MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2015/2016

THIRD YEAR SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN ENVIRONMENTAL SCIENCE WITH INFORMATION TECHNOLOGY

MAIN CAMPUS

NES 312: ENVIRONMENTAL STATISTICS II

Date: 28th April, 2016 Time: 11.00 - 1.00 pm

INSTRUCTIONS:

- Answer question ONE and any other TWO questions.
- Illustrate your answers with suitable examples, diagrams and figures wherever appropriate.

1 (a) By giving examples, discuss the applications of the following in environmental data analyses

(i) Chi-square goodness of fit test [3 marks]
(ii) Chi-square test of homogeneity [3 marks]
(iii) Chi-square test of independence [4 marks]

(b) Two areas with 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. [10 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_p, between the presence (P) or absence (A) of *Sesbania sesban* and % soil moisture and test the significance of r_p, [10 marks]

A or P	A P A A P A P P A A A P P A A A A P P A
% soil moisture	85, 56, 95 ,58, 55, 89, 68, 47, 55, 92, 91, 30, 35, 90, 96, 92, 55, 36, 42, 49

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

2. (a) (i) Describe the methods of transforming variables to achieve linearity. [3 marks]

(ii) Explain how you can perform a transformation to achieve linearity and illustrate successful transformation. [3 marks]

(b) 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 in table 2b:

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

i. Calculate coefficient of determination and linear regression equation that best predicts mean bodyweight of fish, based on chemical pollutant concentration. [6 marks]

ii. Explain the role of the coefficient of determination, residual analysis, Outliers and influential points in regression analysis. [8 marks]

3. The table below shows plant species richness and habitat age (in months) from 26 vacant urban plots in Kisumu City.

Plant species richness	Habitat age
11	3
9	3
16	7
27	15
21	18
32	20
22	20
16	20
15	20
26	22
25	25
15	30
30	30
45	40
22	50
56	65
47	70
20	70
45	80
44	90
54	100
47	100
37	100
69	113
46	120
47	150

(a) Calculate the product-moment correlation coefficient for data on the number of herbivore species and number of individuals of shrubs and test the statistical significance. [10 marks]

(b) Calculate the Spearman's rank correlation for data on the number of herbivore species and number of individuals of shrubs and test the statistical significance. [10 marks]

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

4. The table below shows the mean amount of solid wastes generated in two residential urban estates in terms of kilograms for 25 days.

Amount of solid wastes generated (kg)	
Estate A	Estate B
54.7	37.5
49.5	45.6
56.2	59.4
63.1	46.7
54.8	42.8
54.3	43.6
55.7	48.2
51.2	44.5
56.6	49.1
58.2	50.6
54.5	41.8
53.5	38.8
54.2	39.7
60.1	41.6
59.7	42.1
57.6	44.3
56.2	43.2
53.1	48.9
53.1	37.1
52.9	45.3
56.4	46.4
61.2	47.1
57.3	44.3
58.4	43.7
50.3	40.4

(a) Assuming a significance level of 0.05 and critical t value is 1.68, test hypothesis that there is no difference between the sample means for Estate A and Estate B. [15marks]

(b) Discuss the applications of t-test for difference between the means of independent samples and t-test for paired samples. [5 marks]

5. (a) Kenya Power Company wants to reduce the use of electric energy. Will meters reduce electricity use or chart for monitoring electricity use? The company finds 80 single-family residences in Kisumu City willing to participate, so it assigns 20 residences at random to each of the four treatments. Give an outline of the design of the experiment comparing two approaches. [6 marks]

(b) The progress of viral disease differs in lion and lioness. An experiment is set to compare four treatments for this viral disease. Two separate randomization are done, one assigning the lion subjects to the treatments and other assigning the lioness subjects. Design the experiment. [6 marks]

(c) Discuss bias in survey sampling and quality of survey results. [8 marks]

6. The table 6 below shows productivities of plant species in fertilized plots and unfertilized plots on top Mt. Kenya. Productivity in g/m^2 day obtained by dividing peak biomass of each species by time from last frost to that biomass.

(a) Assuming a significance level of 0.05 and critical t value is 1.74, test hypothesis that there is no difference between the productivities. [10 marks]

(b) Assuming a significance level of 0.01 and critical T value is 32, test hypothesis that the productivities in fertilized plots is greater than is greater than in unfertilized plots. [10 marks]

Table 6: Productivities of plant species in fertilized plots and unfertilized plots on top Mt. Kenya.

Plant species	Unfertilized (control) plot (U)	Fertilized (treated) Plot (F)
A	0.034	0.247
B	0.244	0.096
C	0.041	0.146
D	0.310	0.365
E	0.062	0.088
F	0.001	0.055
G	0.441	0.385
H	0.592	0.626
I	0.387	0.911
J	1.369	1.510
K	0.260	0.208
L	0.610	0.773
M	0.054	0.116
N	0.843	1.967
O	0.201	0.097
Q	0.278	0.148
R	0.156	0.197
S	0.100	0.151