Economics 101
Spring 2019
Answers to Homework #3
Due Thursday, March 14th, 2019

Directions:

- The homework will be collected in a box labeled with your TA's name **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 **staple** your homework: we expect you to take care of this prior to coming to the large lecture. You do not need to turn in the homework questions, but your homework should be neat, orderly, and easy for the TAs to see the answers to each question.
- Late homework will not be accepted so make plans ahead of time.
- Show your work. Good luck!

1. Consider the market for designer crocs in the country of Philan. The domestic demand curve and domestic supply curve are given below, where Q is the quantity of designer crocs and P is the price in Philanese dollars:

Domestic Demand: P = 1600 – 20Q
Domestic Supply: P = 100 + 10Q

Additionally, we know that designers crocs are sold and bought around the world at a world price of $500 per pair of designer crocs.

a) Given this information and holding everything else constant:

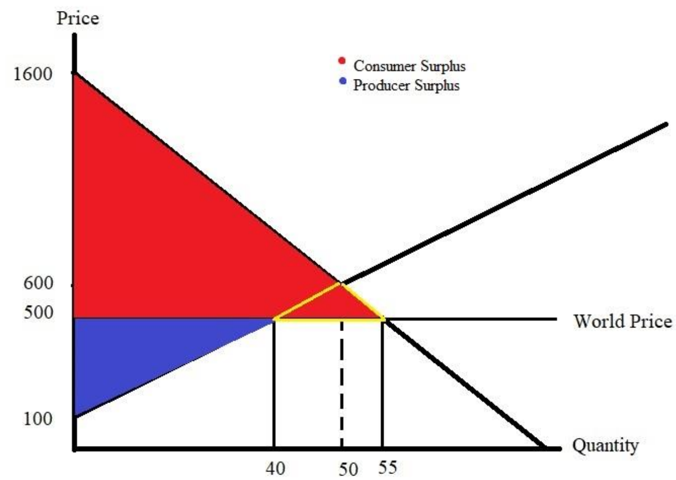
i. What is the equilibrium price and quantity in this market when it is closed to international trade?
ii. What is the value of consumer surplus when this market is closed to trade?
iii. What is the value of producer surplus when this market is closed to trade?
iv. What is the value of total surplus when this market is closed to trade?

i. Setting supply equal to demand and solving for Q: 1600 – 20Q = 100 + 10Q
1500 = 30Q, so Q = 50 pairs of designer crocs
Thus, P = 100 + 10*50 = $600 per pair of designer crocs
ii. Consumer Surplus = ½(50)(1600 – 600) = $25,000
iii. Producer Surplus = ½(50)(600 – 100) = $12,500
iv. Total Surplus = $37,500

b) Now, suppose that Philan opens this market to trade. Given this information and holding everything else constant:

i. How many pairs of designer crocs will domestic consumers buy and what price will they pay?
ii. How many pairs of designer crocs will be sold by domestic producers?
iii. What is the value of consumer surplus (CS) once this market opens to trade?
iv. What is the value of producer surplus (PS) once this market opens to trade?
v. What is the value of total surplus (TS) once this market opens to trade?
vi. What is the deadweight loss that occurs if this market is not opened to trade? Explain your answer.
vii. Draw a clearly labeled graph that illustrates this market indicating the area of CS with trade, the area of PS with trade, and the area of DWL is there is not open trade.

i. At the world price of $500 per pair of designer crocs, Q_D = 80 – (1/20)*500 =55. So when this market opens to trade domestic consumers will buy 55 pairs of designer crocs.
ii. At the world price of $500 per pair of designer crocs, Q_S= (1/10)*500 – 10 = 40. So when this market opens to trade domestic producers will sell 40 pairs of designer crocs.
iii. CS = ½(55)(1600 – 500) = $30,250 (the red triangle)
iv. PS = ½(40)(500 – 100) = $8,000 (the blue triangle)
v. TS = CS + PS = $38,250
vi. Compared to the total surplus in part (a), the change is the DWL = $38,250 - $37,500 = $750 (the yellow outlined triangle)
vii.

