

UNIVERSITY OF FORT HARE

**AGRICULTURAL PRODUCTION ECONOMICS
AGE 211**

DEGREE EXAMINATIONS

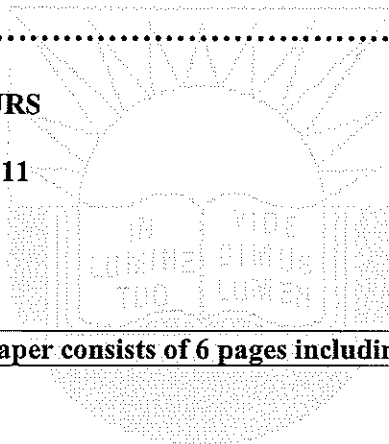
JUNE FINAL EXAM

2023

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Time: 3 HOURS

Subject: AGE 211

Marks: 100



This question paper consists of 6 pages including the cover page

Internal Examiners
Walter Shiba and Michael Aliber

Internal Moderator
STC Mdletshe

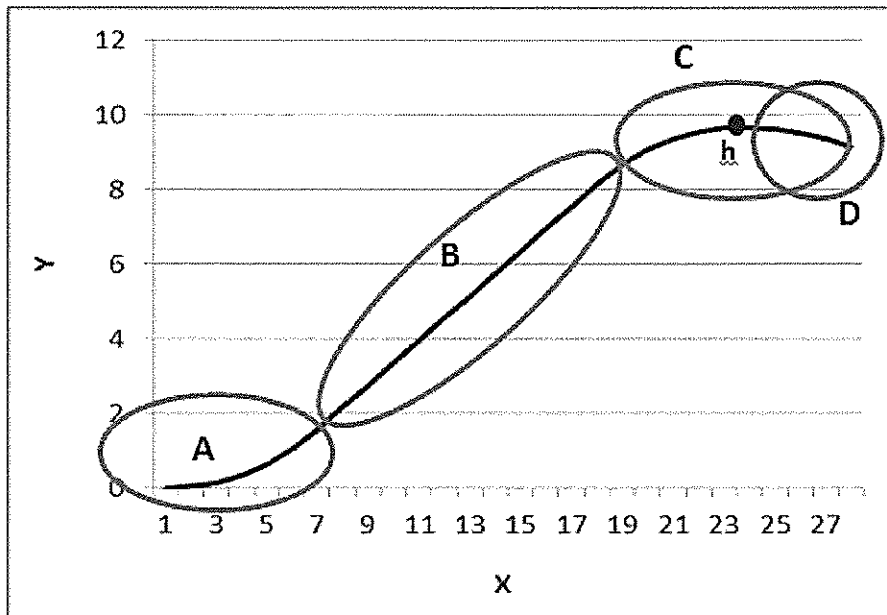
INSTRUCTIONS

Please answer each of the questions below. Show your work and explain your reasoning.

Question 1

[20 Marks]

The graph below represents a production function, meaning how much output, Y, you would expect given different possible values of a variable input, X. Different segments of the production function are marked with circles/ovals which represent different types of relationships between X and Y. Each circle/oval is designated with a letter, i.e. A, B, C and D.



- 1.1 For each distinct segment A through D, indicate whether it is characterized by negative marginal returns, constant marginal returns, decreasing marginal returns, or increasing marginal returns. [8]

- 1.2 Explain what is meant by “diminishing marginal returns”, and further explain why we usually observe diminishing marginal returns in production functions. [7]

- 1.3 The point labelled “h” marks the highest point of the production function, in other words, this is the maximum possible value of Y given this production function. If it were up to you where to produce on this production function, would you choose to produce at point h? Carefully explain why or why not. [5]

Question 2**[35 Marks]**

Suppose you have the following data on a variable input, nitrogen, measured in bags per hectare; and an output, maize yield, measured in kilograms per hectare. In your exam book, please reproduce the table as you see it here.

Nitrogen (bags / hectare)	Maize yield (kg / hectare)	Marginal Physical Product (MPP)	Value of the Marginal Product (VMP)	Marginal Factor Cost
0	50	–	–	–
1	85			
2	105			
3	115			
4	120			

- 2.1 In your table, fill in the values for the Marginal Physical Product. [4]
- 2.2 Apparently the price of the output, P_M , is R3/kg. In the table above, fill in the values for the VMP. [4]
- 2.3 Now, fill in the Marginal Factor Cost column, assuming that nitrogen costs R20 per bag. [2]
- 2.4 What is the optimal number of bags of nitrogen to use? Report your answer and also explain clearly how you determined this. [5]
- 2.5 At this optimal level of fertiliser use, what are your revenues per hectare? [4]
- 2.6 At this optimal level of fertiliser use, what are your variable input costs per hectare? [4]
- 2.7 What is your net benefit (revenues less variable input costs) per hectare? [4]
- 2.8 Suppose you have 10 hectares – what are your *total* revenues less your *total* variable input costs? [4]
- 2.9 Suppose you have fixed costs of R1200. What is your profit? [4]

Question 3**[15 Marks]**

Suppose you have the following data on *two* variable inputs, namely nitrogen (measured in bags per hectare) and maize seed (measured in kg per hectare). Each combination below allows for a production of 1300 kg of maize output per hectare. In your exam book, please reproduce the table as you see it here.

