

Economics 101
Fall 2012
Homework #4
Due 11/20/2012

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 eligibly and neatly**; otherwise you will not receive full credit. Good luck!

1. Consumer Price Index

The table below shows the prices of the only three commodities traded in Shire.

Year	1995	2000	2005	2010
Potatoes	\$1/lb	\$2/lb	\$3/lb	\$4/lb
Pork	\$20/lb	\$25/lb	\$30/lb	\$40/lb
Beer	\$7.5/keg	\$12/keg	\$21/keg	\$25/keg
CPI	70	100	140	180

Suppose the typical Hobbit in a year buys 200 pounds of potatoes, 50 pounds of pork and 50 kegs of beer (that is, consider this the “market basket”). Use this information and the data in the table to answer the following questions.

- a). Complete the table.
- b). Compute the inflation rate from 1995 to 2010.

$$(180-70)/70 * 100\% \approx 157\%$$

- c). Calculate price changes for each commodity from 1995 to 2010 measured as percentages.

$$\text{Potatoes: } (4-1)/1 * 100\% = 300\%$$

$$\text{Pork: } (40-20)/20 * 100\% = 100\%$$

$$\text{Beer: } (25-7.5)/7.5 * 100\% \approx 233\%$$

- d). Compare the individual price changes with the overall inflation rate. What are your observations when you compare these two things?

It is important to notice first that the overall inflation rate need not be the same as the individual commodity's price change. Second, the more weight one commodity takes in the market basket, the more its price change will affect the overall inflation level.

2. Consumer Theory – Income and Substitution Effects

Q_X	1	2	3	4	5	6	7	8	9
MU_X (measured in utils)	72	36	24	18	14.4	12	10.28	9	8
Q_Y	1	2	3	4	5	6	7	8	9
MU_Y (measured in utils)	72	36	24	18	14.4	12	10.28	9	8

Garfield only consumes two goods fish (X) and candy (Y). Through careful negotiation with Jon, Jon agrees to spend \$72 dollars per week to buy Garfield these two goods and Garfield can choose whatever bundle he prefers. One can of fish costs \$9 and one pack of candy costs \$6. The table above shows some of his marginal utilities relating to his consumption of these two goods.

a). Find the equation for Garfield's budget constraint and graph it.

The budget constraint is given by the equation $72 = 9X + 6Y$, and it is shown as BL1 in the graph below.

b). What is Garfield's utility maximizing bundle at this budget constraint? What's his total utility from consuming this bundle?

To answer this question you will need to examine the table carefully and look for a bundle of (fish, candy) that will exhaust the total income of \$72 and that satisfies the utility maximizing rule ($MU_X/MU_Y = P_X/P_Y$). This gives us the consumption bundle: (4,6), labeled point A in the graph below.

The total utility from consuming fish is $72+36+24+18 = 150$ utils

Total utility from consuming candy is $72+36+24+18+14.4+12 = 176.4$ utils

Thus the total utility from this bundle is $150+176.4 = \underline{326.4}$ utils

c). Suppose the price of fish decreases to \$4 per can. Find the equation of Garfield's new budget line and graph it in the same diagram as in a).

The new budget line is given by the equation $72 = 4X + 6Y$ and is shown as BL2 in the graph below.

d). What is Garfield's utility maximizing bundle given his new budget line? What is the change in his consumption of good X?

To answer this question you will need to go again and look for a consumption bundle of fish and candy that both exhausts his total income while simultaneously satisfying the utility maximizing rule ($P_X/P_Y = MU_X/MU_Y$). This will occur when Garfield consumes 9 cans of fish and 6 units of candy. This is point B in the graph below.

Garfield now consumes 5 more cans of fish.

e) Observe the table carefully. What other consumption bundle from this table gives Garfield the same utility level as he got at point A (the amount you calculated in (b))? Once you have found this point label it point C on your graph and draw an indifference curve that contains both point A as well as point C. Label this indifference curve IC_1 in your graph.

From the table we can find that the bundle $(6, 4)$ gives the same total utility of 326.4 as was found at point A. This new point C is labeled in the graph below and both point A and point C sit on same indifference curve.

f) How much money would Garfield need from Jon to afford this bundle C? Why will Garfield need less money to afford this bundle than he needed to afford bundle A?

To be able to afford this bundle, Garfield would need to ask Jon for $6 \cdot 4 + 4 \cdot 6 = \48 .

