real value?
Gas Today: Real 2011 P_{Gas} = [($4.00)/(225)]*100 = $1.78
Solving for the nominal price in 1940 to get the same price level:
[(Nom 1940 P_{Gas})/(15)]*100 = [($4.00)/(225)]*100
Nom 1940 P_{Gas} = (4*15)/225 = $0.27 per gallon

4. Indifference Curves

a. Jerry is 6 years old. He likes to spend his allowance on action figures and toy trucks, but that's about it. His utility from consuming action figures (A) and trucks (T) is given by U(A,T)=AT. Fill in the tables showing all the combinations of action figures and trucks that will give him the listed utilities:

U(A,T) = 12

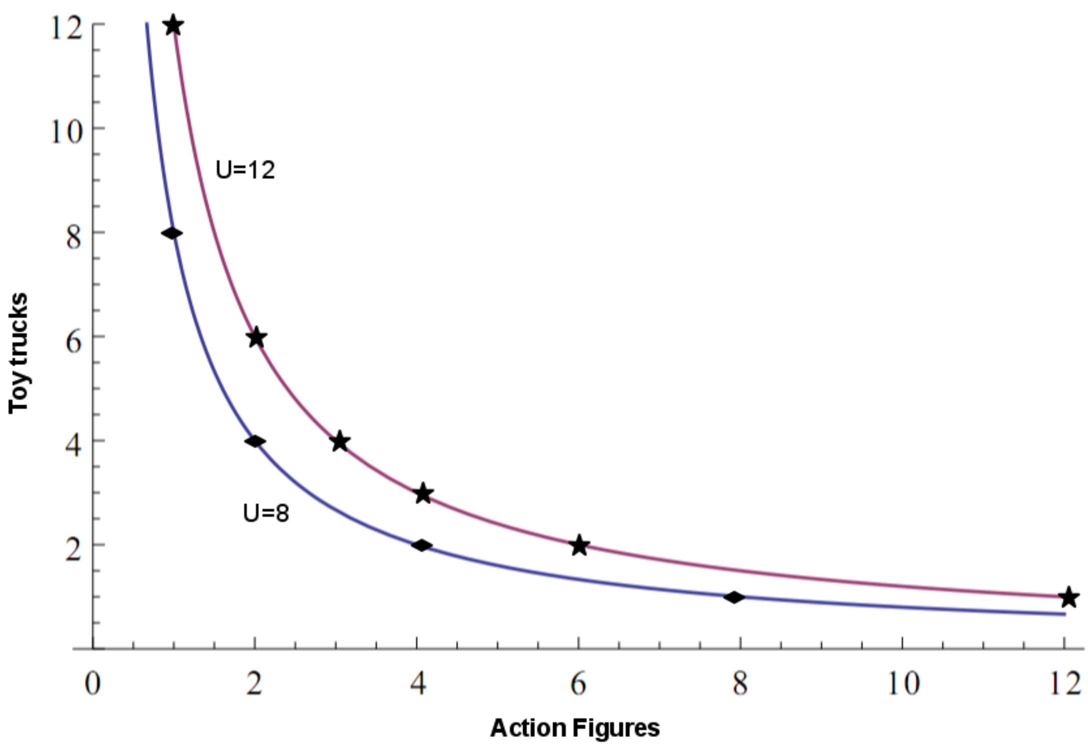
A	T
1	12
2	6
3	4
4	3
6	2
12	1

U(A,T)=8

A	T
1	8
2	4
4	2
8	1

b. Plot the indifference curves for U=8 and U=12 using the data you found in part a, with T on the vertical axis. Connect the points with smooth lines.

Solution:



c. Estimate the marginal rate of substitution of toy trucks for action figures when going from 3 to 4 action figures on the U=12 indifference curve, using the data you found in part a. Be sure to include units.

