

APPLIED MATHEMATICS SCENARIO ITEMS HOLIDAY PACKAGE

JANUARY 2026

RANK CORRELATION AND STATISTICS

ITEM 1

There has been a complaint that some of the s.4 students of a certain school didn't receive their UCE results because they were withheld. The headteacher presented the complaint to uneb and as they were trying to handle the matter, they were to find the relationship between the mock results and end of year examination results. Ten students whose results were withheld were sampled and the table below shows the scores of the students in grade (aggregates) for the best done eight subjects.

Mock Exam	15	20	54	36	40	35	16	36
Final Exam	21	16	40	35	16	20	13	20
Subject	A	B	C	D	E	F	G	H

The head of the school has been given results but he didn't not understand how that Examiner made a comparison between the marks of the two examination bodies and he has called you an A level Mathematics student to guide him.

Task

As a student of mathematics, Help the headteacher to understand the relationship between the mock results and the final uneb score and give him a clear interpretation of your results at the 5% level of significance.

ITEM 2

A group of farmers were called to be given farm clothes. The ministry of agriculture in a certain district is interested in knowing the age and height of each farmer before the clothes are delivered. The tailor has registered farmers with their ages and heights as recorded in the table below.

Height (cm)	156	151	152	160	146	157	149	142	188	140
Age(years)	47	38	44	55	46	49	45	30	45	30

The management wants the committee to present to them a document that graphically tell how the age and height of the farmers are related by plotting a scatter graph together with a line of best fit so that it can be used to find the height of the farmers with the age of 37 years to be given a cloth. They are also interested in getting the order basing on the rank of the farmers so that it can be helpful during the distribution of the farmers clothes with ease.

Task

As a Mathematics student , help the agricultural management committee to

- (a) Plot the data on the scatter graph.
- (b) Draw the line of best fit on the graph and use it to find
 - (i) the height of the farmer with the age of 37 years
 - (ii) the age of the farmer with the height of 150 meters
- (c) Calculate the rank correlation coefficient for the data and comment on your results

ITEM 3

Eight schools had a music competition and three judges J1, J2 and J3 awarded the following points. J1 was the chief judge.

J1	72	50	50	55	35	38	82	72
J2	60	55	70	50	50	50	73	70
J3	50	40	62	70	40	48	67	67

The chief judge wanted to know the results of the other two judges were related but they could not manage to make it and present to him. You're one of the students though you did not participate but you have ideas of how this can be done.

Task

As a Mathematics student, help the judges J1 and J2 by

(a) Determining the rank correlation coefficient between the judgement of

(i) J1 and J2

(ii) J1 and J3

(b) Who of the two judges had a better correlation with the chief judge?

ITEM 4

RK fitness club conducted research to establish whether there is a negative or positive relationship between the hours spent exercising per week and individuals body weight.

The researchers collected data from a sample of participants as shown below.

Participant	A	B	C	D	E	F	G	H
Hours spent in exercise	1	3	5	8	10	12	14	17
B. Weight	85	80	75	70	68	65	53	50

Unfortunately, data of two additional participants I and J was not recorded due to the equation malfunction. Participant I spent 420 minutes exercising but had no body weight recorded. Participant J recorded a body weight of 60kg but had no time indicated. The fitness club will increase on the hours the clients spent exercising if the results of the research are significant at 1% .

Task

Help the researcher to

- (a) (i) Obtain the missing data of participants I and J
 - (ii) ascertain the relationship hours spent exercising per week and an individuals body weight.
- (b) With a clear reason, should the fitness club increase or reduce the hours it's clients spent exercising?

ITEM 5

The teacher marked scripts of 100 learners in a mathematics test and grouped their marks in a range as shown in the table below.

Marks	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85-94
No. of students	3	7	12	20	30	15	8	3	2

Andrew was absent when the teacher taught how to find the mode using the histogram, calculate the mean and the median. This made him perform less as expected. When the scripts were returned, the teacher advised him to make corrections and submit it the following day. Andrew returned home and her mother checked. When she saw the performance of Andrew, she canded him. He tried to do as the teacher told him but he could not manage. However, you were a classmate to him and neighbor at home at he has approached you to help him

Task

As a Mathematics student, help Andrew to complete the assignment by

- (a) Calculating the mean and median.
- (b) Find the mode from the histogram

ITEM 6

The Mathematics department of St. Leonard ss maddu recently administered a standardized Mathematics test to 100 students. The school aims to analyze the performance data to identify the trends in students' achievements, set academic improvement goals and determine how every marks are distributed. The table below shows the marks obtained by students (out of 100)

Marks	20-<40	40-<50	50-<55	55-<60	60-<70	70-<90	90-<100
No. of students	5	15	10	15	25	25	5

The head of department has asked you as a data analyst to help prepare a detailed performance summary report using the following tasks

Tasks

- (a) Construct a frequency distribution table and use it to calculate the mean mark of the student. Based on this mean mark, explain whether the overall performance is closer to the passing threshold (assuming 50 is the pass mark)
- (b) Draw a cumulative frequency curve (Orgive) and use it to determine
 - (i) the median merk, which divides the students into two equal halves.
 - (ii) Find the range of the score between 30th and 70th percentile.

