December 2019 Microeconomics Exam

****Steps kept from going across pages for ease of marking****

Part 1: Multiple Choice

Question 1:	***D***
Question 2:	***B***
Question 3:	***B***
Question 4:	***A***
Question 5:	***C***
Question 6:	***C***
Question 7:	***A***
Question 8:	***D***
Question 9:	***C***
Question 10:	***D***
Question 11:	***D***
Question 12:	***C***
Question 13:	***B***
Question 14:	***B***
Question 15:	***A***
Question 16:	***A***
Question 17:	***C***
Question 18:	***C***
Question 19:	***A***
Question 20:	***B***

Part 2: Long-Answer Questions (Question 1 and Question 2)

Question 1:

Part A)

MU stands for marginal utility and is defined as the extra utility that a consumer gets from consuming the last unit of a good. In this case the marginal utility for espresso (E) for Fie can be found by differentiating the utility function with reference to E as is done below.

$$U = 20E + 80C - E^2 - 2C^2$$

$$\boldsymbol{MU_E = 20 - 2E}$$

This marginal utility can then be applied to find the MRS. MRS stands for marginal rate of substitution and is defined as the amount of one good a consumer is willing to give up for a singular unit of another while maintaining the same level of utility. MRS for Fie between the goods of espresso (E) and candy bars (C) is found below.

MRS is equal to the negative ratio between prices or the slope of the indifference curve essentially

$$MRS = -\frac{MU_E}{MU_C}$$

MRS if found through the following steps utilizing the utility function above.

$$(1)\ MU_E = 20 - 2\mathrm{E}$$

$$(2)\ MU_C = 80 - 4C$$

$$MRS = -\frac{20 - 2E}{80 - 4C}$$

$$\boldsymbol{MRS = \frac{-0.25 + 0.5E}{-C}}$$

As evidenced by the MRS, Fie's preferences very much vary dependent on how much she has of one of the products. For example, if Fie has a sizable amount of espresso, she will be more willing to trade more unit's espresso to gain an additional candy bar. This also works in reverse, as if she has a large amount of candy bars she will be more willing to trade for espresso. This suggests that the marginal utility associated with each of the goods begins to diminish as she spends more and more of her budget on either option. From this it is possible to extrapolate that the optimal bundle is a combination of both goods.

Part B)

Fie is looking to maximize her utility in the utility function U= $20EE + 80CC - EE - 2CC$ with a constrained income (budget) of 41, price (espresso) $p_e = 1€$ and price (candy bars) $p_c = 2€$. This is a utility maximization problem that can be performed using a Lagranian and the 3 first order conditions. This is done below with the specific steps being noted as progress happens.

Step 1: Set up the Lagranian using the general format of the Lagranian model

Lagranian model (ℓ) = What needs to be optimized + λ(The constraint)

$$\ell = U(E,C) + \lambda(Y - p_E E - p_C C)$$

$$\boldsymbol{\ell = 20E + 80C - E^2 - 2C^2 + \lambda(41 - E - 2C)}$$

Step 2: Find the first order conditions through partial differentiation in terms of E (1), C (2) and λ (3)

$$\boldsymbol{(1)\ell_E = 20 - 2E - \lambda = 0}$$

$$\boldsymbol{(2)\ell_C = 80 - 4C - 2\lambda = 0}$$

$$\boldsymbol{(3)\ell_\lambda = 41 - E - 2C = 0}$$

The three first order conditions of the utility maximization Lagranian are expressed above, these can then be used to identify the optimal bundle of consumption with the constrained budget in the next part of the question.

Part C)

Having found and explained the Lagranian as well as the first order conditions, I can now continue applying the utility maximization Lagranian method with all steps noted below. *The steps done in the previous part are not repeated to keep answers concise*

Step 3: Use 1 and 2 to isolate λ and then calculate E in terms of C through using algebra after equating them

$$\lambda = 20 - 2E$$

$$\lambda = 40 - 2C$$

$$20 - 2E = 40 - 2C$$

$$-2E = 20 - 2C$$

$$E = C - 10$$

Step 4: Insert the identified E identity into the into the 3rd differentiation to find **C**

$$\ell_\lambda = 41 - \mathrm{E} - 2C = 0$$

$$\ell_\lambda = 41 - (\mathrm{C} - 10) - 2C = 0$$

$$\ell_\lambda = 41 - \mathrm{C} + 10 - 2C = 0$$

$$\ell_\lambda = 51 - 3\mathrm{C} = 0$$

$$\boldsymbol{C = 17}$$

Step 5: Insert the identified C value into the into the 3rd differentiation to find **E**

$$\ell_\lambda = 41 - \mathrm{E} - 2C = 0$$

$$\ell_\lambda = 41 - \mathrm{E} - 2(17) = 0$$

$$\boldsymbol{E = 7}$$

Step 6: Insert the identified C and E values into the original utility function to determine the correct level of utility