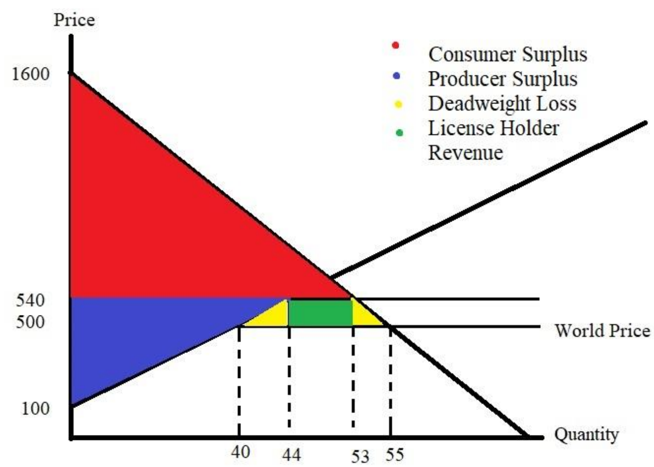


c) Suppose that the government of Philan worries that completely opening this market to trade will hurt their domestic designers. The government decides to impose an import quota of 9 designer crocs in this market. Given this information and holding everything else constant:

i. How many designer crocs will domestic consumers buy once this import quota is implemented and what will be the price of a pair of designer crocs?
ii. How many designer crocs will be sold by domestic producers once this import quota is implemented?
iii. What is the value of consumer surplus once this import quota is implemented?

iv. What is the value of producer surplus once this import quota is implemented?
v. What is the value of license holder revenue once this import quota is implemented?
vi. What is the value of total surplus once this import quota is implemented?
vii. Relative to an open market without an import quota, what is the value of deadweight loss due to the implementation of this import quota?
viii. Draw a well labeled graph that illustrates this import quota.

i. If the import quota is 9 pairs of designer crocs, then we know Q_D - Q_S = 9. Substituting in the equations for domestic supply and demand: [80 – (1/20)*P] – [(1/10)*P – 10] = 9
90 – (3/20)*P = 9
81 = (3/20)*P, so P = $540 per pair of designer crocs
At P = $540, Q_D= 80 – (1/20)*540 = 53 pairs of designer crocs
ii. Q_S = (1/10)*540 – 10 = 44 pairs of designer crocs
Thus, domestic producers will buy 53 designer crocs at a price of $540 per pair, and domestic suppliers will sell 44 pairs of designer crocs.
iii. CS = ½(53)(1600 – 540) = $28,090
iv. PS = ½(44)(540 – 100) = $9,680
v. License Holder Revenue = LHR = (540 – 500)*9 = $360
vi. TS = CS + PS + LHR = $38,130
vii. DWL = $38,250 - $38,130 = $120
viii.



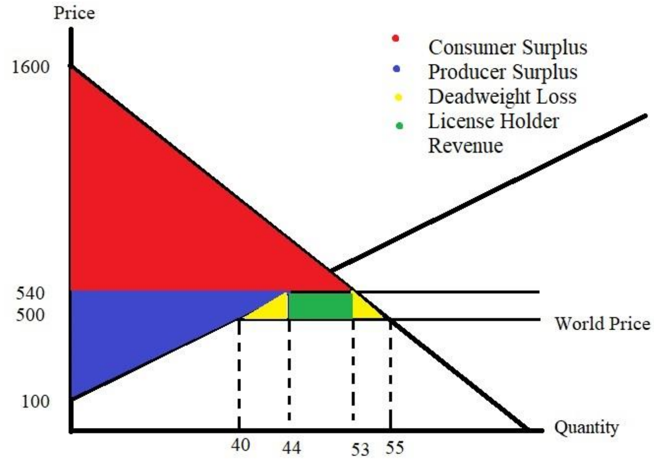
d) Now, suppose the government decides that instead of an import quota in this market that it will implement a tariff. The government wants to set the tariff so that the government tariff revenue is equal to $360. Given this information and holding everything else constant:

i. What is the tariff per unit? Be careful here you may be surprised at your answer-but to get that surprise you need to actually do the work!
ii. What amount will domestic consumers buy with the tariff and what price will they pay once the tariff is implemented?
iii. How many units will be sold by domestic producers once the tariff is implemented?
iv. What is the value of consumer surplus once the tariff is implemented?