Nitrogen (bags/hectare)	Maize seed (kg/hectare)	Δ Nitrogen	Δ Maize seed	MRS (ie Δ Maize seed / Δ Nitrogen)
4	300	-	-	-
6	210			
8	150			
10	100			
12	60			

- 3.1 Fill in the values for the change in nitrogen levels (Δ Nitrogen) as you move from one input combination to the next; and do the same for the change in maize seed levels (Δ Maize seed). [4]
- 3.2 For each combination, calculate the Marginal Rate of Substitution, defined here as Δ Maize seed / Δ Nitrogen. (Strictly speaking, this should be a negative number, but you may ignore the minus sign.) [4]
- 3.3 The price of a bag of nitrogen, P_N , is R68, while the price per kg of maize seed, P_{MS} , is 2. Now, calculate your inverse price ratio (price of nitrogen divided by price of maize seed, ie P_N/P_{MS}). State your inverse price ratio. [2]
- 3.4 What is the optimal combination of nitrogen and maize seed given your target of producing 1300 kg of maize per hectare at the lowest possible cost? Report your answer and also explain clearly how you determined this. [5]

Question 4

[10 Marks]

Suppose you have a Cobb Douglas production function involving two inputs, namely Capital (K) and Labour (L):

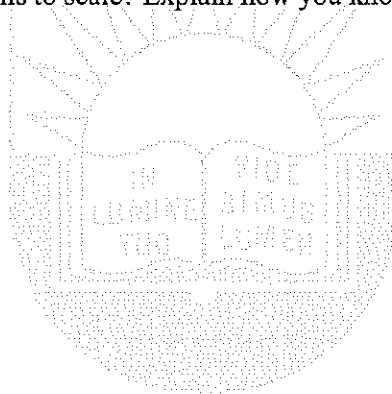
$$Y = A * K^{\alpha} * L^{\beta}$$

Suppose that $A = 1$, $\alpha = 0.5$, and $\beta = 1.15$, then the Cobb Douglas production function is:

$$Y = K^{0.5} * L^{1.25}$$

4.1 Using the above production function, find the value of Y first assuming that $K = 2$ and $L = 1$ (call this Y_1), and then again assuming $K = 4$ and $L = 2$ (call this Y_2). [4]

4.2 Comparing your Y_2 to your Y_1 , is the production function characterised by constant, increasing or decreasing returns to scale? Explain how you know. [6]



Question 5**[20 Marks]**

You are using Activity Analysis to determine the best combination of tomatoes and beetroot to grow on your farm, which is 5 hectares large. You may assume that 'T' indicates the number of hectares of tomatoes you choose to produce, and 'B' represents the number of hectares of beetroot you choose to produce. Your objective is to maximize Total Gross Margin. After costs, you earn R5000 per hectare of tomatoes and R4500 per hectare of beetroot.

You have three constraints, namely land, labour time, and cash for inputs. To produce 1 hectare of tomatoes, you need 4 days of labour and R2000, whereas to produce 1 hectare of beetroot you need 8 days of labour and R3000. Altogether you have 30 days of labour available and R12000.

- 5.1 Write out the 'planning problem' for the situation described above. You may use either the equation format or table format. (Hint 1: the planning problem consists of the objective function and all of the relevant constraints. Hint 2: label your constraints.) [10]
- 5.2 You solve the problem using a computer and find that the optimal solution is 5 hectares of tomatoes and 0 hectares of beetroot. What would happen now if the gross margin per hectare of tomatoes increased by 10%? [5]
- 5.3 Suppose in fact that the gross margin per hectare of tomatoes does not change (ie it remains at R5000). For the constraints indicated above, and the solution given above, the Total Gross Margin is R25000. Suppose now that the labour constraint is relaxed by one unit such that there are now up to 31 units of labour available. Suppose further that the optimal solution remains at 5 hectares of tomatoes and 0 hectares of beetroot. What is the shadow price of labour? Justify your answer. [5]