Garfield needs less money to buy bundle C than he needed to buy bundle A because the price of fish has fallen. His purchasing power from a given level of nominal income is increased when the price of one of the goods falls, holding everything else constant.

g) Verify that the consumption bundle you found in (e) is the utility maximizing bundle for the level of income you determined in (f). This new level of income is based upon the new price of fish.

First check that this new consumption bundle satisfies the utility maximizing rule: $MU_x/MU_y = 12/18 = 4/6 = P_x/P_y$.

Second check that it exhausts the income of \$48.

Since both requirements for utility maximization are satisfied, the bundle in (e) is the utility maximizing bundle.

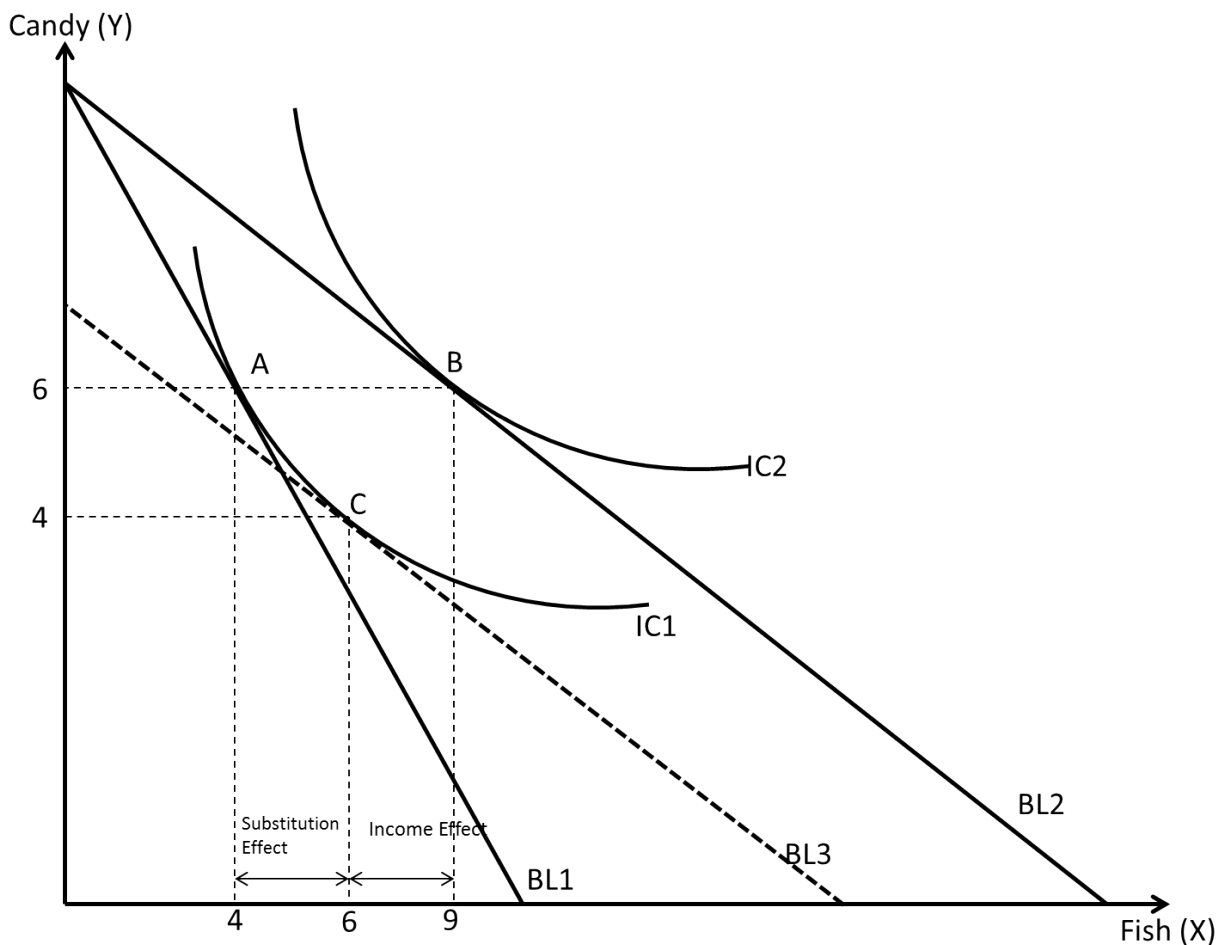
h) What is Garfield's imaginary budget line? Graph it in the same diagram and label it BL3.

