

UGANDA ADVANCED CERTIFICATE OF EDUCATION

SUBSIDIARY MATHEMATICS

REVIEW ITEMS IN SELECTED TOPICS

ITEM 1 (TIME SERIES)

A trader group in Kampala is concerned about the rising cost of essential food items. They decide to track the monthly average prices (in UGX per Kg) of maize flour over one year to understand trends and make better business decisions.

The recorded prices are shown below

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Price (UGX)	1800	2000	2100	2400	2600	2500	2300	2200	2100	2000	1950	2050

The traders also collected the following data for a basket of goods in two different years

Item	Base year price (UGX)	Current year price (UGX)
Maize flour	1800	2400
Beans	3000	3600
Rice	3200	4000

Task

Help the traders

- Calculate the 3 month moving averages for the maize flour prices from march to October. 6mks
- Using the moving averages calculated in (a), describe the trend in maize flour prices over the year. 3mks
- Taking the base year as 100, calculate the price index for each item in the current year. 5mks
- Calculate the simple average price index for the basket of goods. 3mks
- Based on your results, advise the traders on whether the cost of living has increased significantly, giving reasons from your calculations.

ITEM 2

A retail shop in Kampala sells essential household items. The manager wants to analyze how prices, quantities sold and total revenue have changed from 2003 to 2024.

The following data was collected and 2023=100

Item	2023		2024	
	Price (UGX)	Quantity (Kg)	Price (UGX)	Quantity (Kg)
Maize flour	1800	50	2400	60
Beans	3000	30	3600	25
Rice	3200	20	4000	30
Sugar	2500	10	2750	15

Task

a) Price relatives

Calculate the price relative for each item

b) Simple aggregate price index

Calculate the simple aggregate price index for 2024 based on 2023

c) Simple average price index /cost of living index

Calculate the simple average price index

d) Weighted aggregate price index

Using base year quantities, calculate the weighted aggregate price index

e) Weighted average price index/ cost of living index

Calculate the weighted average price index

f) Value index

Calculate the value index for 2024 based on 2023

ITEM 3 (Matrices)

A district sports committee is preparing for a regional athletics competition. They are sourcing equipment for three different sports centers, Nansana, Kira and Entebbe Center. The equipment consists of three main items, starting blocks, High jump cross bars and Shot-Put balls.

In the first phase of procurement, the committee delivered equipment represented by *matrix M*; 6 Starting blocks, 4 Crossbars and 2 Shot Put balls delivered at Nansana sports Center. 5 Starting blocks, 3 Crossbars and 4 Shot put balls at Kira Center. 4 Starting blocks, 5 Cross bars, and 3 Short put balls at Entebbe center.

A second delivery was made to increase on the stock, represented by *Matrix N*; 2 Starting blocks, 1 crossbar and 3 short put balls at Nansana Center. 3 Starting balls, 2 crossbars and 1 Shot Put ball at Kira Center. Then, 1 Starting block, 2 Crossbars and 2 Shot Put balls at Entebbe center.

Following a week of training, some equipment was damaged and returned for repair. The returned items are represented by *Matrix R*; from Nansana Center, 3 Starting blocks, 2 Crossbars and 1 Shot Put ball were returned. 2 Starting blocks, 1 Crossbar and 2 Shot Put balls were returned from Kira Center. And 1 Starting block, 3 Crossbars and 1 Shot Put balls were returned from Entebbe Center.

The total expenditure for the remaining functional equipment at each center was recorded as

Nansana: Shs 610,000, Kira: Shs 680,000 and Entebbe: Shs 600,000.

The committee wants to analyze this data to monitor the equipment and the costs incurred

Task

Help the committee

- a) Construct matrices M, N and R using the data provided
- b) Calculate the total equipment delivered to each center and hence the final functional equipment matrix, F after faulty ones were returned
- c) Let x, y, and z represent the unit cost of starting block, a crossbar, and a short put ball respectively. Using the values in matrix F and total expenditure, form a system of three simultaneous equations.
- d) Use Cramer's rule to find the individual cost of one Starting block, one Crossbar and one Shot Put ball

ITEM 4 (statistics)

The district sports officer collected data on the weights (Kg) of 40 student athletes who qualified for the regional finals. To simplify the records, the weights were grouped into classes as follows.