$$U = 20E + 80C - E^2 - 2C^2$$

$$U = 20(7) + 80(17) - (7)^2 - 2(17)^2$$

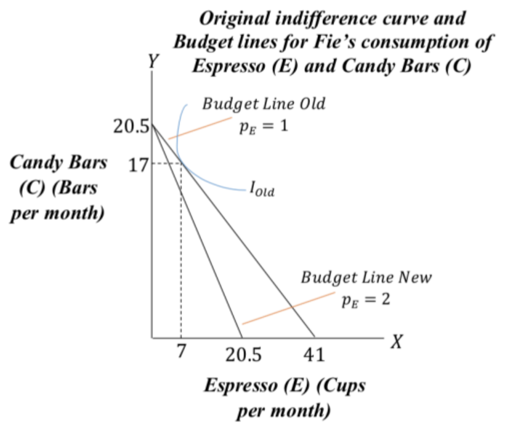
$$U \ = \ 140 + 1360 - 49 - 578$$

$$\boldsymbol{U \ = \ 873}$$

As is shown, the level of utility associated with the utility maximizing point of consumption of espresso and candy bars for Fie is **873**. This optimal bundle of consumption is at **17 candy bars (C) and 7 espressos (E).**

Part D)

The increase in price of espressos from 1€ to 2€ will have a distinct impact on the budget line, changing the slope as illustrated in the below diagram. Candy Bars is intended to be on the Y axis, I inferred this given the MRS equation in part A.



As is illustrated, the change in price of espressos has made the slope steeper towards the x- axis (Espresso) and Fie can now only purchase an absolute maximum of 20.5 units of espresso compared to the previous 41, as shown by the x-intercepts. The new and old budget constraint are written mathematically below while the new optimum bundle is identified.

General Form: $Y = P_C C + P_E E$

$$\textbf{Old}: \mathbf{41 = 2C + E}$$

$$\textbf{New}: \mathbf{41 = 2C + 2E}$$

I can also apply this new budget constraint to find out how this change in price of espressos has impacted the optimal consumption bundle identified previously. *The steps done in the previous part are not repeated to keep answers concise*

$$(1)\ell_E = 20 - 2E - 2\lambda = 0$$

$$(2)\ell_C = 80 - 4C - 2\lambda = 0$$

$$(3)\ell_\lambda = 41 - 2E - 2C = 0$$

$$\lambda = 10 - E$$

$$\lambda = 40 - 2C$$

$$40 - 2C = 10 - E$$

$$E = -30 + 2C$$

$$41 - 2(-30 + 2C) - 2C = 0$$

$$101 - 6C = 0$$

$$\boldsymbol{C_{New} = 16.83}$$

$$\boldsymbol{E_{New} = 3.67}$$

Given the new budget constraint following the price change in espresso, the optimal consumption bundle has changed from C=17 and E=7 to C=16.83 and E=3.67. This translates to a fall in consumption of espresso of 3.33 cups per month and a decrease in the consumption of candy bars of 0.17 bars per month.

Part E)

With Fie having her income adjusted to account for the increase in the price of espresso she will see an increase in income leading to a new optimal consumption bundle. All steps are explained as progress happens with the upward bias explained at the end.

Step 1: Calculate the new price of the previous optimal bundle (Fie's new income)

$$C = 17, p_C = 2$$

$$E = 7, p_E = 2$$

$$Y_{New} = 2(17) + 2(7)$$

$$\boldsymbol{Y_{New} = 48}$$

With this, it is possible to see that if her boss wanted her to keep the same consumption bundle, her new allowance would now be 48€, a 7€ increase from before the price change. This change leads to a new optimal bundle which is found below.

Step 2: Calculate new optimal bundle

$$(1)\ell_E = 20 - 2E - 2\lambda = 0$$

$$(2)\ell_C = 80 - 4C - 2\lambda = 0$$

$$(3)\ell_\lambda = 48 - 2E - 2C = 0$$

$$\lambda = 10 - E$$

$$\lambda = 40 - 2C$$

$$40 - 2C = 10 - E$$

$$E = -30 + 2C$$

$$48 - 2(-30 + 2C) - 2C = 0$$

$$108 - 6C = 0$$

$$\boldsymbol{C_{New\ Budget} = 18}$$

$$\boldsymbol{E_{New\ Budget} = 6}$$

Step 3: Calculate new utility with increased budget

$$U = 20E + 80C - E^2 - 2C^2$$

$$U = 20(6) + 80(18) - (6)^2 - 2(18)^2$$

$$U = 120 + 1440 - 36 - 648$$

$$\boldsymbol{U_{New\ Budget} = 876}$$

This change in monthly allowance leads to the optimal consumption bundle shifting from 17 candy bars and 7 cups of espresso to 18 candy bars and 6 cups of espresso. **This shift offers a utility of 876**, 3 higher than the utility of the previous bundle (873).

This shift in utility shows that Fie has been overcompensated after the change in her income and this is due to a type of substitution effect where she readjusts her consumption in line with the new prices in order to optimize her consumption and subsequent utility. Due to this **Fie does not consume the same bundle as before as she can gain additional utility by adjusting.**

This process where Fie instead consumes a new bundle after an income increase in response to a price change is called an upward bias and a similar phenomenon can be observed with COLA clauses that adjust wage based on the CPI.

