ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

STATISTICS 6046/2

PAPER 2

NOVEMBER 2019 SESSION 3 hours

Additional materials:
- Answer paper
- Graph paper
- List of Formulae MF 7
- Scientific calculator

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 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 continuous random variable, X, has a probability density function given by

$$f(x) = \begin{cases} \frac{x}{12}, & 0 \leq x < 3 \\ k(x-8), & 3 \leq x \leq 8 \\ 0, & \text{otherwise,} \end{cases}$$

where k is a constant.

Find the

(a) value of constant k, [2]

(b) expected value of x. [2]

(c) median of X. [3]

2 (a) (i) Describe briefly, a census as a way of collecting data [2]

(ii) State any **two** advantages of carrying out a census. [2]

(b) The table below shows the amount of water, in litres, taken by 100 athletes during a marathon competition.

Amount of water (litres)	0 – 0.5	0.5 – 1.0	1.0 – 1.5	1.5 – 2.0	2.0 – 2.5
Number of athletes	8	20	29	22	21

Calculate an estimate of the

(i) mean amount of water,

(ii) standard deviation. [4]

3 A discrete random variable **X** has the following distribution.

X	2	3	4	5	6
P($X = x$)	0.1	0.4	0.1	0.3	0.1

(a) Find the

(i) expectation of X, [2]

(ii) variance of X. [2]

(b) Another random variable, $Y = 3X - 2$.

Find

(i) E (Y), [2]

(ii) Var(Y). [2]

4 The number of people who use a lift in a multi-storey building follows a poisson distribution with a mean of 2 in a minute.

Find the probability that

(a) exactly 3 people use the lift in a minute, [2]

(b) less than 4 people use the lift in a period of 2 minutes, [3]

(c) more than 2 people use the lift in a 3 minute period. [3]

5 **(a)** Find how many code numbers of three digits that can be made using digits 1; 2; 3; 4 and 5, if the order of the digits is important and repetition is

(i) permitted, [2]

(ii) not permitted. [2]

(b) At a certain school the probability that a learner passes Advanced Level is 0.8 and the probability that the learner proceeds to Tertiary Education is 0.9. The corresponding probability that a learner who fails Advanced Level does not proceed to Tertiary Education is 0.4.

(i) Find the probability that a learner proceeds to Tertiary Education. [2]

(ii) Given that the learner proceeds to Tertiary Education calculate the probability that the learner fails Advanced Level. [3]

Section B (80 marks)

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

Each question carries 16 marks.

6 When a car is switched on, the temperature ($\theta°$) was measured and recorded at eight different intervals of time (t). The results are given the table below.

t (min)	20	30	40	50	60	70	80	90
θ(°C)	42	52	64	66	91	86	98	104

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

(b) Calculate the equation of the regression line of θ on t and fit it on the scatter diagram. [6]

(c) Estimate the value of θ when $t = 65$ minutes using the fitted line. [2]

(d) Find the temperature (θ) when $t = 95$ minutes. [1]

(e) Calculate the product moment correlation coefficient and comment. [4]

7 A farmer examining the distribution of weeds in a field counts the number of weeds in 100 randomly chosen small areas each of one square metre. The results are given in the table below.

Number of weeds per square metre (X)	0	1	2	3	4	5
Number of square metres	18	25	25	16	7	9

(a) Find the mean of this frequency distribution. [2]

(b) Test at the 5% level, the hypothesis that the number of weeds follows a Poisson distribution. [14]

8 The masses of hard cover books are normally distributed with a mean of 0.5 kg and standard deviation 0.15 kg. The masses of exercise books are normally distributed with mean 0.2 kg and standard deviation of 0.07 kg.

Calculate the probability that the

(a) mass of a hard cover book is less than 0.65 kg, [3]

(b) mass of 4 exercise books is less than 0.9 kg, [4]

(c) mass of 7 randomly chosen exercise books is more than the mass of a randomly chosen hard cover book, [4]

(d) mass of a hard cover is less than three times the mass of an exercise book. [5]

9 (a) A random sample of 75 bags of maize meal each of mass X kg packaged by a milling company gave the following results, $\sum(x-5)=738.5$, $\sum(x-5)^2=18\,723$

(i) Calculate the unbiased estimate of the

1. mean mass, [2]

2. variance of the mass. [3]

(ii) Determine a 98% confidence interval for the mean mass of the bags. [3]

(b) Customers from a particular area launched a complaint that the sugar that the manufacturing company was packing in 2 kg packs of sugar were less than 2 kg. The managing director on investigating the claim took a sample of 100 packs of sugar and recorded the mass of the contents x kg. It was found that

$\sum x = 198\,kg$, $\sum x^2 = 420.5$

$\bar{x} = 1.98$ kg $S^2 = 0.2846$.

(i) Estimate the population variance of the masses of the packs of sugar. [2]

(ii) Test at 10% level of significance whether the customers' claim is true. [6]

10 The heights of people h metres in a community are normally distributed with mean μ and standard deviation δ. It is given that $P(h < 1.2) = 0.15$ and $P(h > 1.6) = 0.10$.

Calculate the

(a) mean μ and standard deviation δ of the heights of the people, [7]

(b) lower and upper quartiles, [4]

(c) interquartile range, [2]

(d) $P(|h - \mu|) < 0.1$. [3]

11 (a) The probability that a form 3 learner passes a given test at a particular school is 0.6.

(i) In a class of 15 form 3 learners find the probability that

1. exactly 4 learners pass the test,

2. less than 13 learners pass the test.

[6]

(ii) In a stream of 200 form 3 learners, find the probability that more than 140 pass the test. [6]

(b) If $X \sim$ Geo (0.25), calculate

(i) the variance of X, [2]

(ii) $P(X > 3)$.

[2]

12 The table below shows the sales of a shop which were recorded over a two-week period.

Week	Day	Sales ($)
1	Monday	162
	Tuesday	143
	Wednesday	138
	Thursday	138
	Friday	149
	Saturday	204
	Sunday	90
2	Monday	155
	Tuesday	130
	Wednesday	123
	Thursday	132
	Friday	142
	Saturday	200
	Sunday	88

(a) Using the above data draw a time series graph of the sales. [3]

(b) Calculate the seven day moving averages correct to the nearest whole number. [4]

(c) Plot the moving average values on your time series and draw a trend line through the points. [3]

(d) The seasonal component for a Monday is 14.2. Estimate the sales realised by the shop on Monday of week 3. [6]