JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF SPATIAL PLANNING

UNIVERSITY EXAMINATION FOR THE DEGREE OF MASTER OF ARTS IN PROJECT PLANNING AND MANAGEMENT

SEMESTER 2022/2023 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: APP 802

COURSE TITLE: QUANTITATIVE METHODS

EXAM VENUE: **STREAM: SPATIAL PLANNING**

DATE: **EXAM SESSION:**

TIME: 3 HOURS

Instructions:

1. **Answer question 1 (compulsory) and ANY other 2 questions.**
2. **Candidates are advised not to write on the question paper.**

1.**Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION 1

a) The ages, in years, of the faculty members of a university biology department are **32.2, 37.5, 41.7,53.8,50.2,48.2,46.3,65.0,** and **44.8**.

   i) Calculate the mean age of these nine faculty members **(2 Marks)**

   ii) Calculate the median of the ages **(2 Marks)**

   iii) If the person 65.0 years of age retires and is replaced on the faculty with a person 46.5 years old, what is the new mean age? **(2 Marks)**

   iv) What is the new median age? **(2 Marks)**

b) Five body weights, in grams, collected from a population of rodent body weights are:

   66.1,77.1,74.6,61.8,71.5.

   i) Compute the "sum of squares" and the variance of these data using the following equations respectively:

$$\text{sample SS} = \sum(X_i - \overline{X})^2$$

(5 Marks)

$$s^2 = \frac{\sum(X_i - \overline{X})^2}{n - 1}$$

(5 Marks)

   ii) Compute the "sum of squares" and the variance of these data by using the following equations respectively:

$$\text{sample SS} = \sum X_i^2 - \frac{(\sum X_i)^2}{n}$$

(5 Marks)

$$s^2 = \frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n - 1}$$

(5 Marks)

   iii) Outline the advantages of using the "machine formula" **(2 Marks)**

QUESTION 2

Using any typical examples from planning, compare and contrast the application of Principal Component Analysis (PCA) and Factor Analysis (FA) under the following headings:

i) Data requirements **(3 Marks)**

ii) Application of the methods **(4 Marks)**

ii) Methods of extraction of the relationships and distances **(5 Marks)**

iii) New PCs and Grouping of variables and **(3 Marks)**

iv) Interpretation of results **(5 Marks)**

QUESTION 3

Using illustrations and given the following equations:

a) $Y_i = \alpha + \beta X_i.$

b) $Y_i = \alpha + \beta X_i + \epsilon_i$

c) $\sum X_i^2$

d) $\sum_{i=1}^{n} (Y_i - \hat{Y}_i)^2$

e) $\sum X_i^2 - \frac{(\sum X_i)^2}{n}$

f) $\sum xy = \sum (X_i - \overline{X})(Y_i - \overline{Y})$

g) $\sum xy = \sum X_i Y_i - \frac{(\sum X_i)(\sum Y_i)}{n}$

h) $b = \frac{\sum xy}{\sum x^2} = \frac{\sum (X_i - \overline{X})(Y_i - \overline{Y})}{\sum (X_i - \overline{X})^2} = \frac{\sum X_i Y_i - \frac{(\sum X_i)(\sum Y_i)}{n}}{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}$

Discuss:

ii) The bivariate simple linear regression **(8 Marks)**

ii) The "best fit" using the concept least squares **(8 Marks)**

iii) The regression coefficient and its interpretation **(4 Marks)**

QUESTION 4

Suppose you are a planner and you believe that Land Sizes in the Bondo Sub-County has gotten smaller over the past few years. You would like to determine whether any association exists between the **Land Size** and m^2, **Value (KES'0000)** as well as whether there is a **Location** effect. Land Size is coded as 1 if < 10 m^2, 2 = 10 to 30 m^2, and 3 = 31 to 60 m^2. Using the statistical outputs below, interpret and discuss the results of this analysis. **(20 Marks)**

