

NATIONAL UNIVERSITY OF LESOTHO
FACULTY OF AGRICULTURE
DEPARTMENT OF SOIL SCIENCE AND RESOURCE CONSERVATION
SSR 213: BIOMETRICS I

DECEMBER 2014

MARKS = 100

INSTRUCTIONS

ANSWER QUESTIONS ONE AND TWO AND SELECT ANY OTHER TWO QUESTIONS

Question 1

a) Define the following terms (5 marks)

- Statistics
- Population
- Sample
- Parameter
- Statistic

b) Differentiate between nominal scale and ordinal scale (4 marks)

c) Write short notes on the types of variables (8 marks)

d) Write short notes on the following types of sampling (8 marks)

- Simple Random sampling
- Systematic sampling
- Stratified sampling
- Cluster sampling

Question 2

a) Construct a grouped frequency table for the following dataset(8 marks)

8, 9, 10, 12, 15, 18, 18, 21, 22, 22, 23, 24, 24, 25, 26, 27, 32, 35, 36, 37, 38, 41, 42, 43, 44, 45, 45, 46, 46, 47.

b) Using a grouped frequency table constructed in (a) above calculate the mean, mode and median of the data set (6 marks)

c) Write short notes on two measures of dispersion (4 marks)

d) The following are marks obtained by 18 students in statistics:

27, 28, 30, 31, 31, 33, 33, 33, 33, 33, 34, 35, 36, 40, 41, 41, 46, 55

Using these marks calculate the following:

- i. First quartile, third quartile and inter-quartile range (3 marks)
- ii. The 35th percentile of the marks (2 marks)
- iii. The percentile rank for a student who scored 36 marks (2 marks)

Question 3

- a) The probability that a student will pass soil physics this semester is 0.7 and the probability that he/she will pass statistics this semester is 0.9. If these events are independent, what is the probability that he/she will pass both soil physics and statistics? **(2 marks)**
- b) A farmer has ten cows tagged (marked) with numbers 1 – 10. A butcher is interested in buying a cow. What is the probability that the farmer will select a cow tagged with an odd number or an even number? Is this a mutually exclusive event or non-mutually exclusive? **(3 marks)**
- c) A group of people was asked whether they were left-handed or right-handed. The following table shows the results.

	Right-handed	Left-handed	Total
Male	0.41	0.08	
Female	0.45	0.06	
Total			

Find the probability that a randomly selected person is:

- i) Right-handed **(1 mark)**
 - ii) Left-handed **(1 mark)**
 - iii) A male **(1 mark)**
 - iv) A female **(1 mark)**
 - v) A male given that he is right-handed **(2 marks)**
 - vi) Right-handed given that he is a male **(2 marks)**
 - vii) A female given that she is left-handed **(2 marks)**
- d) State two properties of a probability distribution **(2 marks)**
- e) Consider the random variable X to be the number of heads obtained in three tosses of a coin.
- i) List all possible outcomes and numerical values of X **(4 marks)**
 - ii) Construct the probability distribution of X **(4 marks)**

Question 4

- a) For a standard normal random variable Z , find:
- $P [Z > 1.49]$ (2 marks)
 - $P [Z > - 1.49]$ (2 marks)
 - $P [Z < - 0.62]$ (1 mark)
- b) Suppose X is a normally distributed random variable with $\mu = 10$ and $\sigma=2$. Find
- The probability that X is greater than 7.34 (3 marks)
 - The probability that X is greater than 7.34 and less than 12.66(4 marks)
- c) A population consists of the five numbers 2, 3, 6, 8, 11. Samples of size $n = 2$ are randomly drawn with replacement from this population. Find
- The mean μ of the population(1 mark)
 - The standard deviation σ of the population(2 marks)
 - The mean, variance and standard deviation of the sample means (10 marks)

Question 5

a) The students at the university gave a statement that the average student must travel for *at least* 25 minutes in order to reach the university. The university admissions office obtained a random sample of 36 travel times from students and came up with a mean of 20.5 minutes. Therefore the admissions office claims that the travel time is less than 25 minutes. Assuming that the population standard deviation σ is 9.6 minutes test this claim at alpha $\alpha = 0.05$ by answering the following questions:

- i) State both the null and the alternative hypotheses? (2 marks)
- ii) Is the test an upper or lower tailed test (1 marks)
- iii) Determine the p – value (3 marks)
- iv) Based on the p – value does the admissions office has sufficient evidence to reject the student's statement? State reasons (5 marks)

b) What is the difference between Pearson's correlation coefficient and Spearman's rank correlation? (2 marks)

c) The table below shows the results of grain yield per rate of fertilizer. Calculate the Pearson's correlation coefficient and state your conclusion (4 marks)

Fertilizer rate (kg/ha)	0	30	50	75	100	125	150
Grain yield (kg/ha)	25	42	54	60	66	71	74

d) Determine the simple linear regression equation for fertilizer rate and grain yield (2 marks)

e) At an agricultural show 10 rams were ranked by a qualified judge and a trainee judge. Their rankings are shown in the table below. Compute the Spearman's rank correlation coefficient and state whether there is a strong agreement between the two judges (6 marks)

Ram	A	B	C	D	E	F	G	H	I	J
Qualified judge	1	2	3	4	5	6	7	8	9	10
Trainee judge	1	2	5	6	7	8	10	4	3	9

Additional information

a) **Pearson Correlation Coefficient:** $r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2] \times [n\sum y^2 - (\sum y)^2]}}$

b) **Spearman's Rank Correlation:** $r_s = 1 - \frac{6\sum D^2}{n(n^2 - 1)}$

c) **Simple linear regression parameters:** $b = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}$

$$a = \frac{\sum y}{n} - \frac{b\sum x}{n} = \bar{Y} - b\bar{X}$$

d) Rejection regions for Common Values of Alpha

Alternative Hypothesis

	Lower Tailed	Upper Tailed	Two Tailed
alpha = .10	$z < -1.28$	$z > 1.28$	$z < -1.645$ or $z > 1.645$
alpha = .05	$z < -1.645$	$z > 1.645$	$z < -1.96$ or $z > 1.96$
alpha = .01	$z < -2.33$	$z > 2.33$	$z < -2.575$ or $z > 2.575$