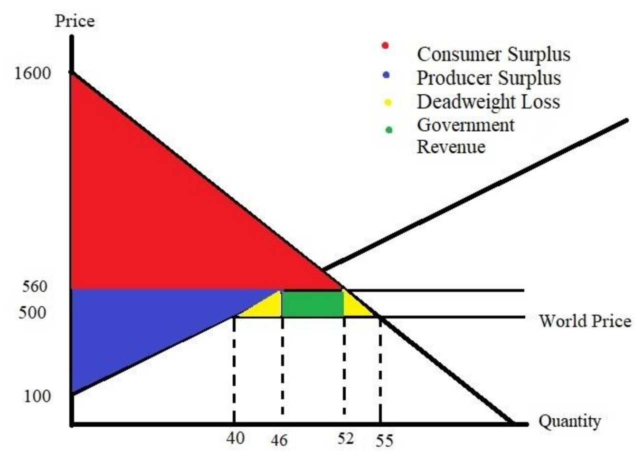
v. What is the value of producer surplus once the tariff is implemented?
vi. What is the value of the deadweight loss relative to open trade from implementing this tariff?
vii. Draw a well labeled graph that illustrates the tariff.

i. Government Revenue (GR) = t*(Q_D - Q_S) = $360 where t is the tariff amount
t*{[80 – (1/20)*P] – [(1/10)*P – 10]} = 360
t*{90 – (3/20)*P} = 360
Notice that P = 500 + t
t*{90 – (3/20)*500 – (3/20)*t} = 360
t*{15 – (3/20)*t} = 360
15t – (3/20)t^2= 360
– (3/20)t^2 + 15t – 360 = 0
Multiply everything by (-20/3) and you get:
t^2 – 100t + 2,400 = 0
(t – 60)(t – 40) = 0
t = $60 per pair of designer crocs or t = $40 per pair of designer crocs
So there are two such tariffs! Answers below are provided for both answers, but you can provide answers for just one tariff!

With a tariff of $40, this is the same as the quota for part (c), because P = 500 + 40 = 540
ii. Domestic consumers will buy 53 pairs of designer crocs at a price of 540:
540 = 1600 – 20Q
20Q = 1060
Q = 53
iii. Domestic producers will sell 44 pairs:
540 = 100 + 10Q
440 = 10Q
Q = 44
iv. CS = ½(53)(1600 – 540) = $28,090
v. PS = ½(44)(540 – 100) = $9,680
vi. DWL = $38,250 - $38,130 = $120
viii. This is the same graph as in (c):



With a tariff of $60, P = 500 + 60 = 560
ii. Domestic consumers will buy 52 pairs of designer crocs at a price of 560:
560 = 1600 – 20Q
20Q = 1040
Q = 52
iii. Domestic producers will sell 46 pairs:
560 = 100 + 10Q
460 = 10Q
Q = 46
iv. CS = ½(52)(1600 – 560) = $27,040
v. PS = ½(46)(560 – 100) = $10,580
vi. DWL = $38,250 - $37,980 = $270
vii.



2. The domestic demand and domestic supply curves for corn in a small closed economy are given by the following equations where P is the price per unit and Q is the number of bushels of corn:

Supply: $P = Qs$
Demand: $P = 32 – Qd$

a) Calculate the consumer surplus and producer surplus for the corn market in this small closed economy.

$CS = (1/2)(32 – 16)(16) = \$128$
$PS = (1/2)(16 – 0)(16) = \$128$

Assume that this small closed economy opens to free trade and that the world price per bushel of corn is $10.

b) With free trade, what is the quantity supplied by domestic producers? What is the quantity demanded by domestic consumers? How many bushels of corn are imported or exported by this country?

To find Qs, plug P = 10 into the domestic supply curve: Qs = 10
To find Qd, plug P = 10 into the domestic demand curve: 10 = 32 – Qd => Qd = 22
The quantity imported is: Qimports = Qd – Qs => Qimports = 12

c) Calculate the consumer surplus and producer surplus with free trade. Who is better off with free trade? How much are producers willing to pay to enter and/or exit the free trade agreement?

