JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF SPATIAL PLANNING AND NATURAL RESOURCE MANAGEMENT

UNIVERSITY EXAMINATION FOR THE DEGREE OF MASTER OF PLANNING
1ST YEAR 1ST SEMESTER 2024/25 APRIL/MAY EXAMS

MAIN CAMPUS

COURSE CODE: PPM 5103

COURSE TITLE: QUANTITATIVE METHODS

ACADEMIC YEAR: 2024/2025 **SEMESTER:** I

VENUE-------- **YEAR OF STUDY:** I

DATE: 22/4/2024
SESSION: 9.00-12.00
TIME: 3HOURS

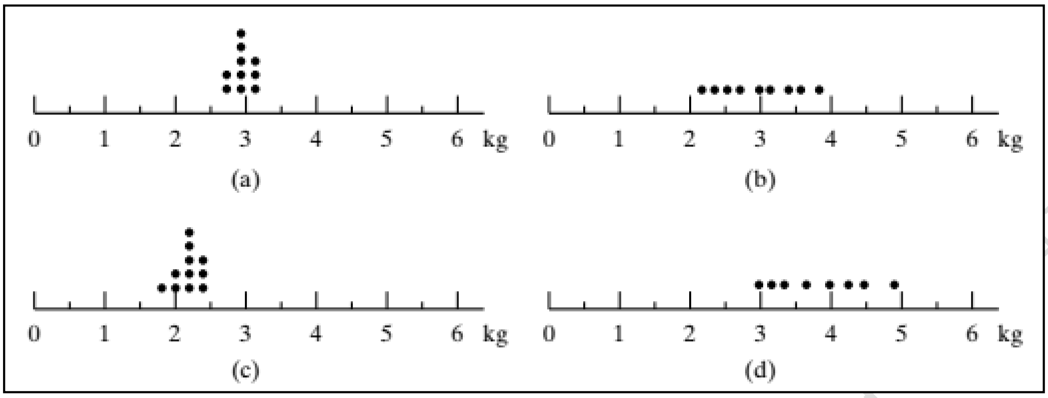
Instructions:

1. **Answer QUESTION ONE and ANY OTHER TWO questions**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

QUESTION 1

a) Using typical examples, explain the data types measured in interval scale: (6 Marks)

b) Given the following diagram, explain the difference between precision and accuracy (4 Marks)



c) Consider the following data, which are a sample of upmarket property rental values in KES '000: 240.6, 238.2, 236.4, 244.8, 240.7, 241.3, 237.9.

i) Determine the range of the data (1 Marks)

ii) Calculate the "sum of squares" of the data. (5 Marks)

iii) Calculate the variance of the data. (2 Marks)

iv) Calculate the standard deviation of the data. (2 Marks)

QUESTION 2

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			
$\overline{X}_{ij}$	=	67.9			
Total SS $= \sum_{i=1}^{k}\sum_{j=1}^{n_i}(X_{ij} - \overline{X})^2$	=	479.7			

$$\text{groups SS} = \sum_{i=1}^{k} n_i(\overline{X}_i - \overline{X})^2 \quad = \quad \mathbf{338.9}$$

$$\text{within-groups (error) SS} = \sum_{i=1}^{k}\left[\sum_{j=1}^{n_i}(X_{ij} - \overline{X}_i)^2\right] \quad = \quad \mathbf{140.8}$$

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)**

QUESTION 3

Given the following information, discuss Pearson's Product Moment Correlation Coefficient based on:

a) Principles in bivariate correlation **(4 Marks)**
b) The boundary limits of r **(4 Marks)**
c) Contrast with regression **(4 Marks)**
d) Coefficient of determination r^2 **(4 Marks)**
e) Standard Error **(4 Marks)**

Wing length (cm) (X)	*Tail length* (cm) (Y)
10.4	7.4
10.8	7.6
11.1	7.9
10.2	7.2
10.3	7.4
10.2	7.1
10.7	7.4
10.5	7.2
10.8	7.8
11.2	7.7
10.6	7.8
11.4	8.3

$n = 12$

$\sum X = 128.2 \text{ cm}$ $\quad \sum Y = 90.8 \text{ cm}$

$\sum X^2 = 1371.32 \text{ cm}^2$ $\quad \sum Y^2 = 688.40 \text{ cm}^2$ $\quad \sum XY = 971.37 \text{ cm}^2$

$\sum x^2 = 1.7167 \text{ cm}^2$ $\quad \sum y^2 = 1.3467 \text{ cm}^2$ $\quad \sum xy = 1.3233 \text{ cm}^2$

$$\text{correlation coefficient} = r = \frac{1.3233 \text{ cm}^2}{\sqrt{(1.7167 \text{ cm}^2)(1.3467 \text{ cm}^2)}} = 0.870$$

$$\text{coefficient of determination} = r^2 = 0.757$$

QUESTION 4

Five body weights, in grams, collected from a population of rodent body weights are: 66.1, 77.1, 74.6, 61.8, 71.5.

