AFRICAN ECONOMIC RESEARCH CONSORTIUM

Collaborative PhD Programme in Economics for Sub-Saharan Africa

COMPREHENSIVE EXAMINATIONS IN CORE AND ELECTIVE FIELDS

FEBRUARY 19 – MARCH 10, 2021

MICROECONOMICS

Time: 08:00 – 11:00 GMT **Date: Wednesday, February 24, 2021**

INSTRUCTIONS:

Answer a total of FOUR questions: ONE question from Section A, ONE question from Section B, and TWO questions from Section C. Please note that Question 5 in Section C is compulsory.

The sections are weighted as indicated on the paper.

SECTION A: (15%)

Answer only ONE Question from this Section

Question 1

(a) Explain the difference between income and substitution effects. Illustrate them using an example of two goods and a price increase of good 1, where the quantity of good 1 is on the vertical axis and the quantity of good 2 on the horizontal axis. **[10 Marks]**

(b) Illustrate whether the Giffen good paradox implies an inferior good. **[5 Marks]**

Question 2

(a) What is an externality? (*In your answer be sure to consider both positive and negative externalities and their associated economic problems*)**.** **[7 Marks]**

(b) What is public good? State two criteria that must be fulfilled for a good to be public good. **[8 Marks]**

SECTION B: (25%)

Answer only ONE Question from this Section

Question 3

(a) Derive the profit function $\pi(P)$ and the supply function (or correspondence) for the single output technology whose production function is $f(z) = \sqrt{(z_1 + z_2)}$ **[12 Marks]**

(b) Derive the cost function $c(w,q)$ and conditional factor demand functions (or correspondences) for the single output constant returns technology.

$$f(z) = (Z_1^{\rho} + Z_2^{\rho})^{\frac{1}{\rho}}, \rho \leq 1$$

[13 Marks]

Question 4

Consider a Cournot duopoly with the standard linear demand curve $P=a - bQ$ where Q is a market supply P is market price and a and b are the standard intercept and slope coefficients. Let c be the marginal cost of production and let fixed costs be zero.

(a) Obtain the Cournot (Nash) equilibrium quantities for each firm, profits and the market price. **[6 Marks]**

(b) Now assume that the two firms decide to collude. Obtain the equilibrium quantities price and profits, and compare them to your answers in (a) above. **[6 Marks]**

(c) Is the equilibrium in (b) a Nash Equilibrium? Why or why not? Demonstrate. **[6 Marks]**

(d) Suppose the market (Cournot) game above is played sequentially, with firm 1 as the leader. Assume that firm 2 observes firm 1's move. Obtain the optimal outputs and profits for the two firms. Compare your findings to (a) above and comment. **[7 Marks]**

SECTION C: (60%)

Answer TWO Questions from this Section,

One of which MUST be Question 5, which is COMPULSORY.

Question 5 (Compulsory)

Briefly define the **underlined concepts** in **any 4 of the following statements** and then **explain** whether the statements you have chosen are **true** or **false**.

(a) Every **Walrasian Equilibrium** allocation is **Pareto efficient.** **[7.5 Marks]**

(b) In contrast to a **separating equilibrium**, in a **pooling equilibrium**, insurance companies can distinguish high risk customers from low risk customers. **[7.5 Marks]**

(c) **The equilibrium price and quantity** for a market with the following **demand and supply functions**, D(p) = 20-2p and S(p) = 40-6p respectively are 3 and 10. **[7.5 Marks]**

(d) Any **constant sum game** can be transformed into a **zero sum game**. **[7.5 Marks]**

(e) Preferences defined by $(x_1, x_2) \succ (y_1, y_2)$ if $x_1 + x_2 < y_1 + y_2$ exhibit **local non satiation** and the consumer facing positive prices will spend all income on non negative quantities of these goods. **[7.5 Marks]**

(f) The following Bernoulli utility function $u(x) = \sqrt{x}$ exhibits **decreasing absolute risk aversion**. **[7.5 Marks]**

Question 6

(a) Formally define "feasible allocation" for K goods in n-consumer exchange economy. Define the notion of "blocking coalition" in this economy. Define the "core" and briefly explain how this concept relates to competitive equilibrium. **[15 Marks]**

(b) Let consumer A and B have utility functions:

$u_A(x_1^A, x_2^A) = (x_1^A)^a (x_2^A)^{1-a}$ and $u_B(x_1^B, x_2^B) = (x_1^B)^b (x_2^B)^{1-b}$ for consumption of good 1 and 2. Each agent has an endowment $e_A = (1, 0)$ and $e_B = (0, 1)$. The prices of the goods are given by $p = (p_1, p_2)$

(i) Compute the aggregate demand functions associated with such consumptions. **[7.5 Marks]**

(ii) Determine the general equilibrium and market clearing conditions for the markets of good 1 and good 2. **[7.5 Marks]**

Question 7

Mensah, a famous hunter, has to choose one of two routes *a* and *d* (listed in order of speed in good conditions) to walk down a mountain. Fast routes are more likely to be struck by a rock-fall. At the same time, Kofi, a notorious rival hunter has to choose whether to use (*y*) or not use (*x*) a valuable explosive device to cause a rock-fall. The game is represented in normal form below:

		Kofi	
		x (β)	*y* (1 – β)
Mensah	*a* (α)	12 , 0	0 , 6
	d (1 – α)	9 , 3	6 , 0

(a) State the fundamental theorem of mixed strategy Nash equilibrium. **[2 Marks]**

(b) Find the mixed strategy Nash Equilibrium (NE) of this game. Assume that Mensah plays *a* with probability α and Kofi plays *x* with probability β as represented in the game table above. **[5 Marks]**

(c) Now assume that Mensah has four possible routes from which he can choose. Determine Mensah's pure strategy best responses when $\beta = \frac{2}{3}$, when $\beta < \frac{2}{3}$, and when $\beta > \frac{2}{3}$, by calculating Mensah's expected payoffs from his pure strategies for the different values of β. The normal form for this game is presented below. **[12 Marks]**

		Kofi	
		x (β)	*y* (1 – β)
Mensah	*a*	12 , 0	0 , 6
	b	11 , 1	1 , 5
	c	10 , 2	4 , 2
	d	9 , 3	6 , 0

(d) If you were hired by Mensah to analyse this strategic interaction, which route (i.e., strategy) would you suggest that Mensah should **never** choose? **[2 Marks]**

(e) Finally, find a mixed strategy NE of the new game (i.e., the one where Mensah has 4 strategies) in which one player adopts a pure strategy s_i and the other player adopts a mixed strategy σ_j. Then find another mixed strategy NE in which the same pure strategy s_i is assigned zero probability. **[9 Marks]**

Question 8

(a) Briefly explain and give economic application of the following concepts of information economics.

(i) Signaling **[4 Marks]**

(ii) Adverse selection **[3 Marks]**

(iii) Moral hazard **[3 Marks]**

(b) Consider a job market signalling model in which firms intend to hire workers whose productivity is unobservable. There are two types of workers, some with high productivity ($\theta = \theta_H$) and others with low productivity ($\theta = \theta_L$), where $\theta \in [\underline{\theta}, \bar{\theta}]$. The firms believe that the level of education, e, of a worker is a good signal for the unobservable productivity and the probability of hiring a high productivity worker type θ_H is $\mu(e)$ [i.e. Prob($\theta = \theta_H \mid e$) = $\mu(e)$]. The cost of education level e for worker type θ is $c(e, \theta)$, where $c(0, \theta) = 0$, $c_e(e, \theta) > 0$, $c_{ee}(e, \theta) \geq 0$, $c_\theta(e, \theta) < 0$ and $c_{e\theta}(e, \theta) < 0$. Education is assumed to be just a signal which does not to enhance productivity. If the firm offers a wage $w = \theta \geq r(\theta)$ then the iso-utility level, u_0, for the worker is given by $w - c(e, \theta) = u_0$.

(i) Explain why the worker's preference over the education and wage level pairs (e, w) is upward sloping in the w-e space (w on the horizontal axis and e on the vertical axis). **[5 Marks]**

(ii) Explain and show using a fully labelled diagram in the w-e space why the utility function satisfies the single crossing property. **[5 Marks]**

(iii) What are the implications of the single crossing property on the effect of the education signal on the equilibrium wage rate that the firms can offer to workers? **[5 Marks]**

(iv) Describe, in terms of the number of workers employed and the wages paid by the firms, the equilibrium that will exist if productivity is observable and the reservation utility of workers $r(\cdot)$ which is strictly increasing in θ and $r(\theta) \leq \theta$ for all θ. **[5 Marks]**