BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

DEPARTMENT: NATURAL RESOURCES

PROGRAMME: FAES PART 1 JUN 2024

COURSE CODE: NR 122: Introduction to Statistics

DURATION: 2 HOURS **TOTAL MARKS: 70**

INSTRUCTIONS TO CANDIDATES

Answer **THREE** questions out of the following five questions. You must answer question **One** from **SECTION A** and any **Two** questions from **SECTION B.** All answers should be rounded to 2 decimal places. The **List of Formulae** is at the end of the paper.

SECTION A (COMPULSORY)

1a) Define the following terms used in statistics

i) Population **[1 Mark]**
ii) Sample **[1 Mark]**
iii) Parameter **[1 Mark]**
iv) Statistic **[1 Mark]**
v) Variable **[1 Mark]**

b) Outline any three characteristics of a binomial distribution **[3 Marks]**

c) A mine safety team inspects the mine zero, one, or two days a week. The probability that they inspect zero days is 0.1, the probability that they inspect one day is 0.5, and the probability that they inspect two days is 0.4

i) Calculate the long term average of the number of days a week the mine safety team inspect the mine **[4 Marks]**
ii) Calculate the standard deviation **[2 Marks]**

d) A student at Bindura University recorded marks from a statistics test in a stem and leaf plot below,

STEM	LEAF
4	0,5,5,8,9
5	3,7,8
6	0,1,1,6,6,7,7,7,8,8,8,8,8,8,9
7	0,2,3
8	0,0,3,4

Calculate

i) Mean **[2 Marks]**
ii) Median **[2 Marks]**
iii) First and Third quartile **[4 Marks]**
iv) Interquartile range **[2 Marks]**

v) Write the R code you would use to calculate (i) to (iv) above. **[6 Marks]**

SECTION B

2. a) The average weight of sampled impala in a game ranch is normally distributed with a mean 63kgs and standard deviation of 5kgs.
Calculate

i) The probability that a randomly selected impala has a mass above 69kgs **[2 Marks]**

ii) The percentage of impala who weighed between 54 and 64 kgs **[3 Marks]**

b) A student wanted to see the effect of 2 diets A and B on the weight gain in goats at BUSE farm. The weight gain (kgs) of goats on two different diets were recorded in the table below

Diet A	24	25	32	31	33	14	30	28	20
Diet B	40	24	40	22	32	33	34	35	42

Test whether the mean increase in weight differs between diets at 5 % significant level. **[10 Marks]**

c) Distinguish between stratified random sampling and cluster sampling. **[5 Marks]**

3. a) A forestry manager wanted to test if forest work related accidents are based on gender of employees. He extracted the following data from Recorded accidents.

	Fire Accidents	Chainsaw Accidents	Chemical treatment Accidents
Male	9	23	18
Female	5	25	10

Test if there is a relationship between gender and work related accidents at 5 % significance level. **[10 Marks]**

b) Nakai was collecting data on the weight and height of captured elephants in a zoo for continuous health monitoring. She entered her data in R as follows;

ID = c("ele1", "ele2", ele3, ele4, ele5)

Height = c (2.3, 3.1, 3.6; 1.3; 1.87)

Weight = (245, 555, 376, 945, 819)

She created a data frame using the code; **data.frame(ID, Height, Weight)** and she got an error message.

i) Rewrite the R codes used by Nakai correcting the errors in them **[6 Marks]**

ii) Suppose Nakai want to use a t test to test the difference between weight and height of elephants, write down the R code she would use. **[4 Marks]**

4. A fire insurance company wants to relate the amount of fire damage in major residential fires to the distance between the residence and the nearest fire station. The study is conducted in a large suburb of a major city. A Sample of 12 recent fires in this suburb were studied and the results are Shown on the table below.

Sample	Distance (km)	Fire Damage
1	3.4	26.2
2	1.8	17.8
3	4.6	31.3
4	2.3	23.1
5	3.1	27.5
6	5.5	36
7	0.7	14.1
8	3.0	22.3
9	2.6	19.6
10	4.3	31.3
11	2.1	24
12	1.1	17.3

a) Construct a scatter diagram and comment on it. **[5 Marks]**

b) Estimate the linear regression equation and interpret the coefficients. **[12 Marks]**

c) Predict the fire damage if the distance is 3.8 km. **[3 Marks]**

5) A small environmental consultancy Eden SHEQ, receives on average 8 calls per hour.

a) Find the probability that the consultancy will receive exactly 7 calls in one hour. **[3 Marks]**

b) What is the probability that the consultancy receive at most 5 calls in one hour. **[5 Marks]**

c) What is the probability that the consultancy will receive more than 6 calls in one hour. **[2 Marks]**

d) EA sports believe that an average athlete finishes a 100 m race in over 9.54 seconds, ten athletes were timed for a 100-meter race and the results were as follows

8.75; 10.2; 11.4; 13.5; 12.1; 13.3; 11.2; 9.2; 9.5; 10.2

Assuming that the time is normally distributed with a standard deviation of 5.02, test EA sports' belief at 5% significant level. **[10 Marks]**

End of Paper

List of Formulae

Binomial Distribution $P(x) = nCx\ p^x\ q^{n-x}$

Where p is the probability of success and q is the probability of failure

Poison distribution $P(X=x) = \frac{\mu^x e^{-\mu}}{x!}$

Mean $\bar{X} = \frac{\Sigma x}{n}$

Standard Error of mean $= \frac{\sigma}{\sqrt{n}}$

Standard Deviation (σ) $= \sqrt{\frac{\Sigma(x-\bar{x})2}{n-1}}$

Variance (Var) $= (\sigma)^2$

One Sample t test $= \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}}$ **Z Test** $= \frac{x-\mu}{\sigma}$

Two Sample t test

$$t = \frac{(X_1 - X_2)}{\sqrt{\frac{(S_1)^2}{n_1} + \frac{(S_2)^2}{n_2}}}$$

Chi squared test $(x^2) = \Sigma \frac{(Oi-Ei)^2}{E}$

Straight line equation $y = a + bx$

$a = \bar{y} - b\bar{x}$ where $\bar{y} = \frac{\Sigma y}{n}$ and $\bar{x} = \frac{\Sigma x}{n}$ (n is the number of observations)

$$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$$

Product moment correlation coefficient $(r) = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{\sqrt{\Sigma(x-\bar{x})^2\Sigma(y-\bar{y})^2}}$