



MASENO UNIVERSITY
UNIVERSITY EXAMINATIONS 2013/2014

FIRST YEAR SECOND SEMESTER EXAMINATIONS FOR THE
DEGREE OF MASTER OF SCIENCE IN ENVIRONMENTAL
SCIENCE
(CITY CAMPUS)

NES 828: ENVIRONMENTAL SYSTEMS ANALYSIS

Date: 8th April, 2014

Time: 9.00 - 12.00 noon

INSTRUCTIONS:

- Answer ANY FOUR questions.
- Illustrate your answers with suitable examples, diagrams and figures wherever appropriate.



1. (a) Describe the application of parametric and non-parametric tests in the analysis of environmental data. [4 marks]
- (b) Two areas with very different farming regimes and environments were selected, and data on the numbers of plant species were collected by sampling a 32m length of 15 different hedgerows in Kisumu and 13 similar lengths in Kakamega. The numbers of higher plant species in each of these lengths are shown in the table below.

No. of higher plant species in a 32m-length of hedge	
Kakamega	Kisumu
28	14
27	20
33	16
23	13
24	18
17	21
25	23
23	20
31	14
23	20
23	20
22	14
15	11
	16
	13

Use the Mann-Whitney U test to test the hypothesis that there was no difference between the numbers of species in the samples of hedgerows from the two towns. Use $\alpha = 0.05$ level of significance. [7 marks]

(Note: critical value for a one-tailed test is 61)

- (c) Using the data in the table below, calculate the point-biserial correlation coefficient, r_{pb} , between the present or absence of *Pteridium aquilinum* and % soil moisture and test the significance of r_{pb} . [5 marks]

Presence (P) or Absence (A)	% soil moisture
A	85.2
P	55.9
A	95.2
A	58.1
P	54.9
A	89.4
P	68.2
P	46.8
A	54.8
A	92.2
A	90.7
P	30.2
P	35.2
A	90.3
A	95.6
A	91.5
A	55.4
P	35.5
P	42.1
A	49.3

(Note: $\alpha = 0.01$, critical t value at 24 degrees of freedom = 2.49, and critical t value at 18 degrees of freedom = 2.55)

2. Suppose Municipal Council of Kisumu consults you to identify for them one site for dumping solid wastes out of four potential alternative sites found in Obambo, Mambo Leo and Kibos within the municipality.
- (a) Explain FOUR criteria which can help you to select the most suitable site for dumping solid wastes. [4 marks]
- (b) Illustrate analytical hierarchy process diagrams. [6 marks]

- (c) Describe how you can use fundamental scale for pairwise comparisons and judgment table to select the best suitable site for dumping solid wastes. [5 marks]

3. An environmentalist is interested in the relation between a chemical pollutant concentration (in parts per million) and the growth of fish in terms of bodyweight (g) in five streams. The mean chemical pollutant concentration (in parts per million) and mean body weight of fish in five streams is as follows:

Stream	1	2	3	4	5
Chemical pollutant concentration (ppm)	95	85	80	70	60
Mean bodyweight (g) of fish	85	95	70	65	70

- (a) What linear regression equation best predicts body weight of fish, based on chemical pollutant concentration? [4 marks]
- (b) Calculate the coefficient of determination [2 marks]
- (c) Discuss the role of the coefficient of determination, standard error, Outliers and influential points in regression analysis. [9 marks]
4. (a) An experiment to study how noise pollution affects the performance of pupils tested second grade hyperactive pupils and a control group of second graders who were not hyperactive. One of the tasks involved solving mathematics problems. The pupils solved problems under both high noise and low noise conditions. The mean scores from the three streams are as follows:

Group	High Noise	Low Noise
Control	214	170
	210	168
	211	174
Hyperactive	120	140
	112	135
	128	144

- (i) Calculate the means and marginal means of mathematics scores of control and hyperactive pupil under low and high noise conditions. [3 marks]
- (ii) Plot the mean mathematics scores of control and hyperactive pupil under low and high noise conditions. Describe the pattern. [3 marks]
- (iii) Discuss the main effects and interactions. [5marks]

- (b) An ecologist is interested in comparing the concentration of the pollutant cadmium in five streams. The mean concentrations of cadmium in five streams are as follows:

Stream	1	2	3	4	5
Cadmium concentration (ppm)	29.1	28.9	29.6	28.7	27.5

- (i) Give the hypothesis to be tested. [1 mark]
- (ii) Interpret the results of ANOVA. [3 marks]

Source of Variation	Sum of squares(SS)	Degree of freedom(df)	Mean squares (MS)	F-calculated	P-value	F-critical
Between groups	620.944	1	620.944	399.578	4.09	5.3177
Within groups	12.432	8	1.554			
Total	633.376	9				

5. The table below shows plant species richness and site age (in months) from 26 vacant urban plots in Nairobi City.

Site	Species	
	richness (Y_i)	Plot age (X_i)
1	11	3
2	9	3
3	16	7
4	27	15
5	21	18
6	32	20
7	22	20
8	16	20
9	15	20
10	26	22
11	25	25
12	15	30
13	30	30
14	45	40
15	22	50
16	56	65
17	47	70
18	20	70
19	45	80
20	44	90
21	54	100
22	47	100
23	37	100
24	69	113
25	46	120
26	47	150

- (a) Calculate the product-moment correlation coefficient, r , for data on plant species richness and site age and test the significance of r . [8 marks]
- (b) Calculate the Spearman's rank correlation, r_s , for data on plant species richness and test the significance of r_s . [7 marks]

6. (a) A public opinion poll surveyed a simple random sample of 1000 residents of two urban estates to select the best solid wastes management method. The estates were classified by social status and by solid wastes management method preference. Results are shown in the contingency table below.

	Solid wastes management method preferences		
	Composting	Sanitary landfill	Open dumps
Low class	200	150	50
High class	250	300	50

Do the low class estate's voting preferences differ significantly from the high class estate's preferences? Use $\alpha = 0.05$ level of significance. [8 marks]

(Note: $P(X^2 > 19.91) = 0.0000$; $P(X^2 > 16.2) = 0.0003$)

- (b) A drug manufacturing company develops a new drug, designed to prevent colds. The company states that the drug is equally effective for men and women. To test this claim, they choose a simple random sample of 100 women and 200 men from a population of 100,000 volunteers. At the end of the study, 38% of the women caught a cold; and 51% of the men caught a cold. Test the company's claim that the drug is equally effective for men and women? Use $\alpha = 0.05$ level of significance. [7 marks]

(Note: $P(z < -2.13) = 0.017$ and $P(z > 2.13) = 0.017$)