# BINDURA UNIVERSITY OF SCIENCE EDUCATION

## FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

**DEPARTMENT: NATURAL RESOURCES**

**PROGRAMME: FAES PART 1**

**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.**

## SECTION A (COMPULSORY)

**1**a) Define the following measurement scales using examples:

i) Nominal scale **[3 Marks]**
ii) Ordinal scale **[3 Marks]**
iii) Ratio scale **[3 Marks]**
iv) Interval scale **[3 Marks]**

b) The following data were obtained from examination marks scored in a Statistics examination by 30 students at Bindura University of Science Education.

84; 49; 61; 40; 83; 67; 45; 66; 70; 69; 80; 58; 68; 60; 67; 72; 73; 57; 53; 61; 68; 66; 68; 68; 67; 68; 48; 68; 45; 80

Calculate the following from the sample data above

i) Mean **[2 Marks]**

ii) Standard Deviation **[2 Marks]**

iii) Variance **[2 Marks]**

iv) Standard error of mean **[2 Marks]**

c) A researcher gathered the following data on different ages of participants in a study.

15; 17; 13; 18; 23; 22; 45; 33; 64; 51; 27; 22; 20; 55; 46

Write the r code for calculating the following using this data

i) Mean **[4 Marks]**
ii) Standard Deviation **[2 Marks]**
iii) First quartile **[2 Marks]**

iv) Third quartile **[2 Marks]**

**SECTION B**

**2.** a) Distinguish between type I and type II errors **[5 Marks]**

b) To test the efficacy of a new drug a controlled experiment was conducted. 300 dairy cows were administered with the new drug and 100 other cows were not given the drug. The cows were monitored and the results were obtained as follows.

| | Cured | Condition Worsened | No effect |
|---|---|---|---|
| Given Drug | 200 | 40 | 60 |
| Not Given Drug | 20 | 30 | 50 |

Use a Chi-Squared test to test the effect of the drug at 5% significant level. **[15 Marks]**

**3.** a) A hospital records weight of every new born child, the distribution of the weights is normally distributed, with the mean of 2.9kg and a standard deviation of 0.45.

i) Determine the percentage of new born babies who weighed between 1.8 kg and 4 kg **[3 Marks]**

ii) Determine the percentage of new born babies who weighed under 2.1 kg **[2 Marks]**

b) A student wanted to see the effect of 2 diets A and B on the weight gain in cows. The weight gain (kgs) of cows 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 **[15 Marks]**

**4.** The following are real data from Santa Clara County. As of a certain time, there had been a total of 3059 documented cases of AIDS in the county. They were grouped into the following categories.

| | Homosexual | IV drug user | Heterosexual contact | other |
|---|---|---|---|---|
| Female | 0 | 70 | 136 | 49 |
| Male | 2146 | 463 | 60 | 135 |

a) Suppose a person with AIDS in Santa Clara is randomly selected.

i) Find P (Person is Female) **[2 Marks]**

ii) Find P (Person has a risk factor of heterosexual contact) **[2 Marks]**

iii) Find P (Person is female or has a risk factor of IV Drug user) **[2 Marks]**

iv) Find P (Person is female and has a risk factor of homosexual) **[2 Marks]**

v) Find P (Person is female given the person got the disease from heterosexual contact) **[2 Marks]**

b)You buy a lottery ticket to a lottery that costs $10 per ticket. There are only 100 tickets available to be sold in this lottery. In this lottery there are one $500 prize, two $100 prizes, and four $25 prizes.
Find your expected gain or loss. **[5 Marks]**

c) There are only red marbles and green marbles in a bag. There are 18 red marbles and 12 green marbles. Dwayne takes at random a marble from the bag. He does not put the marble back in the bag. Dwayne takes at random a second marble from the bag.

i) Complete the probability tree diagram. **[3 Marks]**

ii) Find the probability that Dwayne picks a red ball first and a green ball second. **[2 Marks]**

**5.** A fire insurance company wants to relate the amount of fire damage in major residential fires to the dist...ce between the residence and the nearest fire station. The study is conducted in a large suburb ( 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]**

## 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

**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** $= \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}}$

**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** $(r) = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{\sqrt{\Sigma(x-\bar{x})2\Sigma(y-\bar{y})2}}$