His imaginary budget line is given by this equation $48 = 4X + 6Y$, and it is labeled as BL3 in the graph below.

i) Identify graphically and numerically how much of the change in Garfield's consumption of fish is due to the income effect and how much of the change is due to the substitution effect?

In the graph below, the movement along the X-axis from point A to point C measures the substitution effect, which is 2 cans of fish. The movement along the x-axis from point C to point B measures the income effect, which is 3 cans of fish.

The graph is as below:



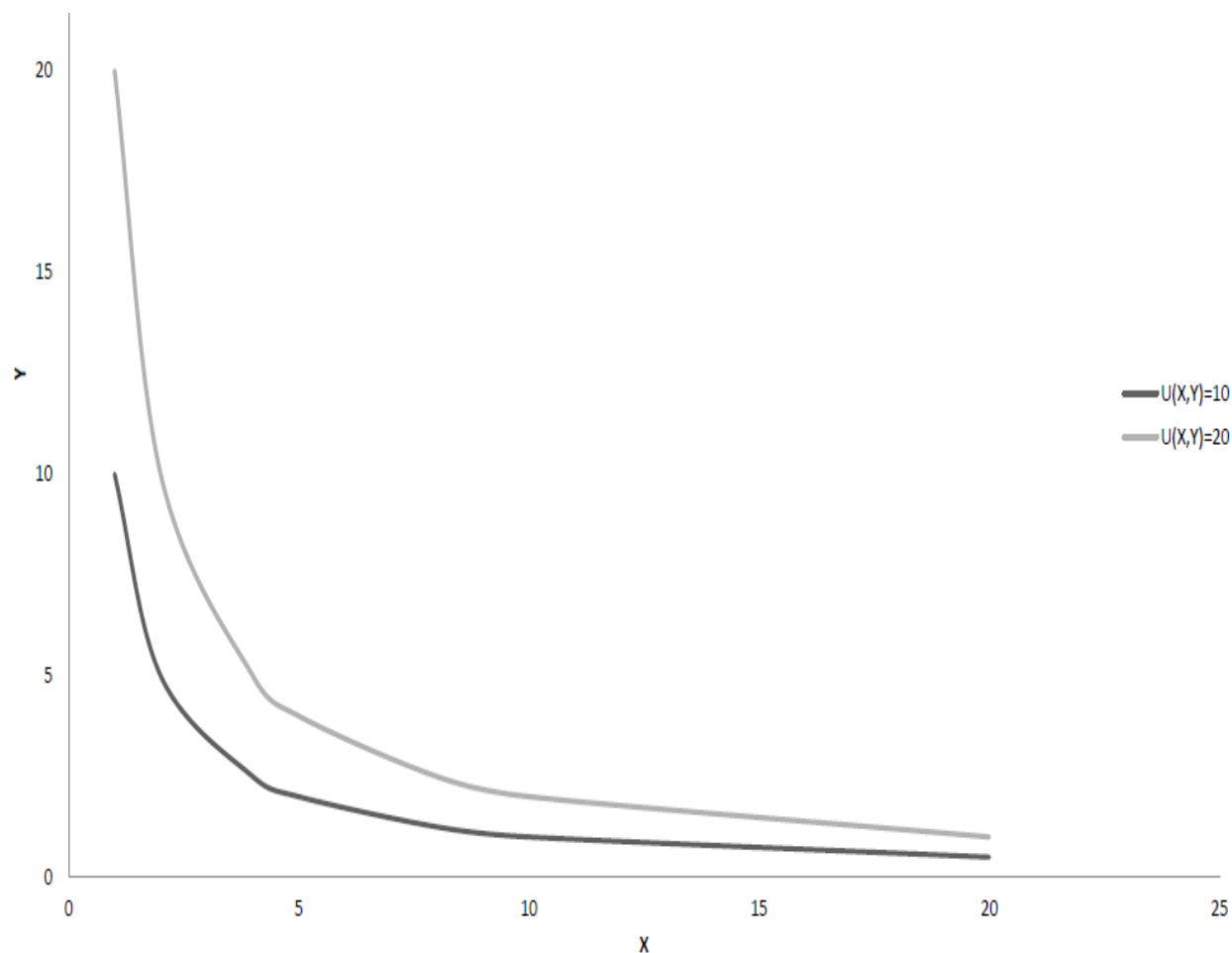
3. Consumer Theory – Utility Maximization