$CS_{freetrade} = (1/2)(32 – 10)(22) = \$242$
$PS_{freetrade} = (1/2)(10 – 0)(10) = \$50$

Domestic consumers are better off and domestic producers are worse off when this market opens to trade. In the closed economy, PS was $128 whereas with free trade it is $50. Producers are willing to pay up to $78 to avoid the free trade.

3. Suppose you are the manager of an airline company. As a recent MBA graduate, you decided to use all the knowledge you have acquired to improve the firm's pricing decisions. To begin with, you search for a market survey company to find out the demand curve for flights. The market survey company sent you back a report stating that there are two distinct segments of consumers - tourists and business travelers – and that their demand curves are given by the following equations:

Market Demand for Tourists: $Q = 500 – 2P + 2I$

Market Demand for Business Travelers: $Q = 1000 – P + I$

Where Q is the quantity demanded (in thousands of tickets), P is the price for a ticket, and I is the median income of each segment of consumers.

Currently, the price for tourists is $200 and the price for business travelers is $500. Moreover, the median income of tourists is $50 and the median income of business travelers is $100.

a) Using the point slope elasticity formula, what is the price elasticity of demand for airline tickets at the current price and income level for each group of consumer? Hint: to answer this question you will need to accurately determine the slope of the two demand curves given the level of income for each group and find the quantity each group demands at the current price for the group given the income that each group has.

Qtourists = 500 – 2(200) + 2(50) => Qtourists = 200
Slope of demand curve for tourists = -1/2 when Income is $50
Qbusiness = 1000 – 500 + 100 => Qbusiness = 600
Slope of demand curve for business travelers = -1 when Income is $100
E = [1/(-slope of the demand curve)][P/Q]
=> Etourists = 2 x (200/200) = 2
=> Ebusiness = 1 x (500/600) = 5/6

b) Based on your result in (a), do you think you should raise or lower the price paid by tourists? What about the price paid by business travelers?

Since the current price of $200 is in the elastic part of the demand curve (we know this since E is greater than one), you should decrease the price paid by tourists. When you decrease price you will get less money per ticket sold, but you will sell more tickets. Since you are in the elastic portion of your demand curve the increase in the number of tickets you sell will raise revenue more than the revenue falls because you are selling tickets at a lower price. Hence, your revenues will increase when you decrease the price of the tickets that tourists buy.

Since the current price of $500 is in the inelastic part of the demand curve, you should increase the price paid by business travelers. By doing so, prices will increase more than quantities will decrease. Hence, revenues will increase.

c) To verify your answer in (b), set a new price for tourists that is $50 higher or lower than the original price of $200 and a new price for business travelers that is $50 higher or lower than the original price of $500. Make your determination of whether to raise or lower the price based on your answers in (b). Relative to the revenue accrued in each market segment with the original prices, what happens to the revenue accrued by the airline in each market segment with the new prices? Hint: If the revenue does not increase then you need to redo this problem by moving the price in the opposite direction!

If Ptourist = $150 then Qtourist = 500 – 2(150) + 2(50) = $300 => REVtourist = (150)(300) = $45,000. At the old prices, REVtourist = (200)(200) = $40,000. Thus, the price decrease increased revenues by $5000.

If Pbusiness = $550 then Qbusiness = 1000 – 550 + 100 = 550 => REVbusiness = (550)(550) = $302,500. At the old prices, REVbusiness = (500)(600) = $300,000. Thus, the price increase increased revenues in $2500.

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? In doing this problem hold income constant.

Earc = [(Qnew – Qold / (Qnew + Qold)] / [(Pnew – Pold)/ (Pnew + Pold)]

Tourists: Qmidpoint = (300 + 200)/2 = 250; Pmidpoint = (200 + 150)/2 = 175
Earc = (300 – 200 / 250) / (150 – 200 / 175) = -7/5

Business travelers: Qmidpoint = (550 + 600)/2 = 575; Pmidpoint = (550 + 500)/2 = 525
Earc = (550 – 600 / 575) / (550 – 500 / 525) = -21/23

4. Laura substitutes popcorn for potato chips sometimes, but always drinks soda when she eats potato chips.

a) The price of a bag of popcorn doubles. As a result, Laura's demand for potato chips increases from 1 bag of potato chips to 2 bags of potato chips.

i) What is the cross-price elasticity of Laura's demand for potato chips?

ii) From Laura's perspective are these goods substitutes or complements? Use the elasticity obtained in (ii) to explain your answer.