Ordinal Logistic Regression: Land Size versus Location, Value

a) **Link Function:** Logit

b) **Response Information**

Variable	Value	Count
Land Size	1	15
	2	46
	3	12
	Total	73

c) Factor Information

Factor	Levels	Values
Location	2	1, 2

d) Logistic Regression Table

					Odds	95% CI	
Predictor	Coef	SE Coef	Z	P	Ratio	Lower	Upper
Const(1)	-7.04343	1.68017	-4.19	0.000			
Const(2)	-3.52273	1.47108	-2.39	0.017			
Location							
2	0.201456	0.496153	0.41	0.685	1.22	0.46	3.23
Value	0.121289	0.0340510	3.56	0.000	1.13	1.06	1.21

e) Log-Likelihood = -59.290

f) Test that all slopes are zero: G = 14.713, DF = 2, P-Value = 0.001

g) Goodness-of-Fit Tests

Method	Chi-Square	DF	P
Pearson	122.799	122	0.463
Deviance	100.898	122	0.918

h) Measures of Association:(Between the Response Variable and Predicted Probabilities)

Pairs	Number	Percent	Summary Measures	
Concordant	1126	79.2	Somers' D	0.59
Discordant	288	20.3	Goodman-Kruskal Gamma	0.59
Ties	8	0.6	Kendall's Tau-a	0.32
Total	1422	100.0		

QUESTION 5

Given the following data on forest cover on forest cover at five locations over a 50-year period, demonstrate the procedure of testing the null hypothesis that there is no variation in forest cover among the five sites if $F_{0.05(1),3,15} = 3.29$, show the following steps in your calculations:

	Time		For1	For2	For3	For4
	Yr10		60.8	68.7	69.6	61.9
	Yr20		67.0	67.7	77.1	64.2
	Yr30		65.0	75.0	75.2	63.1
	Yr40		68.6	73.3	71.5	66.7
	Yr50		61.7	71.8		60.3
i		=	**1**	**2**	**3**	**4**
n		=	**5**	**5**	**4**	**5**
$\sum_{j=1}^{n_i} X_{ij}$		=	**323.1**	**356.5**	**293.4**	**316.2**
$\overline{X_i}$		=	**64.62**	**71.30**	**73.35**	**63.24**

$\sum_{i=1}^{k}\sum_{j=1}^{n_i} X_{ij}$	=	**1289.2**
$\bar{X}_{ij}$	=	**67.9**
$\text{Total SS} = \sum_{i=1}^{k}\sum_{j=1}^{n_i}(X_{ij} - \bar{X})^2$	=	**479.7**
$\text{groups SS} = \sum_{i=1}^{k} n_i(\bar{X}_i - \bar{X})^2$	=	**338.9**
$\text{within-groups (error) SS} = \sum_{i=1}^{k}\left[\sum_{j=1}^{n_i}(X_{ij} - \bar{X}_i)^2\right]$	=	**140.8**

Within-groups (error) SS	= Total SS - Groups SS = 479.6874 - 338.9373 = 140.7501
Total DF	= N-1 = 19 – 1 = 18
Group DF	= k – 1= 4 – 1 = 3
Within-groups (error) DF	= N - k = 19 - 4 = 15
Within-groups (error) DF	= Total DF - Groups DF = 18 - 3 = 15

i) Group mean squares (MS) **(5 Marks)**

ii) Error mean squares (MS) **(5 Marks)**

iii) F-statistic **(5 Marks)**

iv) Interpretation of the above results **(5 Marks)**

SN	OTHER USEFUL FORMULAE
1.	$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$ or $\bar{X} = \frac{\sum X_i}{n}$
2.	$\bar{X} = \frac{\sum_{i=1}^{k} f_i X_i}{n}$
3.	$\text{sample median} = X_{(n+1)/2}.$
4.	$\text{median} = \left(\begin{array}{c}\text{lower limit}\\ \text{of interval}\end{array}\right) + \left(\frac{0.5n - \text{cum. freq.}}{\text{no. of observations in interval}}\right)\left(\begin{array}{c}\text{interval}\\ \text{size}\end{array}\right)$
5.	$\text{sample range} = \text{largest } X - \text{smallest } X.$
6.	$\text{sample SS} = \sum X_i^2 - \frac{\left(\sum X_i\right)^2}{n}$
7.	$\text{sample SS} = \sum f_i X_i^2 - \frac{(\sum f_i X_i)^2}{n}$
8.	$s^2 = \frac{\sum (X_i - \bar{X})^2}{n - 1}.$

9. $$s^2 = \frac{\sum X_i^2 - \frac{\left(\sum X_i\right)^2}{n}}{n - 1}$$

10. $$s = \sqrt{\frac{\sum X_i^2 - \frac{\left(\sum X_i\right)^2}{n}}{n - 1}}.$$