Let Abe's utility function be $U(X,Y)= XY$, where X is an quantity of good X consumed and Y is the quantity of good Y consumed. The marginal utility from consuming X is $MU_x=Y$ and marginal utility from consuming Y is $MU_y=X$. (For those of you have learnt about calculus and differentiation, you will recognize that these are the first derivatives with respect to X and Y respectively).

a) Fill out the following table and graph these two indifference curves. For example, on line 1 of the table you have that $U(X, Y) = 10$. So since $U(X, Y) = XY$ you have $XY = 10$. What combination of X and Y will make this equation true? An infinite number of combinations: for example, when $X = 1$ and $Y = 10$ then $XY = 10$.

U(X,Y)=10	X	1	2	4	5	10
	Y	10	5	2.5	2	1
U(X,Y)=20	X	1	2	4	8	20
	Y	20	10	5	2.5	1

The indifference curves look something like this:



Suppose $P_x = \$2$ and $P_y = \$2$ and Abe has income of \$20.

b) Which consumption bundle of X and Y would Abe choose? What's his total utility at this bundle?

To maximize utility: $MU_x / MU_y = P_x / P_y$

Then from the given marginal utility functions, we have $Y/X=1$, this gives $X=Y$.

Also we know that $2X+2Y=20$, solving this we have $X=Y=5$

So the consumption bundle is (5,5)

The total utility at this bundle is $5 \cdot 5 = 25$

c) Suppose the government decides to levy an excise tax of \$1 per unit on good Y. What's Abe's budget constraint now that he is facing this tax?

With this tax, the price of Y faced by Abe increases to $P_y' = \$3$. So the budget line is given by this equation: $20 = 2X + 3Y$.

d) Which consumption bundle would Abe choose now that this tax on good Y has been implemented? What's his total utility at this bundle?

Using $MU_x/MU_y = P_x/P_y$ again, we have first $Y/X=2/3$. Also the budget constraint needs to be satisfied: $20 = 2X + 3Y$, solving this we have the bundle (5, 10/3), his total utility is 50/3 or 16.67

e) What is the tax revenue collected by the government given the tax on good Y described in (c)?

The tax revenue collected by the government is: $1 * 10/3 = \$10/3 = \3.33 .

f) Now assume that **instead of** the excise tax on good Y, the government wants to impose an income tax. To generate the same tax revenue, what must be the income tax rate?

The tax rate is $(10/3)/20 * 100\% = 16.67\%$

g) Facing this income tax, what consumption bundle would Abe choose? What's his total utility when he maximizes his utility given the income tax?

Using the utility maximizing rule again, we have $MU_x/MU_y = P_x / P_y$, which means $Y/X = 2/2=1$

Then the budget constraint with income tax is $50/3 = 2X + 2Y$, then this solves to (25/6, 25/6)

The total utility is $(25/6)*(25/6)=625/36$ or 17.36

h) Comparing your answers from (d) and (f), which tax would Abe prefer? Why?

Abe would prefer the income tax as it gives him higher utility.

i) For the previous part we did not specify what the government would do with the tax revenue collected. If the government plans to give the tax revenue collected back to Abe as a lump-sum subsidy, which tax do you think Abe would prefer now? Briefly explain your answer.

If the government collects the tax revenue found in part e) and gives it back to Abe as a lump-sum subsidy, then if the tax was on good X, Abe's budget constraint after receiving the subsidy will be $70/3 = 2X+3Y$ and the utility maximizing bundle would be (35/6, 35/9), total utility is 22.67.

If the tax was on income, then after the government gives the money back to Abe, his budget constraint will shift back to the one in b), thus Abe will consume (5,5) and total utility is 25.

So Abe would still prefer the income tax.

4. Production and Cost

Suppose you are making muffins for a party. First you need to buy an oven, which cost you \$x. And for each cupcake, you use one pouch of cake mix, each cost you \$y. Besides, you need time to do it, the opportunity cost for your labor is \$z/minute.