Doubling the price of popcorn is equivalent to a 100% increase in its price. Moreover, changing the quantity of popcorn from 1 bag to 2 bags is also equivalent to a 100% increase in quantity. Using the elasticity definition,

E = % change in Qchips / % change in Ppopcorn => E = 100% / 100% => E = +1

The elasticity we obtained is +1 which implies that a 1% increase in the price of popcorn generates a 1% increase in the quantity demanded of potato chips. Hence, the goods are substitutes.

b) The price of soda increases by 10%. As a result, Laura's demand for potato chips decreases from 3 bags of potato chips to 2 bags of potato chips.

i) What is the cross-price elasticity of Laura's demand for potato chips?

ii) From Laura's perspective are these goods substitutes or complements? Use the elasticity obtained in (b.1) to explain your answer.

Using the elasticity definition,

E = | % change in Qchips / % change in Psoda |

Where,

% change in Qchips = (2 – 3)/3 = -33.3%

Thus, E = $|$-33.3% / 10% $|$ => E = $|$-3.33$|$ = 3.33

The elasticity we obtained is 3.33 which implies that a 10% increase in the price of soda generates a 33.3% decrease in the quantity demanded of potato chips. Hence, the goods are complements.

c) Laura got a new job that pays 10% more than her old job. As a result, her demand for soda increases by 5%. At the same time, Laura's demand for popcorn decreases by 10%.

i) What is Laura's income elasticity of demand for soda?

ii) What does this income elasticity tell us about Laura's valuation for soda (is soda a normal or inferior good)?

iii) What is Laura's income elasticity of demand for popcorn?

iv) What does this income elasticity tell us about Laura's valuation for popcorn (is popcorn a normal or inferior good)?

i) Using the elasticity definition,

E = % change in Qsoda / % change in Income => E = 5% / 10% => E = 0.5

ii) The elasticity we obtained is +0.5 which implies that a 1% increase in income generates a 0.5% increase in the quantity demanded of soda. Hence, soda is a normal good for Laura.

iii) Using the elasticity definition,

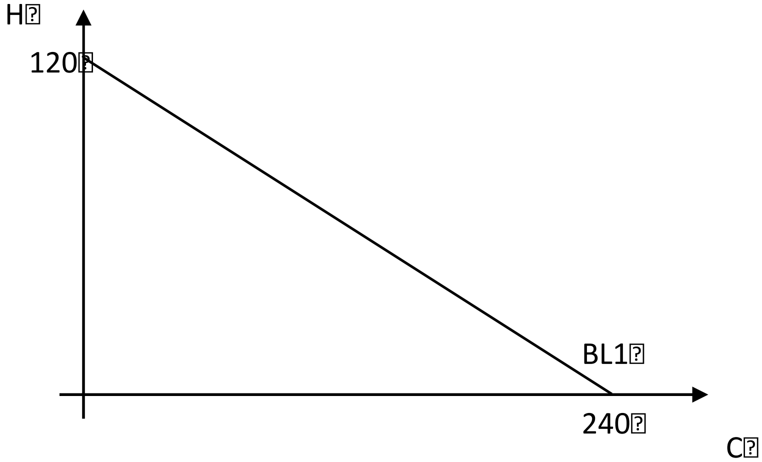
E = % change in Qpopcorn / % change in Income => E = -10% / 10% => E = -1

iv) The elasticity we obtained is -1 which implies that a 1% increase in income generates a 1% decrease in the quantity demanded of popcorn. Hence, popcorn is an inferior good for Laura.

5. John has an income of $480 to buy two goods: chocolate (C) and hamburger (H). The price of a chocolate bar is $2 and the price of a hamburger is $4.

