For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

STATISTICS 6046/1

PAPER 1

NOVEMBER 2020 SESSION 3 hours

Additional materials:
- Answer paper
- Graph paper
- List of Formulae MF7
- Electronic calculator (Non-programmable)

TIME 3 hours

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces provided on the answer paper/ answer booklet.

Answer **all** questions.

If a numerical answer cannot be given exactly, and the accuracy required is not specified in the question, then in the case of an angle it should be given to the nearest degree, and in other cases it should be given correct to 2 significant figures.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 120.

The use of an electronic calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

This question paper consists of 6 printed pages and 2 blank pages.

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1 A student travels to school by bus or car or on foot with probabilities $\frac{1}{6}, \frac{1}{3}$ and $\frac{1}{2}$ respectively.

For each mode of travel the student's probabilities of being late for school are $\frac{1}{5}, \frac{1}{4}$ and $\frac{1}{20}$ respectively.

(a) Find the probability that the student is early for school. [2]

(b) If the student arrives early one day, find the probability that the student's travel was on foot. [3]

2 The times to the nearest minute taken by 12 students to complete a task are given below:

43; 45; 46; 42; 48; 42; 46; 55; 47; 42; 41; 44.

(a) Find the median and quartiles. [3]

(b) Draw a box and whisker diagram, identifying any outliers. [2]

(c) Comment on the shape of the distribution. [1]

3 A team of four is chosen at random from 5 women and 6 men.

(a) Find the number of ways in which the team can be chosen if

(i) there are no restriction,

(ii) there must be more men than women. [3]

(b) Calculate the probability that the team contains only one man. [3]

4 The probability distribution of a random variable X is shown below.

X	1	2	a	b
P(X = x)	0,1	0,3	0,4	0,2

Given that E(X) = 3,5 and Var(X) = 2,65. Find the values of a and b. [6]

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5 (a) Calculate the equation of the regression line y on x for the following distribution. [4]

x	25	30	35	40	45	50
y	78	70	65	58	48	42

(b) Can a value of x be found for $y = 54$? Give a reason. [2]

6 The masses of 18 pupils in a form one class are summarised as follows:

$$\sum x = 745, \quad \sum x^2 = 33\,951$$

(a) Calculate the mean and variance of the masses of this group of pupils. [3]

(b) One pupil leaves the group and the mean mass of the remaining 17 pupils is exactly 41 kg.

Find

(i) the mass of the pupil who left.

(ii) the standard deviation of the remaining group of pupils. [4]

7 Given that $X \sim \text{Bin}\left(5, \frac{1}{6}\right)$,

find,

(a) $P(X = 2)$, [2]

(b) $P(X \geq 4)$, [3]

(c) $P(X < 3)$. [2]

8 If $X \sim \text{Geo}(0,6)$, calculate

(a) $P(X = 4)$, [2]

(b) $E(X)$ and $\text{Var}(X)$, [3]

(c) $P(X \geq 3)$. [3]

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9 It is given that

$$f(x) = \begin{cases} c(2x - x^2), 0 < x < \frac{5}{2} \\ 0 \text{ otherwise} \end{cases}$$

and $c > 0$.

(a) Show that $f(x)$ defines the probability density function (p.d.f) of a random variable **X**. [3]

(b) Hence or otherwise find

(i) the value of the constant c.

(ii) **E(X)**. [5]

10 The random variable **X** is normally distributed with parameters $\mu = 3$ and $\sigma^2 = 9$, calculate

(a) $P(2 < X < 5)$, [3]

(b) $P(X > 0)$, [2]

(c) $P(|X - 3| > 6)$. [4]

11 The following trend equation is given as:

$\hat{y} = 284 + 14.4x$ with origin 1 July 1974
x unit = 1 year
y unit = annual sales × ($1 000)

(a) If 1982 was the last year of the data, find the number of years of data used to determine the equation assuming that the origin has not been moved. [1]

(b) Calculate projected sales for 1985. [2]

(c) Find the annual dollar increase. [1]

(d) Convert the equation to a monthly equation with the x unit = 1 month and set the origin at 15 July 1980.

Estimate sales for September 1980. [5]

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12 The probability density function of **X**, the lifetime of a type of electronic device (measured in hours) is given by

$$f(x) = \begin{cases} \frac{10}{x^2}, & x > 10 \\ 0, & x \leq 10 \end{cases}$$

(a) Evaluate P(X < 20). [3]

(b) Find the cumulative distribution function of **X**. [3]

(c) Calculate the probability that of 6 such types of devices at least 3 will function for at most 20 hours. [4]

13 A and B are independent normal variables with

A ~ N(75, 36) and
B ~ N(65, 25)

Calculate the probability that

(a) a random chosen value of **A** is greater than 65, [2]

(b) 3 randomly chosen values of **A** are more than 3 randomly chosen values of B. [4]

(c) a randomly chosen value of **A** is 15% more than that of **B**. [4]

14 A health department reports that 40% of all injuries occur at home.

Find the probability that out of 500 randomly selected injuries, the number of injuries occurring at home is

(a) exactly 190, [5]

(b) between 180 and 210 inclusive, [3]

(c) more than 180. [3]

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15 The following is the distribution of the number of calls received at a switchboard during 600 five-minute intervals.

Number of calls	0	1	2	3	4	5	6	7
Frequency	34	131	160	136	72	37	22	8

Test at 1% level of significance the hypothesis that the underlying distribution from which the sample came is a Poisson distribution with mean 2.5. [13]

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