Quantity	Time (minute)	MPL Q/min	VC	FC	TC	AVC	AFC	ATC	MC
0	0	---	0	30	30	---	---	---	---
1	15	1/15	17	30	47	17	30	47	17
2	20	1/5	24	30	54	12	15	27	7
3	24	1/4	30	30	60	10	10	20	6
4	30	1/6	38	30	68	9.5	7.5	17	8
5	40	1/10	50	30	80	7.8	6	16	10
6	60	1/20	72	30	102	7	5	17	20

a) From the information given, find out x, y and z, and complete the table.

From the table we can first note that when $Q = 1$, then $FC = TC - VC(1) = 47 - 17 = 30$. This tells us that the price of the stove (the fixed input) is equal to \$30, or $x = 30$. Then we need to note that the variable cost includes the muffin mix as well as the cost of your labor: so $VC = (\text{price of muffin mix per muffin})(\text{number of muffin mixes}) + (\text{price of your labor per minute})(\text{number of minutes of your labor})$ or $VC = y(\text{number of muffin mixes}) + (z)(\text{number of minutes of your labor})$. From the table we note that we can produce one muffin using 1 muffin mix and 15 minutes of labor and that this results in VC equal to 17. So, $17 = 1*y + 15*z$. I looked at this and thought-the price of a muffin mix is probably \$2 and the price of a minute of labor is probably \$1 since those were the “nicest” numbers that would fit this equation. But, you could find another VC equation from the table and then use these two equations to solve for y and z to make sure that this is the correct answer. Thus, $x = \$30$, $y = \$2$ and $z = \$1$.

b) According to the table, at what level of quantity does average cost (ATC) attain its minimum?
 $Q = 5$

c) Over what range of outputs do you experience diminishing returns to your labor?
When Q is greater than 3 units we find that there is diminishing returns to labor. To see this, look at the MPL column and rewrite the values in this column using the same common denominator. Thus, the numbers would be 4/60, 12/60, 15/60, 10/60, 6/60, 3/60. When you make the fourth muffin, your MPL decreases, signaling the beginning of diminishing returns to your labor.

d) From the class lecture we know that MC intersects ATC at its minimum point. From the table determine a range of quantities for where this point of intersection will occur.
From the table we can see that the ATC of producing a muffin is equal to 17 at quantities of 4 muffins and quantities of 6 muffins. We can also see from the table that when output is equal to 5 muffins the ATC is equal to 16. From this we can deduce that the ATC is decreasing when muffin production is greater than 4 and increasing when muffin

production is 6 or greater. Thus, the ATC must reach its minimum at some range of muffin production between 4 muffins and 6 muffins.

5. Perfect Competition

Suppose the market for Android smart phones is perfectly competitive. All firms are identical with the same cost functions: $TC = q^2 + 80q + 100$, $MC = 2q + 80$, (q is the quantity produced by a representative firm). The market demand is $P = 150 - Q$. (Q is market quantity).

a) Given the above information: find the equation for FC, VC, TC, ATC, and AVC. In a graph draw the ATC, AVC, and MC curves.

To find the FC equation recall that $FC = TC$ when $q = 0$. So, using the TC function and replacing q with 0 yields: $TC = FC = 100$. So, $FC = 100$. This implies that $VC =$ the part of the TC function that varies as q varies. Thus, $VC = q^2 + 80q$. To find the ATC curve recall that $ATC = TC/q$. Thus, $ATC = q + 80 + 100/q$. To find the AVC curve recall that $AVC = VC/q$. Thus, $AVC = q + 80$.

b) Determine q , P and the number of firms in the long run.

In the long run in perfect competition we know that $MC = ATC$ for a representative firm. Thus, $2q + 80 = q + 80 + (100/q)$ and solving for q we get $q = 10$. We can then use this quantity and either the ATC curve or the MC curve to calculate the price the firm will charge for each unit of output: $MC = P = 2q + 80$ and if $q = 10$, then $P = 100$. Using this price and the market demand curve we can find the market quantity: $P = 150 - Q$ and since $P = 100$ this implies that $Q = 50$. Since each firm produces 10 units and since total production is equal to 50 units, this implies that there must be 5 firms in the industry.

c) Calculate the value of profits for a representative firm in the long run?

$$\text{Profits} = TR - TC$$

$$\text{Profits} = P \cdot q - TC(q) = 1000 - 100 - 800 - 100 = 0$$

d) Derive the market supply curve. (Hint: use your MC curve to find another point on the firm supply curve: when $q = 0$, then $MC = 80$. So, when price is 80, the quantity produced by a representative firm is 0 units and therefore the market quantity is also 0 units.)

$$P = 0.4Q + 80$$

Suppose that Apple introduces the iPhone 6. This causes a negative demand shock of 28 units at every price in the market for android phones.

e) In the short run, we know that the number of firms in the market doesn't change. So given the change in market demand how many android phones will a representative firm now produce in the short run? (Hint: start by writing the new market demand curve, and then think about where the new short-run equilibrium is in this market.)