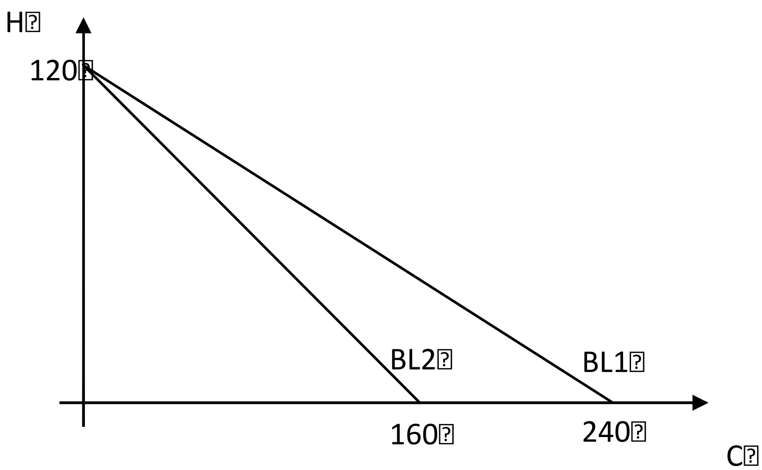
a) Derive the equation for John's budget line, BL1, and then draw it in a well-labeled graph. (Put chocolates on the X-axis and hamburgers on the Y-axis.)

John's budget line is given by: 2C + 4H = 480



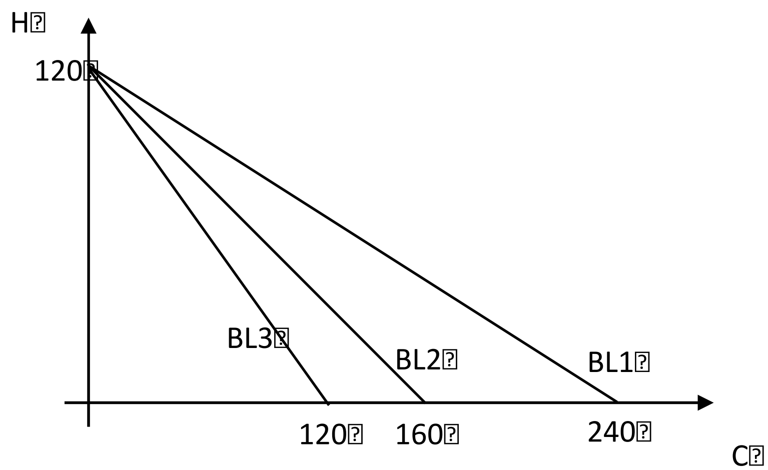
b) Assume that the price of a chocolate bar increases by $1. What is the equation for the new budget line, BL2? Add this new budget line to the graph you drew in (a). Make sure you label the new budget line, BL2.

Since the price of a chocolate bar increased by $1, the new price is $3. Hence, the new budget line is given by: $3C + 4H = 480$



c) Assume that the price of a chocolate bar increases by $2 relative to the original price. What is the equation for the new budget line, BL3? Add this new budget line to the graph you drew in (a). Make sure you label the new budget line, BL3.

Since the price of a chocolate bar increased by $2, the new price is $4. Hence, the new budget line is given by: 4C + 4H = 480



Assume John's utility function is given by:

$$U(C,H) = CH$$

You are also told that John's marginal utility for chocolate and his marginal utility for hamburgers are given by the following equations:

Marginal Utility for Chocolate: MUc = H
Marginal Utility for Hamburgers is MUh = C

d) What is John's Marginal Rate of Substitution (MRS)?

The marginal rate of substitution is MRS = MUx/MUy = MUc/MUh. Hence, MRS = H/C.

e) What is the optimal quantity of chocolate for John to consume given the original prices? What are the optimal quantities of chocolate for John to consume given the prices in (b) and (c)? Show all the work you did to get your answers! Draw a graph that associates the price of chocolate to the quantity of chocolate: that is, draw John's demand curve using the relationship between the prices of chocolate at $2, $3, and $4 and the quantities that he demands at these prices to construct this demand curve.