ITEM 7

You're part of a city traffic planning committee tasked with analysing the daily number of cars passing through a busy checkpoint over 32 days. The data collected is grouped into intervals showing the number of cars and days observed in the range.

No. of cars	-10	-20	-30	-40	-50	-60
No. Of days	6	5	3	10	3	5

Your goal is to help the committee understand traffic patterns for better planning.

Task

(a) Construct a histogram based on this 32 day data, use it to estimate the most cars passing through the checkpoint, hence describe what your value means about the traffic flow.

(b) Calculate the average and variance of the number of cars passing through the checkpoint hence guide the committee on the significance of the variance for traffic variability.

(c) Construct a 95% confidence interval for mean daily number of cars.

(d) How confident can the city planner be about future traffic volumes based on your result in (c) above.

PROBABILITY, NUMERICAL METHODS AND MECHANICS

ITEM 8

A farmer in Mbale has five different types of maize seeds to plant. He wants to choose two types to plant in two separate plots. However, he needs to choose the two highest yielding types.

Task

As a Mathematics student, Help the farmer to choose the two highest yielding types.

ITEM 9

A committee in Kampala is organizing a community event and they need to select three speakers from a pool of 8 applicants. There are two of the applicants who are experts on the event topic and they are uncertain of the chance of being selected both of them.

Task

As a Mathematics student, help the applicants to know the chance of both of them being selected.

ITEM 10

During Bobi wine campaign rally in Mbale and bududa districts, he set off for bududa before coming to finalize in Mbale City. It was expected that the chance of him leaving Mbale for bududa on time is 0.83 and that of leaving bududa then back to Mbale is on time is 0.78. Supporters in bududa are waiting and they are uncertain of the chance of arriving in bududa on time given that he leaves Mbale on time. Others are arguing that he has just passed Mbale and they are uncertain of him leaving Mbale on time given that he has arrived in bududa on time.

Task

As a Mathematics student, help the supporters to know the chances that Bobi wine

(a) arrives in bududa on time given that he leaves Mbale on time

(b) Leaves Mbale on time given that he arrives in bududa on time.

ITEM 11

At the wedding party, the food became limited to the number of people present. In the calculations by the chefs, it was found that 10% are to have hot breakfast, 20% are to have a hot lunch and 25% are to have a hot breakfast and a hot lunch.

The members were chosen at random and the servers wanted to select basing the chances of those who will have a hot breakfast and a hot lunch and those that will have a hot lunch given that they will have a hot breakfast.

Task

As a Mathematics student, help the people to get the chance that a person chosen at random will

(a) have a hot breakfast and a hot lunch

(b) have a hot lunch given that they will have a hot breakfast

ITEM 12

Three boys A,B and C take part in a swimming competition. The respective probabilities of hitting the target are $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$. If they all throw at the target at once

Task

Find the probability that the target will be hit by all of them.

ITEM 13

There is a shooting contest and three men A, B and C are said to participate. The shooting involves firing at once and the judges want to know the chances that the target will be hit by non of them, only two of them, at least one of them and utmost two of them. However, it is known that the chances of hitting the target by 3 men are $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{9}$ respectively.

Task

As a Mathematics student, help the judges to find the probability that the target will be hit by:

(a) non of them

- (b) all of them
- (c) only one of them
- (d) only two of them
- (e) at least one of them
- (f) utmost two of them

ITEM 14

S.2 students have invented a game as their project from the subject of integration of physical education. During the weekend in the evening, three participants A,B,C took part in the shooting competition. Their respective probabilities of hitting the target are $\frac{1}{4}$, $\frac{1}{3}$ and $\frac{1}{5}$. It is known that if one of the three hits the target first, he becomes the winner and the competition ends. If it is A who starts first, followed by C and then B. Find the probability that

- (a) C wins on the second trial
- (b) B wins

ITEM 15

Two boxes P and Q contain similar marbles. Box Q contains 6 red and 4 blue marbles, while box P contains 3 red and 5 blue marbles. A box is randomly drawn and from it a ball is randomly drawn and put into the other. A ball is then drawn from this later box. Find the probability that:

- (a) both balls are red
- (b) the final ball drawn is blue
- (c) the first ball drawn is red given that the second ball drawn is blue.