The Marginal Rate of Substitution is the absolute value of the slope of the indifference curve, which we estimate using rise over run:
$MRS_{AT}=|(4-3)/(3-4)|=1$ toy trucks per action figure

d. Using calculus, we could find the exact formulas for the marginal utility of toy trucks and the marginal utility of action figures at a given point. (Note: you will not have to do this yourself in 101!) For this example and using calculus we would find that the marginal utilities are given by: $MU_T = A$ and $MU_A = T$. Using this information, what is the marginal rate of substitution when A=3 and U=12? Was your estimate in part c close?

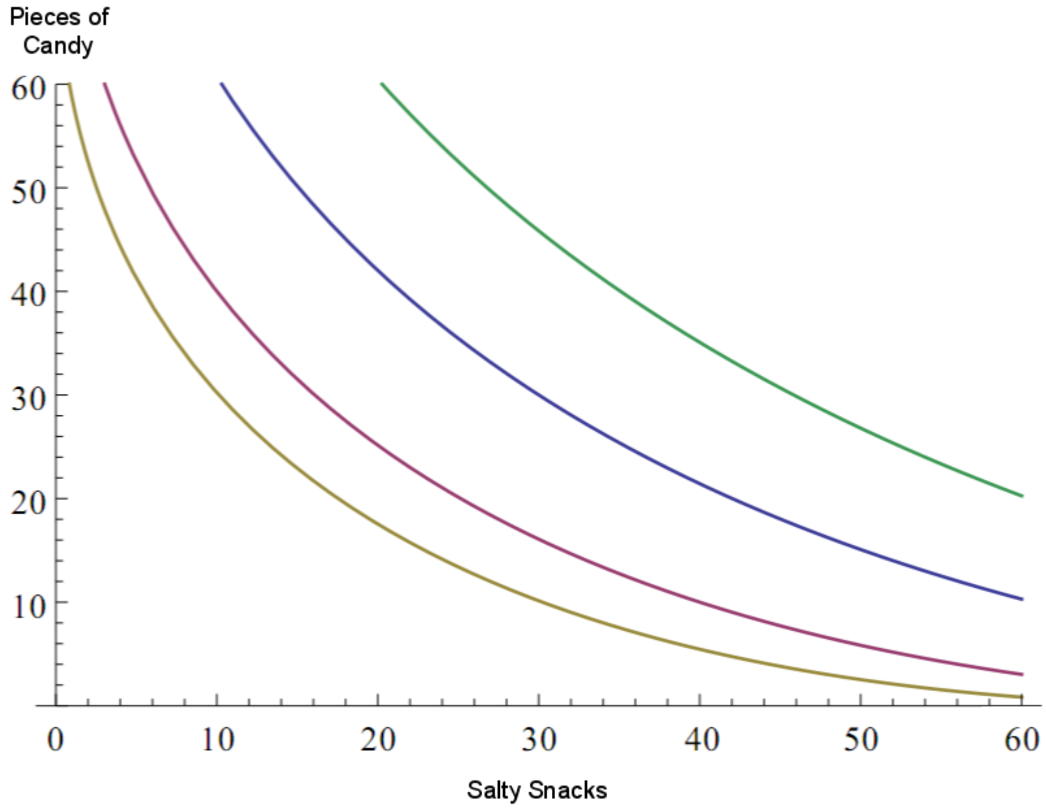
$MRS_{AT}=MU_A/MU_T=T/A$
A=3, U=12 ➔ T=4
Thus $MRS_{AT}=4/3$ toy trucks per action figure
The estimate is somewhat close, but not perfect!

e. Suppose your budget line goes through the point on the U=12 indifference curve where A=3, and that this is your optimal consumption point. Use the marginal rate of substitution you found in part d to find the price of action figures if the price of toy trucks is $1. (Round your answer to the nearest cent.)

