STRATHMORE UNIVERSITY

STRATHMORE INSTITUTE OF MATHEMATICAL SCIENCES

MASTER OF SCIENCE IN DATA SCIENCE AND ANALYTICS

END OF SEMESTER EXAMINATION

DSA 8105: FUNDAMENTAL CONCEPTS IN FINANCE AND ECONOMICS

Date: 4th October, 2022 **Time: 3 hours**

Instructions

Attempt any **Four (4)** questions

Question 1

(a) Suppose Kisumu can produce 120 million bushels of wheat if it uses all of its productive resources in the wheat industry, or 80 million yards of cloth if it uses all of its resources in the cloth industry. Use a diagram to illustrate your answers to the following questions. Label the diagram and explain in words.

(i) Assuming constant opportunity costs, draw Kisumus production-possibility curve. (Place wheat on the x-axis) {2 marks}

(ii) Suppose Kisumu's consumers choose to consume 70 million bushels of wheat. How much cloth will Kisumu then be able to produce? {2 mark}

(iii) What is the true price of a bushel of wheat in Kisumu? (2 marks)

(iv) Can Kisumu produce 60 million bushels of wheat and 50 million yards of cloth? If so why? {2 marks}

(b) If you buy 100 shares of East African Breweries stock

(i) To what are you entitled? {3 marks}

(ii) What is the most money you can make on this investment over the next year? {2 marks}

(iii) If you paid KES180 per share, what is the most money you could lose over the year? {2 marks}

[15 marks]

Question 2

(a) Table 1 summarizes information extracted from the national income statistics of Country Z

Table 1: **Country Z National Income Statistics**

Statistic	**Value in KES million**
Consumption expenditure	$0.6Y^d$
Investment expenditure	200
Government expenditure	400
Exports	100
Imports	0.3Y

If the rate of taxation in this country is 50% of all the income, Y is national income and Y^d is disposable income you are required:

(i) Calculate the equilibrium level of income {2 marks}

(ii) Calculate the equilibrium level of consumption expenditure {1 mark}

(iii) Calculate the fiscal budget surplus/deficit at equilibrium level of national income {1 mark}

(iv) Calculate the current account surplus/deficit at equilibrium level of national income {1 mark}

(v) State any three utilities of GDP as a statistic to a data scientist {3 marks}

(vi) Given the shortfalls of measuring GDP, what solutions would you propose as a data scientist to solve these shortfalls {2 marks}

(b) In Kenya, as in other developing countries, farmers experience the winner's curse irrespective of the weather or market conditions. As a data scientist who has learnt about various types of financial instruments and modelling techniques you seek to solve this problem once and for all in both crop farming and animal rearing. With the help of relevant examples, identify and explain the various types of financial instruments that you would use to solve this perennial curse and how you would ensure their widespread adoption {5 marks}

[15 marks]

Question 3

(a) Informal micro, small and medium enterprises (MSMEs) are important for employment and livelihoods in Kenya. According to the Kenya National Bureau of Statistics (2018) MSMEs employ over 83% of the workforce in the country. However, policy analysts are unable to intervene in the informal labour markets due paucity of data. What innovative solutions could you as a data scientist use to capture this hard to find data set? {3 marks}

(b) If one of the MSMEs has the short run production function $Q = f(k, l) = 6l^2 - 0.4l^3$. Where Q is output, k is capital and l is labour. Capital is fixed at one unit. Use the function to find the values of output (TP_l) for $l = 1, 2, 3, ..., 12$ {3 marks}

(c) Use the the resulting table in 3(b) above to:

(i) Find the marginal product of labour of labour MP_l {2 marks}

(ii) The average product of labour of labour AP_l {2 marks}

(iii) Identify the three stages of production {2 marks}

(iv) Find the optimal number of workers who should be hired if the output price is KES2 and the prevailing wage rate is KES11.2 {2 marks}

(v) Can this approach be applied to find the level of employment at the macro level? {1 mark}

[15 marks]

Question 4

(a) You wish to disabuse the notion that financial markets in Kenya are too small to matter using data. As an initial step, you first wish to establish the connection between financial markets and the economy in general using a list of channels. State any five connections between financial markets and the macroeconomy that would be contained in your list {5 marks}

(b) One important role of a data scientist is to predict human behaviour. You've keenly observed John's consumption behaviour and realized that he derives satisfaction from T-shirts and movies according to Table 2

Table 2: **Utility derived from John's Consumption of T-shirts and Movies**

Units	**Total Utility from T-shirts**	**Total Utility from Movies**
0	0	0
1	20	24
2	38	45
3	54	63
4	68	78
5	80	87
6	90	90

(i) Suppose that John has a total of KES24 that he wishes to spend on T-shirts and movies, how many units of each good will he consume if a T-shirt goes for KES2 and a movie goes for KES3? {3 marks}

(ii) Suppose you had estimated Table 2 using an app that gathered John's information overtime. Suppose further that you wish to prove to your classmates the effectiveness of your app in predicting human behaviour by predicting John's stepwise decision making. While detailing the rationale for the various decisions made by John state the step wise decisions (expenditures) that would be predicted by your app.{7 marks}

[15 marks]

Question 5

(a) Suppose that you have the following investment plans
I) You deposit KES10, 000 every end of the year for next 10 years
II) You deposit KES10, 000 at the beginning of every year for the next 10 years
Which plan would you go for and why given that the investment earns 7.5% semi-annually? {7 marks}

(b) Table 3 shows the quantity and price of bread and butter produced in country Z between 2009 and 2013.

Table 3: **Price and quantity of bread and butter produced in country z**

Year	**Quantity of bread**	**price of bread**	**Quantity of butter**	**Price of butter**
2009	150	30	20	80
2010	160	40	50	95
2011	165	55	55	105
2012	180	60	59	110
2013	185	64	66	115

Assuming that only bread and butter is produced in this country calculate and interpret (where applicable):

(i) The nominal GDP {2 marks}
(ii) The real GDP if 2009=100 {2 marks}
(iii) The GDP deflators for 2010, 2011, 2012 and 2013 {2 marks}
(iv) Economic growth for the various years {2 marks}

[15 marks]

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