The new market demand curve is $P = 122 - Q$. At the new short run equilibrium the market demand curve will equal the market supply curve. Thus, $122 - Q = 0.4Q + 80$ or $Q = 30$.

Since there are 5 firms in the industry this implies that each firm is producing 6 units at the new short run equilibrium.

f) Calculate the short run profit for a representative firm. Given this profit calculation what do you predict will happen in the long run, holding everything else constant?

We can find the market price by substituting $Q = 30$ into the new market demand curve, $P = 122 - Q$. Thus, $P = 92$. When $P = 92$ and $q = 6$ then the short run profit of a representative firm is $\text{Profit} = \text{TR} - \text{TC}$ or $\text{Profit} = \$552 - \$616 = -\$64$. The representative firm is making negative economic profits in the short run and we should expect some firms to exit in the long run. At $q = 6$, the VC of production are equal to \$516 so we can note that the representative firm covers all of its VC when $q = 6$ but fails to cover all of its FC. In the long run when firms can get rid of their fixed inputs we should expect to see some firms exiting this industry.

Go back to the time before iPhone 6. Suppose another change take place: there's a new technology for making phone chips. This new technology causes the marginal cost to decrease by \$28 per unit and the fixed cost to increase by \$96.

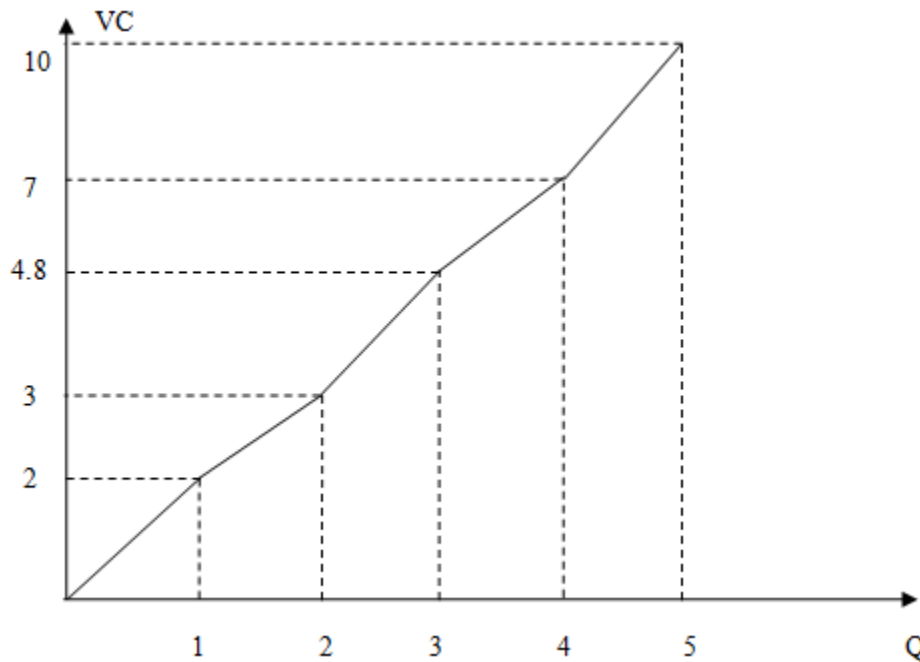
g) Given this information, what is the TC function for a representative firm now? What is the MC function for this representative firm? What is the market supply curve in the short run? Given the new TC and MC equations as well as the market supply curve, calculate P , q , Q , and short run profits for a representative firm. Will firms exit or enter this industry in the long run?