Weight (Kg)	Number of athletes
40-44	4
45-49	8
50-54	12
55-59	9
60-64	5
65-69	2

Task

- a) Create an expanded frequency distribution table for the data including class marks(x), fx, and cumulative frequency (F) and class boundaries (c/f)
- b) Calculate the estimated mean weight and modal weight for the athletes and hence tell the sports officer what he should know about your values.
- c) Using a cumulative frequency curve, determine
 - i) The median weight of the athletes and
 - ii) The interquartile range of weights from your graph

Item 5 (quadratics)

In Wakiso town, a young entrepreneur named Amina runs a road side chapatis business. She currently sells 20 chapatis daily at UGX 1000 each. After observing customer behavior, she notices that every time she increases the price of the chapati by UGX 100, she loses 2 customers. Her daily cost of production (ingredients, charcoal, transport) is UGX 8000.

Her aim to realize the best price she should sell her chapatis and make maximum profits each day.

Task

Help Amina to

- Write an expression to determine the new price per chapati. (let x represent the number of times she increases the price by UGX 100)
- Write an expression for the number of chapatis sold daily and hence form an expression, $P(x)$, for daily profits she makes.
- Show that the profit function can be written in form, $P(x) = ax^2 + bx + c$.
- Determine the maximum profit she can make per day and advise her on the best pricing strategy.

Item 6 (permutations and combinations)

At a secondary school, a group of students is organizing a Science and innovation Exhibition. The organizing committee must carefully plan how participants, projects, and presentations are arranged.

There are 8 students shortlisted to present their projects. Only 5 students will be selected to present on the main stage. Out of the 5 selected students, 3 will be assigned speaking roles. 1 will give the opening presentation, 1 will present in the middle and 1 will give the closing presentation. The remaining two students will display their projects without speaking

Additionally, the exhibition has 6 different project booths, and the 5 selected students must be assigned to different booths. Two particular students, Amina and Brian, cannot both be selected together due to overlapping project content.

Task

- In how many ways can the committee select students who are to present on the main stage.
- Given that those who are to present on the main stage are selected, in how many ways can they be assigned speaking roles. (opening, middle, closing)
- Calculate the number of ways the committee can assign the selected students to the different booths such that Amina and Brian are not both selected.

Item 7 (vectors)

A marine rescue team is coordinating a search for a fishing boat that sent a distress signal. The rescue center is located at the origin $(0, 0)$ on the command center's coordinate grid. Rescue Boat A positioned at a vector $\vec{a} = 8\mathbf{i} + 6\mathbf{j}$ and rescue Boat B positioned at $\vec{b} = -2\mathbf{i} + 10\mathbf{j}$.

Task

- The commander needs Boat A to rendezvous with Boat B to share equipment.

- i) Find the displacement vector of Boat A to Boat B.
 - ii) A refueling buoy is located exactly at the midpoint between the current positions of Boat A and Boat B. Find the position vector of this buoy.
 - iii) If Boat A's fuel efficiency allows for a maximum direct travel of 12 units, state whether it can reach Boat B without refueling.
- b) Boat B identifies a potential debris field. The field is located at point **D**, which is defined by the vector $\vec{d} = 2\vec{b} - \vec{a}$. Calculate the coordinates of the debris field D.
 - c) To maximize radar coverage, the controllers check the spread between the two boats relative to the center. Calculate the angle between position vector of boat A and that of B to the nearest degree.

Item 8

A logistics company is setting up a new distribution drone system in a city laid out on a grid. The main hub is located at the origin (0, 0).

A delivery drone starts at the hub and performs a test flight. First, it travels to a charging station located at point **A** (3, 4), representing its first displacement vector, \vec{a} . After charging, the company decides to test the drone's long-range capabilities by sending it to point **B**, a path exactly **three times** the length of its original trip, in the same direction, starting from the hub.

Task

- a) Calculate the coordinates of the new destination, point **B**.
- b) Calculate the total distance the drone would travel if it flew directly from the hub to point **B**.
- c) Later, the drone is redirected to a different warehouse at point **C** (5, -2). Find the angle between the original displacement vector \vec{a} and the new warehouse vector \vec{c}

“Success is by planning and not by fortune”

BY TR KAJUBI CHARLES

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