Question 2:

Part A)

In a perfectly competitive market, firms can make abnormal profits or losses in the short run but many of the rules still apply that can be used to decipher the minimum price necessary for the firm to earn non-negative prices

Step 1: Use rules of perfectly competitive markets and given information to find MC

$$TR = pq$$

$$MR = p$$

$$TC = 32 + 2q^2$$

$$MC = 4q$$

Step 2: Equate MR to MC and substitute the p identity into the TR formula

$$p = 4q$$

$$TR = 4q^2$$

Step 3: Set TR = TC to find the minimum quantity at which nonnegative profits are made

$$TR = TC$$

$$4q^2 = 32 + 2q^2$$

$$2q^2 = 32$$

$$\mathbf{q = 4} \text{ (cannot be } -4)$$

Step 4: Substitute the quantity into the original TR=TC to find the price

$$TR = TC$$

$$pq = 32 + 2q^2$$

$$p(4) = 32 + 2(4)^2$$

$$\mathbf{P = 16}$$

In the short run, it is evident through the above calculations that **the minimum price to earn nonnegative profits is 16** leading to a quantity of 4 and total profit 0.

Part B)

With the assumption that every seller is identical, it is possible to derive the overall market supply curve by using the individual total cost function using the steps below. N is the number of firms and steps from above are not repeated to keep answers concise.

Step 1: Find and identify pertinent figures needed

$$\mathrm{MC_{firm}} = 4\mathrm{q}$$

$$\mathrm{MR_{firm}} = \mathrm{p}$$

$$N = 400$$

Step 2: Synthesize given information into a function that describes market supply

$$MC_{Firm} = N \times MR_{Firm}$$

$$4\mathrm{Q} = 400\mathrm{p}$$

$$\mathrm{Q} = \frac{400\mathrm{p}}{4}$$

$$\mathbf{Q = 100}\boldsymbol{p}$$

With the information given and calculations done in part A it is evident that the market supply curve is Q = $100pp$ and this can be verified as accurate by testing that it gives the correct market supply at a price of 16 using the data from Part A.

Step 3 (For validation): Test market supply function to ensure accuracy

$$\mathrm{p} = 16$$

$$\mathrm{Q} = 4$$

$$\mathrm{N} = 400$$

$$\textbf{Market supply } (\mathbf{Q \times N}) = \mathbf{1600}$$

$$\mathrm{Q} = 100p$$

$$\mathrm{Q} = 100(16)$$

$$\mathbf{Q = 1600}$$

Both results match and thereby the market supply curve is verified as correct.

Part C)

In the long run, a different cost function applies due to all factors being variable and other such reasons. In order to find the equilibrium price, I need to use steps associated with long run competitive markets and this is done below. Similar but adjusted steps to part A.

Step 1: Use rules of perfectly competitive markets and given information to find TR and TC

$$TC = q^3 - 16q^2 + 109q$$

$$TR = pq$$

Step 2: Identify MR and MC and equate them to end up with an inverse demand function

$$MC = 3q^2 - 32q + 109$$

$$MR = p$$

$$p = 3q^2 - 32q + 109$$

Step 3: Substitute the inverse demand function into the TR function and equate TR to TC to find q

$$q^3 - 16q^2 + 109q = (3q^2 - 32q + 109)q$$

$$q^3 - 16q^2 + 109q = 3q^3 - 32q^2 + 109q$$

$$16q^2 = 2q^3$$

$$16 = 2q$$

$$\boldsymbol{q = 8}$$

Step 4: Substitute the quantity into the TR and TC function to find price.

$$pq = q^3 - 16q^2 + 109q$$

$$p(8) = (8)^3 - 16(8)^2 + 109(8)$$

$$8p = 512 - 1024 + 872$$

$$8p = 360$$

$$\mathbf{p = 45}$$

Through using the rules of competitive markets, it is clear that the long run equilibrium exists where p=45 and q=8, thereby **the long run equilibrium price in the market is 45.**

Part D)

In order to find the long-run equilibrium number of firms I can use the market equilibrium I found previously. All the steps in this process are shown below.

Step 1: Substitute the equilibrium price into the market demand curve in order to find the market quantity

$$Q = 2050 - 10p$$

$$Q = 2050 - 10(45)$$

$$\boldsymbol{Q = 1600}$$

Step 2: Divide the overall market size by the equilibrium quantity for each firm found in the previous part of the question (steps not repeated)

$$\frac{Q_{Market}}{Q_{Firm}} = number\ of\ firms$$

$$\boldsymbol{\frac{1600}{8} = 200}$$

The market in the long run equilibrium consists of 200 firms in total, each contributing 8 units at the equilibrium price of 45, leading to an overall market supply of 1600 units.

Part E)

Babette cannot increase the price of her baguettes because the demand curve in a long run competitive market is horizontal and thereby any changes in price will lead to none of her baguettes being demanded (leading to massive losses and bankruptcy, P=MC=AC).

It is an economic assumption and is likely a good idea for Babette to remain in the market as she is currently an efficient producer and that the opportunity cost of doing something else is high, with no reason to move away from the market (any other competitive market will look the same in the long run and an economic profit of 0 is still considered a profit)