ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

STATISTICS 6046/2

PAPER 2

NOVEMBER 2023 SESSION 3 hours

Additional materials:
- Answer paper
- Graph paper
- List of Formulae MF 7
- Scientific calculator [Non-programmable]
- Mathematical Instruments

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 in **Section A** and any **five** from **Section B**.

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 a non-programmable scientific calculator is expected, where appropriate.

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

This question paper consists of 7 printed pages and 1 blank page.

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Section A (40 marks)

Answer all questions in this section.

1 **(a)** 5 students attended a career guidance workshop, as shown in table below.

School	Number of students
A	2
B	1
C	1
D	1

In how many ways can they sit on a circular table if

(i) those from school A sit next to each other,

(ii) students from School A do not sit next to each other. [5]

(b) A girls soccer squad has 17 players. Find the number of teams, each team made up of 11 players that can be chosen from the squad. [2]

2 Two fair ordinary dice are tossed. The random variable X denotes the sum of the two scores.

(a) Construct the probability distribution table of X. [3]

(b) Find

(i) $E(X)$, [2]

(ii) $Var(X)$ [3]

3 A biology student measured the lengths of worms, to the nearest centimetre, obtaining the following data.

11; 4; 24; 20; 9; 18; 7; 25; 21; 16; 22; 12; 15; 17; 14; 15; 8; 21; 18; 14

(a) Using classes 0-4; 5-9; … construct a grouped frequency table. [2]

(b) Represent these data by means of a stem and leaf diagram. [3]

(c) Find the

(i) median, [1]

(ii) quartiles, [2]

(iii) interquartile range. [2]

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4 The lengths of metal rods are normally distributed such that 40% of them are greater than 3m and 30% are greater than 3,5m.
Use the above information to estimate the

(i) mean,

(ii) standard deviation of the lengths of metal rods. [6]

5 A box contains 2 white marbles and 4 red marbles. The marbles are identical except for the colours. Two marbles are taken at random without replacement.

X is the number of red marbles obtained.

(a) Construct a fully labelled probability tree diagram for the experiment. [2]

(b) Construct a probability distribution table for the random variable X. [2]

(c) Find

(i) $E(X)$, [2]

(ii) $Var(X)$ [3]

Section B (80 marks)

Answer any **five** questions from this section.

Each question carries 16 marks.

6 In country A, 7% of registered pregnant women give birth to premature babies.

(a) In a sample of 20 registered pregnant women, find the probability that

(i) exactly six will give birth to premature babies, [3]

(ii) between three and five (inclusive) will give birth to premature babies. [3]

(b) In a sample of 42 registered pregnant women, find the

(i) expected number of registered pregnant women who give birth to premature babies. [1]

(ii) standard deviation for the number of registered pregnant women who give birth to premature babies. [2]

(c) For another sample of 80 registered pregnant women, use a suitable approximation, to estimate the probability that exactly seven will give birth to pre-term babies. [7]

7 **(a)** State any **three** components of a time series. [3]

(b) Find a 4-point centred moving averages for the following data:

13; 7; 9; 17; 3' 6; 10; 20; 11; 15 [6]

(c) Consider the enrolment patterns below, of a school since its opening in 2005.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Enrolment	147	175	150	191	188	179	200	220	208	230

(i) Calculate the trend line by coding 2005 as year 1, 2006 as year 2 and so on. [5]

(ii) Predict the number of students in 2019. [2]

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8 A soft drink is sold in bottles of two sizes, standard and large. For each size the content in litres of a randomly chosen bottle is normally distributed with mean and standard deviation as given in the table.

bottle	mean	Standard deviation
standard	0,76	0,008
large	1,010	0,009

Find the probability that

(a) a randomly chosen large bottle contains less than 1,011l, [4]

(b) a randomly chosen standard bottle contains less than 0,75 l, [4]

(c) a box of 10 randomly chosen standard bottles contains at least 3 bottles whose contents are each less than 0,75 l , [3]

(d) there is more of the soft drink in 4 randomly chosen standard bottles than in 3 randomly chosen large bottles. [5]

9 **(a)** Differentiate between periodical and cyclical components of a time series. [2]

(b) State any **one** reason for smoothening. [1]

(c) The quarterly sales of a certain company are as displayed, in thousands of dollars, in the table below.

Year	Q1	Q2	Q3	Q4
1992	711	708	845	864
1993	1042	917	960	769
1994	841	653	638	423

(i) Plot the data on a time series graph. [3]

(ii) Find the 4 point centred moving averages for the data. [6]

(iii) Plot your results in (ii) above on the same graph and comment. [4]

10 A continuous random variable X has a probability density function given by

$$f(x) = \begin{cases} \frac{1}{4}e^{-kx} & x \geq 0 \\ 0 & x < 0 \end{cases}$$

(a) Find the value of k. [4]

(b) Find $Var(X)$ [2]

(c) Calculate the upper quartile of the distribution. [4]

(d) Calculate the following probabilities:

(i) $P(X < 8)$ [2]

(ii) $P(X > 10)$ [2]

(iii) $P(5 < X < 7)$ [2]

11 The table below shows the number of days of business trips taken by directors of a company and their corresponding claims, in dollars, they made to cover the total expenditure of the trips.

Number of days	10	3	8	17	5	9	14	16	21	13
Amount claimed	116	39	85	159	61	94	143	178	225	134

(a) Plot the data on a scatter diagram. [3]

(b) Determine the regression line for amount claimed on the number of days of business trips in the form $y = a + bx$. [5]

(c) Interpret the values of a and b found in (b) above. [2]

(d) Using the equation estimate the expected expenditure of a trip lasting eleven days. [2]

(e) State giving a reason whether or not you would use the line to find the expected expenditure of a trip lasting two months. [2]

(f) Calculate the product – moment correlation coefficient. [2]

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12 **(a)** Define X^2 goodness-of-fit. [1]

(b) The following data is for 90 different candidates who attempted 4 types of psychometric tests on a particular website.

	Type of Psychometric test			
	Aptitude	Spatial	Diagrammatic	Deductive
Good mark	11	4	3	12
Bad mark	12	20	12	16

Test at 5% significance level whether the mark obtained is independent of the type of the psychometric test. [15]