The new TC equation will be $\text{TC} = q^2 + 52q + 196$ and the new MC equation will be $\text{MC} = 2q + 52$. The market demand curve is still $P = 150 - Q$. The new market supply curve will have the same slope as the original supply curve but a different y-intercept: $P = 52 + 0.4Q$. Find the new short run equilibrium price and quantity in this market by equating the market demand curve to the market supply curve. Thus, $150 - Q = 52 + 0.4Q$ or $Q = 70$. When $Q = 70$ this implies that $P = \$80$. Since there are 5 firms in the industry this implies that each firm will produce $70/5 = 14$ units of the good. To find the short run profits for the representative firm use the formula $\text{Profit} = \text{TR} - \text{TC}$. Or, $\text{Profit} = (14)(80) - [(14)^2 + 52(14) + 196]$ or $\text{Profit} = \$1120 - 1120 = \0 . Since the representative firm earns an economic profit in the short run equal to zero we do not anticipate either entry or exit of firms in the long run.

h) In the long run and holding everything else constant, how many firms will there be in the market? (Remember that we are now looking at the new TC curve as well as the new MC curve for the representative firm.)

In the long run the representative firm will earn zero economic profit and that implies that this firm will produce that quantity where $\text{MC} = \text{ATC}$. So, $\text{MC} = 2q + 52$ and $\text{ATC} = q + 52 + 196/q$. Solving this equation we get $q = 14$ and using this quantity and the MC curve we can find that $\text{MC} = P = 80$. Then, use the market demand curve to find Q : $P = 150 - Q$ or $80 = 150 - Q$ and $Q = 70$. Thus the number of firms in the industry in the long run is equal to $70/14$, $P = 80$, $Q = 70$, thus number of firms $= 70/14 = 5$, still 5. This concurs with our prediction in (h) that there would be no entry or exit of firms in the long run.

6. Albert Bros Doughnuts produces doughnuts and it's a price taker in the market. It has to pay \$1 of rent every day it operates as a business. The following graph shows its variable costs per day for the production of doughnuts (Q is the number of doughnuts).



- a. At what quantity does Albert Bros Doughnuts' have its lowest ATC? At what quantity does Albert Bros Doughnuts' have its lowest AVC?

To find the answer to this question you will need to first construct a table that provides quantities of doughnuts, VC, FC, TC, AVC, and ATC. Then it will simply be a matter of reading this table to find the answers to these two questions.

The minimum average total cost \$1.93, at an output quantity of 3 doughnuts.

The minimum average variable cost is \$1.5, at an output of 2 doughnuts.

- b) Suppose that the market price for doughnuts is \$2.10 per doughnut. In the short run, will Albert Bros Doughnuts earn a positive, negative, or zero economic profit? In the short run, should the firm produce or shut down? In the long run, holding everything else constant, do you expect this firm to continue to produce or to exit the industry? Explain your answer.

When the price is \$2.10 per doughnut, the firm will make a positive economic profit: the price is above the firm's minimum average variable cost (the firm's shut-down point) and also above the firm's minimum average total cost (the firm's break-even point). The firm will find that its total revenue is large enough to cover its variable cost and its fixed cost with revenue left over after paying both of these costs. In the short run the firm will continue to produce since it is earning enough economic profits to cover all of its variable costs and all of its fixed costs. In the long run we can anticipate that this firm will continue to produce doughnuts holding everything else constant.

c) Suppose that the market price for doughnuts is \$1.70 per doughnut. In the short run, will Albert Bros Doughnuts earn a positive, negative, or zero economic profit? In the short run, should the firm produce or shut down? In the long run, holding everything else constant, do you expect this firm to continue to produce or to exit the industry? Explain your answer.

When the price is \$1.70 per doughnut, the firm will incur a loss: the price is below the firm's break-even price (the minimum point of the ATC curve). But since the price is above the firm's shut-down price (the minimum point of the AVC curve), the firm should produce in the short run and not shut down. In the long run we can anticipate that this firm will exit the industry holding everything else constant since it is not earning a positive or zero economic profit in the short run.

d) Suppose that the market price for doughnuts is \$1.30 per doughnut. In the short run, will Albert Bros Doughnuts earn a positive, negative, or zero economic profit? In the short run, should the firm produce or shut down? In the long run, holding everything else constant, do you expect this firm to continue to produce or to exit the industry? Explain your answer.

When the price is \$1.30, the firm would incur a loss if it were to produce: the price is below the firm's breakeven point as well as below the firm's shut-down point. Since the firm is not covering all of its variable costs (we know this since the price of \$1.30 per doughnut is less than the minimum point on the firm's AVC curve) it should not hire any variable input and should produce zero units of output in the short run resulting in economic profits equal to the negative of its fixed costs. In the long run holding everything else constant the firm should exit the industry.