ITEM 16

During elections at a certain polling station, arguments were raised to an individual that belonged to a certain group of people called conservatives. They wanted to know the chance that he voted and also that chance given that he did not vote and that he is a conservative. In the city, 30% of the people are conservatives, 50% are liberals and 20% are independents. Records indicated that 65% of the conservatives voted, 85% of the liberals voted and 50% of the independents voted. The person in the city was selected at random.

Task

As a Mathematics student, help the polling officials and the people yelling at the polling station to

- (a) determine the probability that he voted so that they stop complaints
- (b) given that he did not vote, determine the probability that he is a conservative.

ITEM 17

The physics class of the year 2024 embarked on a project to model the distribution of lifetime (x) in hours of a certain type of the dry cells used in the physics laboratory. The two different set ups were used in order to archive the above objectives in two different intervals. Additionally, the team was to graphically represent their results, establish the average lifetime and the variance of the lifetime of the dry cells used.

If the average lifetime of the dry cells used is less than 2 hours, the physics department will stock another type of the dry cells. Otherwise it will continue using the current type. The project report showed that the distribution of the lifetime of the dry cells can be modelled by a continuous random variable, X with a constant K and the probability density function given by :

$$f(x) = \begin{cases} kx; & 0 \leq x \leq 2 \\ k(4-x); & 2 \leq x \leq 4 \\ 0; & \text{otherwise} \end{cases}$$

Task

As a student of mathematics, help the project team to:

- (a) Establish the value of the constant K
- (b) Hence illustrate the distribution on the sketch diagram
- (c) Determine the:
 - (i) likelihood that any drycell selected randomly has a lifetime between 0 hours and 3 hours inclusive given that the dry cells has a lifetime of at least one hour
 - (ii) the mean lifetime and variance of the lifetime of the drycells used in the project
 - (iii) Should the physics department stock another type of of the dry cells?. Justify your response.

ITEM 18

A company is designing a water tank with a curved bottom. The shape of the bottom can be modelled by the equation $y = x^2$, where y is the height of the tank above the x -axis and x is the horizontal distance. The tank spans from $x = 0$ to $x = 4$. However, the company designers are not certain of the area covered by the bottom of the tank. Designer A suggested that this area can be approximated through graphical analysis using scales of 4cm:1unit horizontally and 2cm : 2 units vertically. While designer B

argued that using calculus would give an accurate result to a maximum of 4 decimal points. The head of the project tasked the designers A and B to present clear results of the area of the bottom of the tank using the suggested methods. On the receipt of the results, Tim, made a thorough analysis of the results and discovered that there was a significant percentage relative error made in their results. He requested his team to make necessary adjustments so that the percentage error can be reduced to preferably a smaller value before the actual project commences.

Task

Help Tim to:

- (a) Clearly understand how each designer obtained the results.
- (b) Establish the percentage relative error he discovered
- (c) Suggest how the designers can reduce the percentage relative error made.

ITEM 19

As a certain construction company was purchasing a pulley and a cable to use on its construction sites, its engineers tested their strength using the reactions experienced by the pulley when masses of 80kg and 120kg are connected using the cable to pass their smooth fixed pulley. They used their two experiments to test that. For the first experiment, an 80kg mass was placed on a rough horizontal plane whose coefficient of friction is 0.5 and this light inelastic cable was connected to it and then passed over the smooth pulley fixed at the edge of the plane. 120kg mass was attached to the end of the cable to vertically hang freely before the system is released from rest. For the second experiment, the same rough plane whose coefficient of friction is 0.5 was inclined at an angle of 60° to the horizontal such that an 80kg mass remains in contact with this plane with the same inelastic cable connected to it to pass over the same smooth pulley fixed at the top edge of this incline for the cable to hold a 120kg mass on its other end to vertically hang freely before the system is released from rest.

The company plans to buy the cable and the pulley if the reaction on the pulley in each of the experiments is greater than 900N

Task

As a student of mathematics, determine whether this construction company will purchase the product

ITEM 20

Bio reliant limited produces a new antibiotic, cure fast, using an automated production machine. The machine's components have a lifespan that follows a normal distribution with mean 5000 hours and standard deviation of 400 hours.

Once produced, cure fast is administered to patients. Clinical trials show that the recovery time follows a normal distribution with mean 10 days and standard deviation 2 days. The company wants to ensure both machine reliability and medicine effectiveness meet strict quality standards.

Task

(a) (i) Determine the probability that a company lasts between 4800 hours and 5200 hours.

(ii) Find the preventive replacement time so that only 10% of the component fail before replacement.

(b) (i) Find the proportion of the patients who recovers in less than 8 days

(ii) Calculate the semi-interquartile range of the patient's recovery time.

(iii) If only 5% of the patients are considered slow responders, find the minimum recovery time that defines a slow responder.

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