

	MOCK MARCH 2025	SCORE
SUBJECT TITLE	PURE MATHEMATICS WITH STATISTICS	
SUBJECT CODE	0770	
PAPER NUMBER	3	
CLASS	ADVANCED LEVEL	
TIME ALLOWED	3 Hours	
CANDIDATE NAME		
CANDIDATE NUMBER		

TIME ALLOWED: 3 hours

INSTRUCTIONS TO CANDIDATES

1. Mobile phones are not allowed in the examination room. Non programmable calculators are allowed
2. Full marks may be obtained for answers to All questions
3. In calculations, you are advised to show all the steps in your working, giving your answer at each stage.
4. You are reminded of the necessity for good English and orderly presentation of your work

1. The examination marks of some pupils in a certain class are given in the table below

Marks, x	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29	30 – 34	35 – 39	40 – 44	45 – 49	50 – 54
Frequency, f	3	4	5	15	22	19	14	10	6	2

- Calculate the mean and variance of the distribution of the marks
- Draw an ogive of the distribution of the marks
- Estimate the median mark and the quartile deviation of the distribution of marks
(6, 2, 5) marks

2. (i) Given that $P(A) = 0.4$, $P(B) = 0.6$ and $P(A \cap B) = 0.2$, find $P(B)$ if

- A and B are mutually exclusive,
- A and B are independent. (3, 3) marks

(ii) On a given day, a petrol station serves 3 times as many males as female customers. Two types of fuel, super (S) and diesel (D) are available. 60% of the males and 40% of the females buy super. Customers pay for their fuel either in cash or cheque. Of the males who buy super, 80% pay in cash while 20% of the males who buy diesel, pay in cash. Of the females who buy super, 60% pay in cash while of the females who buy diesel, 40% pay in cash. Using a tree diagram, find the probability that

- A customer buys super,
- A customer pays in cash,
- A customer who pays in cash for super is a male. (3, 3, 2) marks

3. The probability mass function of a discrete random variable X is defined by

$$f(x) = \begin{cases} kx^2, & \text{for } x = 0, 1, 2, 3, \\ 0, & \text{otherwise} \end{cases}$$

- Obtain the value of the constant k
- Write down the probability distribution of X
- Find $E(X)$ and $Var(X)$
- Calculate the values of $E(11X - 4)$ and $Var(11X - 4)$ (3, 3, 6, 4) marks

4. (i) State the principal features of the Poisson distribution.

A manufacturer of components finds that on the average, 2% of the components are defective. Components are packed in cartons of 50. Use the Poisson distribution to find the probability that a carton selected at random, will contain

- At most 1 defective component,
- Exactly 2 defective components,
- More than two defective components. (1, 3, 2, 3) marks

(ii) A random variable X has a normal distribution with mean $\mu = 20$ and standard deviation $\sigma = 4$. Find the probability that an observation X selected at random

- Is less than 15,
- Is greater than 25,
- Lies between 18 and 22. (2, 3, 3) marks

5. A continuous random variable X has probability density function f given by

$$f(x) = \begin{cases} cx^2(1-x^3), & \text{for } 0 \leq x \leq 1 \\ 0, & \text{otherwise} \end{cases}$$

Find

- (a) The value of the constant c ,
- (b) The mean and variance of X ,
- (c) The mode of X .

Given that m is the median of X , show that $3m^4 + 4m^3 + 1 = 0$. (3, 6, 3, 4) marks

6. (i) State two conditions under which the normal distribution may be used as an approximation to the binomial distribution. 1 mark

(ii) In a particular factory, the probability that a machine produces a defective item is 0.3. A random sample of 120 items is taken from the factory. Using the normal approximation as an approximation to the binomial distribution, find the probability that the number of defective items is:

- (a) Exactly 36,
- (b) Less than 30,
- (c) Between 20 and 40 inclusive

(6, 2, 4) marks

7. (i) Explain briefly, the following as used in hypothesis testing:

- (a) A Type I and type II error,
- (b) The Null and the Alternative Hypotheses

4 marks

(ii) In a study to compare the effectiveness of two different fertilizers on the yield of wheat, samples of wheat were taken from two fields and the yields measured. Let X_1 denote the yields of wheat from one field and X_2 denote the yields of wheat from another field, n_1 and n_2 the number of wheat plants taken from the two fields, respectively

Given that $n_1 = 20, E(X_1) = 25.2 \text{ cm}, \text{Var}(X_1) = 4.2 \text{ cm}^2$

$n_2 = 25, E(X_2) = 27.5 \text{ cm}, \text{Var}(X_2) = 5.1 \text{ cm}^2$

- (c) Find to one decimal place, an estimate of the population variance from the two samples
- (d) Assuming that the yields of wheat are normally distributed with a common variance, test at 5% significance whether there is a difference in the effectiveness of the two fertilizers

(6, 5) marks

8. The table below shows the inflation rate, x percent, and the unemployment rate, y percent, for 10 different countries in the month of December 2010

Inflation rate, x	13.9	21.4	9.6	1.5	31.7	23.1	18.4	34.4	27.6	5.6
Unemployment rate, y	2.9	11.3	5.2	6.1	9.0	8.8	5.9	15.6	9.8	3.7

Calculate, correct to three decimal places,

- (a) The product-moment correlation coefficient for this data.
- (b) The least squares regression line of inflation rate on unemployment rate
- (c) The Kendall's coefficient of rank correlation between inflation rate and unemployment rate

(8, 2, 3) marks

You may use

$$\sum x = 187.2, \sum x^2 = 4599.12, \sum y = 78.3, \sum y^2 = 746.69, \sum xy = 1766.18$$