The optimal quantity is defined by two conditions:

(1) MRS = Pc/Ph
(2) (Pc C) + (Ph H) = Income

At the original prices,

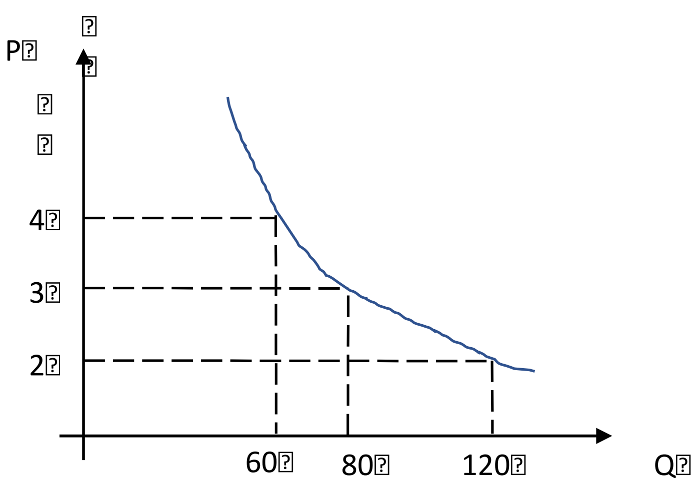
(1) H/C = ½ => C = 2H
(2) 2C + 4H = 480; from (1), C = 2H, then: 4H + 4H = 480 => 8H = 480 => H = 60
Since C = 2H, then C = 120
The optimal bundle for John to consume (C, H) at the original prices is (120, 60).

At the prices in (b),

(1) H/C = ¾ => C = 4/3 H
(2) 3C + 4H = 480; from (1), C = 4/3 H, then: 4H + 4H = 480 => 8H = 480 => H = 60
Since C = 4/3 H, then C = 80
When the price of chocolate is $3 and the price of hamburgers is $4, the optimal bundle for John to consume (C, H) is (80, 60).

At the prices in (c),

(1) H/C = 1 => C = H
(2) 4C + 4H = 480; from (1), C = H, then 4H + 4H = 480 => 8H = 480 => H = 60
Since C = H, then C = 60
When the price of chocolate is $4 and the price of hamburgers is $4, the optimal bundle for John to consume (C, H) is (60, 60).



6. A Wisconsin resident Sarah only consumes two goods: Bananas (B) and Apples (A). Her utility is given by the formula:

$$U = AB$$

You are also told that Sarah's marginal utility for consuming bananas and her marginal utility from consuming applies are given by the following equations:

Marginal Utility for Bananas: MU_B = A
Marginal Utility for Apples: MU_A = B

a. Given this information and holding everything else constant, fill out all the missing information in the table below.

Quantity of Bananas	Quantity of Apples	Utility
1		100
5		100
10	10	
20		100
	4	100

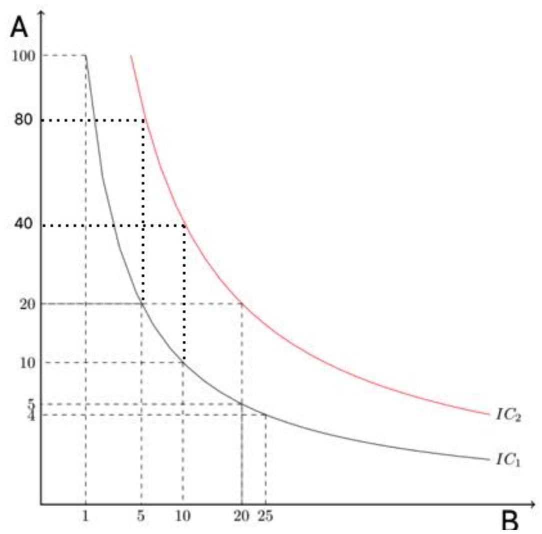
Solution:

Quantity of Bananas	Quantity of Apples	Utility
1	100	100
5	20	100
10	10	100
20	5	100
25	4	100

b. Graph the indifference curve, IC1, for U = 100 using the values you found in part (b). In your graph measure Bananas (B) on the horizontal axis and Apples (A) on the vertical axis. Make sure you label your graph clearly and completely.

Solution: see the graph in (c).

c. Draw the indifference curve, IC2, for U = 400 in this same graph. You might find it helpful to construct a similar table to part (b) with U = 400.



d. Sarah has a budget constraint given by the following formula where Y is her income, P_B is the price of bananas and P_A is the price of apples:

$$Y = P_B B + P_A A$$

Suppose Sarah's income is Y = \$80, and the prices for bananas and apples are $P_B = \$4$ and $P_A = \$1$. What is her optimal consumption bundle? What is the value of Sarah's utility at this consumer optimization point? Show how you found this value.

