



# MASENO UNIVERSITY

## UNIVERSITY EXAMINATIONS 2011/2012

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

### **NES 828: ENVIRONMENTAL SYSTEMS ANALYSIS**

*Date: 18<sup>th</sup> April, 2012*

*Time: 9.00 – 12.00 noon*

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#### **INSTRUCTIONS:**

- ◆ Answer ANY FOUR questions.

1. The table below shows the daily solid waste generated in two residential urban estates in kilograms for 25 days.

Amount of solid waste 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) Calculate the means and standard deviations of solid waste generated in the two estates. [4 marks]
- (b) Construct the stem and leaf plots for the solid waste generated in the two estates. [4 marks]

- (c) Draw the boxplots for solid waste generated in the two estates. [3 marks]
- (d) Interpret the results of the boxplots, stem and leaf plots in environmental data analyses. [4 marks]

2. (a) Within a National Park, endangered animal species were randomly assigned to sanctuary A and sanctuary B at the beginning of the year. After breeding, sanctuary A had 30 individuals and sanctuary B had 25 individuals. At the end of the year, sanctuary A had an average of 78 individuals, with a standard deviation of 10; and sanctuary B had an average of 85, with a standard deviation of 15. Test the hypothesis that sanctuary A and sanctuary B are effective habitats for conserving endangered species. Use  $\alpha = 0.10$  level of significance. [7 marks]

**(Note:  $P(t < -1.99) = 0.027$ , and  $P(t > 1.99) = 0.027$ )**

- (b) The table below shows data relating levels of air pollution to the level of industrialization. The data indicate reported cases of air pollution in less, middle and high industrialized regions.

Air Pollution	Less industrialised	Middle industrialized	High industrialized
High	200	400	700
Medium	500	900	400
Low	800	300	100

Use appropriate measure to calculate statistical association between levels of air pollution to the level of industrialization. Explain the implications of the associations. [8 marks]

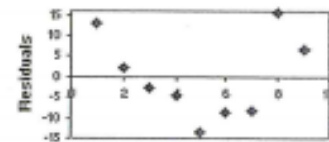
3. An environmentalist is interested in the relationship between a chemical pollutant concentration (in parts per million) and the growth of fish in terms of bodyweight (g) in five streams. The table below gives data obtained:

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) How well does the regression equation fit the data? [2 marks]
- (c) Discuss the role of the coefficient of determination, standard error, outliers and influential points in regression analysis. [9 marks]

4. (a) The table below on the left shows data for independent and dependent variables - x and y, respectively. While the graph on the right shows the result of residual analysis.

x	1	2	3	4	5	6	7	8	9
y	2	1	6	14	15	30	40	74	75



- (i) What indicates that the relation between x and y is nonlinear? [2 marks]
- (ii) Explain how you can perform a transformation to achieve linearity. [3 marks]
- (b) A researcher surveys 101 randomly selected plots in a national park. For each plot, the researcher collects the following: number of individual herbivores (NIH) and biomass (g). Outputs from a regression analysis are shown below.

Regression equation: $NIH = 0.55 * \text{Biomass} + 15$				
Predictor	Coeff.	SE Coeff	T	P
Constant	15	3	5.0	0.00
Biomass	0.55	0.24	2.29	0.01

- (i) What is the 99% confidence interval for the slope of the regression line? [5 marks]
- (ii) Is there a significant linear relationship between number of individual herbivores (NIH) and biomass? Use  $\alpha = 0.05$  level of significance. [5 marks]

(Note: critical value of t-score at 99 degrees of freedom and 99% confidence level= 2.63;  $P(t > 2.29) = 0.0121$  and  $P(t < -2.29) = 0.0121$ )

5. (a) An experiment to study how noise pollution affects the performance of pupils tested a group of hyperactive pupils against a control of hyperactive ones involving solving mathematics problems under both high noise and low noise conditions. The mean scores from the three streams are as follows:

Group	Stream	High noise	Low noise
Control	1	214	170
	2	210	168
	3	211	174
Hyperactive	1	120	140
	2	112	135
	3	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) In a study comparing the concentration of the pollutant cadmium in five streams  
The mean values were 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 for mean values of cadmium in five streams  
in the table below.

[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				

6. (a) A public opinion poll surveyed a simple random sample of 1000 residents of two urban estates to select the best solid waste management method. The estates were classified by social status and by solid wastes management method preference. Results of number of individuals who voted 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 common 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  $P(z > 2.13) = 0.017$ )**