BINDURA UNIVERSITY OF SCIENCE EDUCATION

JUN 2025

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF STATISTICS AND MATHEMATICS

DG102/DMG102: STATISTICS FOR DEVELOPMENT STUDIES/STATISTICS FOR DISASTER MANAGEMENT STUDIES

DURATION: 3 HOURS **TOTAL MARKS: 100**

AUTHORISED AND REQUIRED MATERIALS

- **Calculator**
- **Formular booklet**
- **List of Statistical Tables**

INSTRUCTIONS TO CANDIDATES

Answer ALL questions in Section A and any TWO questions in Section B
The number of marks is indicated in brackets at the end of each question
Each question should start on a fresh page correctly numbered

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SECTION A [40 MARKS]

A1. Cartons of orange juice are advertised as containing 1 litre. A random sample of 100 cartons gave the following results for the volume, x.

$$\sum x = 101.4, \quad \sum x^2 = 102.83$$

Calculate the mean and the standard deviation of the volume of orange juice in these 100 cartons. [4]

A2. The pulse rates of 30 company directors were measured before and after taking exercise.

Before: 110,93, 81, 75, 73, 73, 48, 53, 69, 69, 66, 111, 105,93, 90, 50, 57, 64, 90, 111,91, 70, 70,51, 79,93, 105,51,66,93.

After: 117, 81, 77, 108, 130, 69, 77, 84, 84, 86,95, 125,96,104,104,137,143, 70,80, 131, 145, 106, 130, 109, 137,75, 104, 75, 97, 80. (Use class intervals 40-49,50-59,60-69)

Draw back-to-back stemplots for the following data. What conclusions can you draw? [5]

A3.

a. State two differences between bar charts and histogram. [2]
b. The following are the examination marks for a group of 120 first year statistics students.

Mark	0 – 9	10 – 19	20 – 29	30 – 49	50 – 79
Frequency	*8*	*21*	*53*	*28*	*10*

Represent the data in a histogram and comment on the shape of the distribution. [5]

A4. A bag contains four red counters and six black counters. A counter is picked at random from the bag and not replaced. A second counter is then picked. Find the probability that

(a) the second counter is red, given that the first counter is red, [2]
(b) both counters are red, [2]
(c) the counters are of different colors. [2]

A5. A and B are two independent events such that $P(A) = 0.2$ and $P(B) = 0.15$ .Evaluate the following probabilities:

(d) $P(A \mid B)$, [2]
(e) $P(A \, n \, B)$, [2]
(f) $P(A \, U \, B)$ [2]

A6. A manufacturer makes writing pens. The manufacturer employs an inspector to check the quality of his product. The inspector tested a random sample of the pens from a large batch and calculated the probability of any pen being defective as 0.025. Carmel buys two of the pens made by the manufacturer.

(a) Calculate the probability that both pens are defective. [3]
(b) Calculate the probability that exactly one of the pens is defective. [3]

A7. Independent random variables X and Y are such $E(X) = 4$, $E(Y) = 5$, $Var(X) = 1$, $Var(Y) = 2$.

(a) $E(4X + 2Y)$, [2]
(b) $Var(5Y - 3X)$ [2]

SECTION B [60 MARKS]

B8.

(a) The table displays data on age for a sample of cars. Ages are in years while prices are in thousands of dollars.

Age	5	4	6	5	5	5	6	6	2	7	7
Price	8.5	10.3	7.0	8.2	8.9	9.8	6.6	9.5	16.9	7.0	4.8

i. Plot the data on a scatter diagram and comment [8]

ii. Calculate the correlation coefficient of the data and interpret your result [5]

iii. Calculate the regression line for y on x [8]

(b) The discrete random variable X has probability function

$$P(X=x)=\begin{cases}\dfrac{kx}{(x^2+1)}, & x=2,3\\ \dfrac{2kx}{(x^2-1)}, & x=4,5\\ 0 & Otherwise\end{cases}$$

i. Show that the value of k is $\frac{20}{33}$ [3]

ii. Find the probability that X is less than 3 or greater than 4 [2]

iii. Find $E(X)$ *and* $Var(X)$. [4]

B9.

(a) A darts player practices throwing a dart at the bull's eye on a dart board. Independently for each throw, her probability of hitting the bull's eye is 0.2. Let X be the number of throws she makes, up to and including her first success.

i. Find the probability that she is successful for the first time on the third throw. [3]

ii. Write down the distribution of X and give the name of the distribution. [2]

iii. Write down the probability that she will have at least three failures before her first success. [3]

(b) In a survey on washing powder, it is found that the probability that a shopper chooses Soapysuds is 0.25. Find the probability that in a random sample of nine shoppers

i. exactly three choose Soapysuds, [3]

ii. more than seven choose Soapysuds. [3]

(c) On average 20% of the bolts produced by a machine in a factory are faulty. Samples of ten bolts are to be selected at random each day. Each bolt will be selected and replaced in the set of bolts which have been produced on that day.

i. Calculate, to two significant figures, the probability that, in any one sample, two bolts or less will be faulty. [3]

ii. Find the expected value and the variance of the number of bolts in a sample which will not be faulty. [3]

(d) An insurance company receives on average two claims per week from a particular factory. Assuming that the number of claims can be modelled by a Poisson distribution, find the probability that it receives

i. three claims in a given week, [2]

ii. four claims in a given fortnight, [4]

iii. no claims on a given day, assuming that the factory operates on a five-day week. [4]

B10.

(a) Eggs are packed into boxes of 500. On average 0. 7% of the eggs are found to be broken when the eggs are unpacked. Find, correct to two significant figures, the probability that in a box of 500 eggs,

i. exactly three are broken, [3]

ii. at least two are broken. [3]

(b) The time taken by the milkman to deliver to the High Street is normally distributed with a mean of 12 minutes and a standard deviation of 2 minutes. He delivers milk every day. Estimate the number of days during the year when he takes

i. longer than 17 minutes, [5]

ii. between nine and 13 minutes. [4]

(c) The masses of boxes of oranges are normally distributed such that 30% of them are greater than 4.00 kg and 20% are greater than 4.53 kg. Estimate the mean and standard deviation of the masses. [7]

(d) A number of different types of fungi are distributed at random in a field. Eighty % of these fungi are mushrooms, and the remainder are toadstools. Five % of the toadstools are poisonous. A man, who cannot distinguish between mushrooms and toadstools, wanders across the field and picks a total of 100 fungi. Determine, correct to two significant figures, using appropriate approximations, the probability that the man has picked

i. at least 20 toadstools, [4]

ii. exactly two poisonous toadstools. [4]

END OF PAPER