Solution: If (B, A) is the optimal consumption bundle for Sarah, then it must satisfy that $\frac{MU_B}{MU_A} = \frac{P_B}{P_A}$ and $Y = P_B B + P_A A$, so we have 80 = 4B + A and $\frac{A}{B} = \frac{4}{1}$. Then we can solve that B = 10, A = 40, so her optimal consumption bundle is (B, A) = (10, 40). Her utility is U = AB = 40*10 = 400.

e. Now suppose that the price of bananas changes so that the new price level is $P_B = \$8$. The price of apples is still $P_A = \$1$ and Sarah's income is still Y=\$80. What is her optimal consumption bundle now? What is the value of Sarah's utility at this new consumer optimization point? Show all the work you did to find your answers.

Solution: Again, if (B, A) is the optimal consumption bundle for Sarah, then it must satisfy that $\frac{MU_B}{MU_A} = \frac{P_B}{P_A}$ and Y= $P_B B + P_A A$, so we have 80 = 8B + A and $\frac{A}{B} = 8/1$. Then we can solve that B = 5, A = 40, so her optimal consumption bundle is (B, A) = (5, 40). Her utility is U = AB = 40*5= 200.

f. What are the income effect and substitution effects when the price of bananas changes from $4 per unit to $8 per unit? Draw a graph to illustrate your answer. Make sure your graph is clearly and completely labeled. Hint: on this question you will need to use a calculator to get your final values of (B, A). And you should round those final values to the nearest hundredth.

To find the income and substitution effects we need to find point C. Recall that point C is on the imaginary budget line BL3 that has the new prices (hence, BL3 is parallel to BL2) and the same utility as point A (hence, point C and point A are on the same indifference curve). This is what we know:

New prices: Pb = $8 and Pa = $1

New Income for BL3 is unknown: this means that the budget line has three unknowns-the A, the B, and the Income Level

Utility at point A = 400

Utility at point C = 400

Absolute value of the slope of indifference curve at point C = A'/B'

So, we know that BL3 is tangent to IC1: thus, A'/B' = 8/1 or 8B = A

We know that U at point C is: U = A'B' or 400 = A'B'

Use these two equations to find (B', A') the coordinates for point C:

400 = 8B'B'

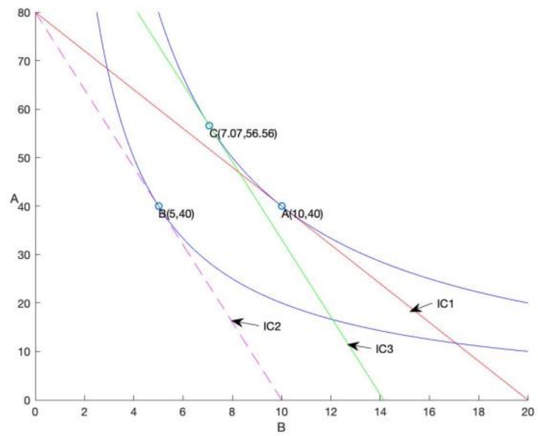
50 = B'B'

B' = $5(2)^{1/2}$

B' = 7.07

And, therefore A' = 8B' or A' = 56.56

(B', A') = (7.07, 56.56)



Solution: Substitution effect is from point A to point C while income effect is from point C to point B.

g. Suppose the price level is $P_B = \$8, P_A = \$1$ and Sarah's income is still Y=$80. How much would Sarah's income need to be adjusted to achieve the same utility as she has at point A (her initial utility maximizing consumption bundle)?

Solution: Sarah wants to achieve the same utility as she had at point A: U = AB = 400. We know (B, A) is an optimal bundle, so it must satisfy $\frac{MU_B}{MU_A} = \frac{P_B}{P_A}$. We then have AB = 400 and $\frac{A}{B} = \frac{8}{1}$. Then we can solve B=7.07 and A=56.56. Income needed to achieve this utility is Y= $P_B B + P_A A$= $113.12. Therefore, Sarah's income has to be increased by $33.12.