At the optimal consumption point, the $MRS_{AT}=P_A/P_T$.
Thus $4/3= P_A/P_T= P_A$
So the price of action figures is ~$1.33

5. Deriving a Demand Curve

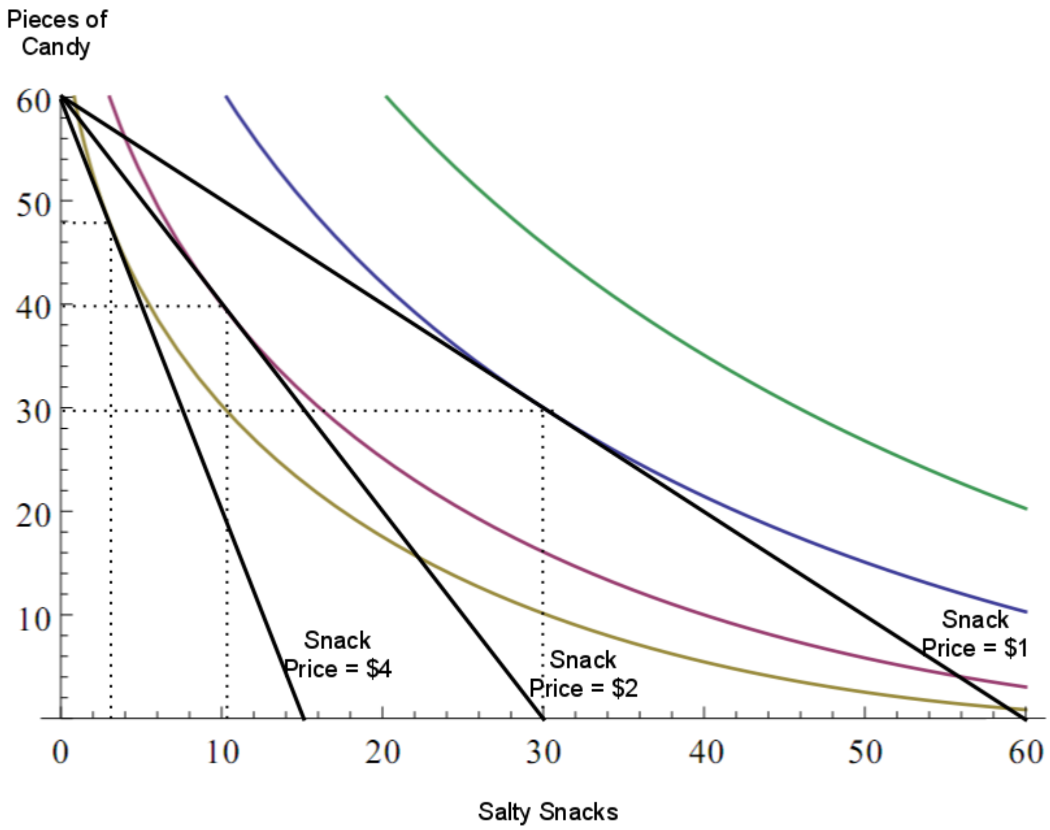
Jimmy has a $60 junk food budget for the month. He can use it to buy candy at $1 a piece, or salty snacks (price to be discussed in a moment). The graph below shows Jimmy's indifference curves for candy and salty snacks, with pieces of candy on the y-axis and bags of salty snacks on the x-axis. (Remember, utility increases from left to right, so each indifference curve represents a higher level of utility than the curves to the left of it.)



a. Using a ruler or straight-edge, carefully draw Jimmy's budget lines on the indifference curve graph for each the following cases:

1. Salty Snacks cost $1
2. Salty Snacks cost $2
3. Salty Snacks cost $4

Solution, with Salty Snacks on the X-axis:

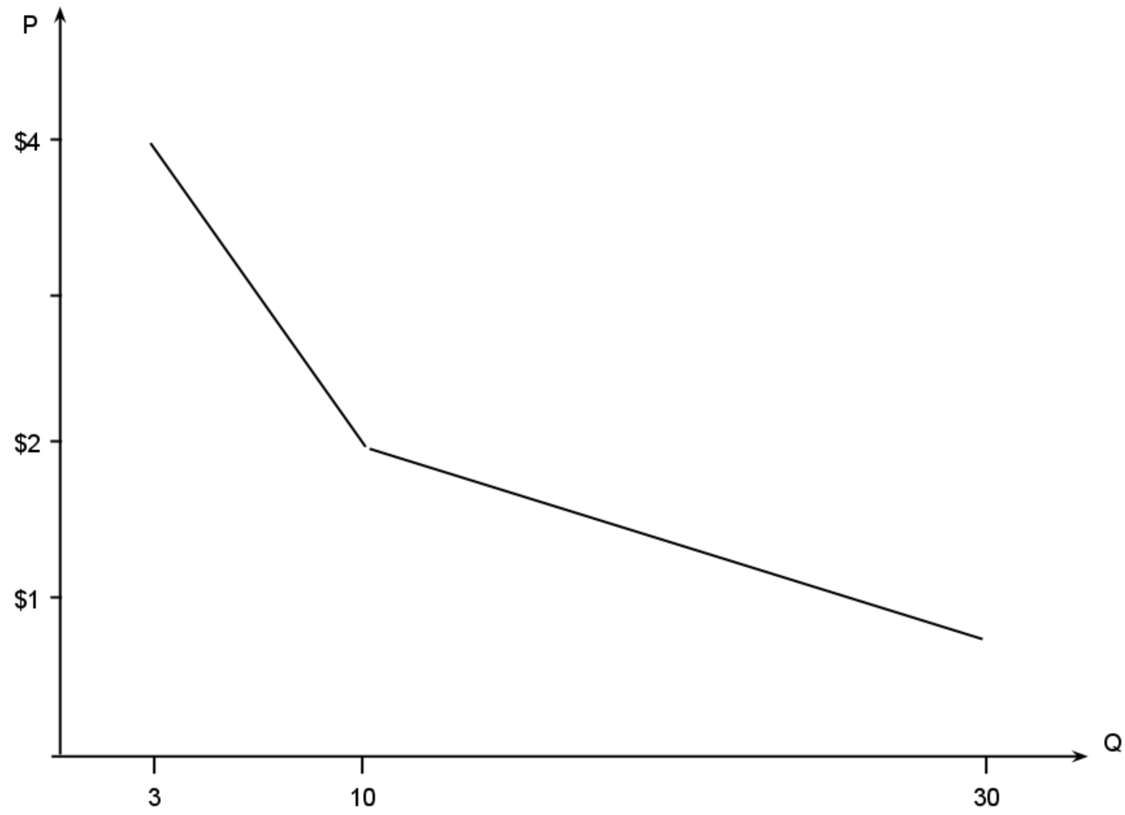


b. Using your graph, fill in the following table with the optimum consumption levels of salty snacks and candy: (Remember, the price of candy has been fixed at $1 in all cases!)

P$_{\text{Salty Snacks}}$	**Q**$_{\text{Salty Snacks}}$	**Q**$_{\text{Candy}}$
$1	30	30
$2	10	40
$4	3	48

c. Using the table in part b, plot your data for your demand curve. (To make things easier, just connect the data points with straight lines. Note that this is an approximation of the actual demand curve, which would be a smooth curve.)

Solution:



d. How could you theoretically improve the approximation of the demand curve you found in part c?

Use more points—this would require having more indifference curves and drawing more budget lines!

e. (This is unrelated to finding your demand curve, but it's good practice for you anyway!) Use your table in part b to find the cross-price elasticity of demand for candy as the price of salty snacks goes from $1 to $2. (Hint: use the standard percentage change formula to calculate the percentage change in the quantity demanded of candy and the percentage change in the price of salty snacks.) Are these goods complements or substitutes?

The cross price elasticity is the percentage change in the quantity of candy demanded over the percentage change in price of salty snacks.

$$\varepsilon = \frac{\left(\frac{Q_{Candy,2} - Q_{Candy,1}}{Q_{Candy,1}}\right)}{\left(\frac{P_{Snacks,2} - P_{Snacks,1}}{P_{Snacks,1}}\right)} = \frac{\left(\frac{40-30}{30}\right)}{\left(\frac{2-1}{1}\right)} = 1/3$$

These goods are substitutes, since the cross-price elasticity is positive.