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

$$\text{sample SS} = \sum(X_i - \overline{X})^2$$ **(4 Marks)**

$$s^2 = \frac{\sum(X_i - \overline{X})^2}{n - 1}$$ **(4 Marks)**

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

$$\text{sample SS} = \sum X_i^2 - \frac{(\sum X_i)^2}{n}$$ **(4 Marks)**

$$s^2 = \frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n - 1}$$ **(4 Marks)**

c) **Outline the advantages of using the "machine formula"** **(4 Marks)**

QUESTION 5

a) **The following computer-based analysis shows the characteristics of 14 census tracts: total population (Pop), median years of schooling (School), total employment (Employ), employment in health services (Health), and median home value (Home). You would like to investigate what "factors" might explain most of the variability. (8 Marks)**

Unrotated Factor Loadings and Communalities

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Communality
Pop	-0.972	-0.149	0.006	0.170	-0.067	1.000
School	-0.545	-0.715	-0.415	-0.140	0.001	1.000
Employ	-0.989	-0.005	0.089	0.083	0.085	1.000
Health	-0.847	0.352	0.344	-0.200	-0.022	1.000
Home	0.303	-0.797	0.523	0.005	0.002	1.000
Variance	3.0289	1.2911	0.5725	0.0954	0.0121	5.0000
% Var	0.606	0.258	0.114	0.019	0.002	1.000

Sorted Unrotated Factor Loadings and Communalities

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Communality
Employ	-0.989	-0.005	0.089	0.083	0.085	1.000
Pop	-0.972	-0.149	0.006	0.170	-0.067	1.000
Health	-0.847	0.352	0.344	-0.200	-0.022	1.000
Home	0.303	-0.797	0.523	0.005	0.002	1.000
School	-0.545	-0.715	-0.415	-0.140	0.001	1.000
Variance	3.0289	1.2911	0.5725	0.0954	0.0121	5.0000

% Var	0.606	0.258	0.114	0.019	.002	1.000

Factor Score Coefficients

Variable	Factor1	Factor2	Factor3	Factor4	Factor5
Pop	-0.321	-0.116	0.011	1.782	-5.511
School	-0.180	-0.553	-0.726	-1.466	0.060
Employ	-0.327	-0.004	0.155	0.868	6.988
Health	-0.280	0.272	0.601	-2.098	-1.829
Home	0.100	-0.617	0.914	0.049	0.129

b) Given the following information:

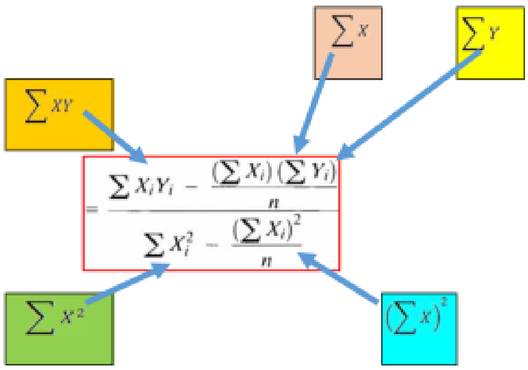
- **i) Discuss the concept of linear regression** — **8 Marks**
- **ii) Compute the regression coefficient "b)** — **1 Marks**
- **iii) Compute the Y-intercept "a"** — **1 Marks**
- **iv) Provide an interpretation of both "b" and "a"** — **2 Marks**

	SN	X_i	Y_i	X_i^2	X_iY_i
	1	3	1.4	9	4.2
	2	4	1.5	16	6.0
	3	5	2.2	25	11.0
	4	6	2.4	36	14.4
	5	8	3.1	64	24.8
	6	9	3.2	81	28.8
	7	10	3.2	100	32.0
	8	11	3.9	121	42.9
	9	12	4.1	144	49.2
	10	14	4.7	196	65.8
	11	15	4.5	225	67.5
	12	16	5.2	256	83.2
	13	17	5.0	289	85.0

$\bar{X}$		10			
$\bar{Y}$			3.415		
$\sum x$		130			
$\sum y$			44.4		
$(\sum x)^2$		16900			
$\sum x^2$				1562	
$\sum xy$					514.8

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

$$= \frac{\sum X_iY_i - \frac{(\sum X_i)(\sum Y_i)}{n}}{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}$$



$$a = \bar{Y} - b\bar{X}$$

SN	USEFUL FORMULAE
1.	$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$ or $\overline{X} = \frac{\sum X_i}{n}$
2.	$\overline{X} = \frac{\sum_{i=1}^{k} f_i X_i}{n}$
3.	$r = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}}$
4.	$r = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{\left(\sum X^2 - \frac{(\sum X)^2}{n}\right)\left(\sum Y^2 - \frac{(\sum Y)^2}{n}\right)}}$
5.	$\text{sample SS} = \sum X_i^2 - \frac{\left(\sum X_i\right)^2}{n}$
6.	$\text{sample SS} = \sum f_i X_i^2 - \frac{(\sum f_i X_i)^2}{n}$
7.	$s^2 = \frac{\sum (X_i - \overline{X})^2}{n - 1}$
8.	$s^2 = \frac{\sum X_i^2 - \frac{\left(\sum X_i\right)^2}{n}}{n - 1}$
9.	$s = \sqrt{\frac{\sum X_i^2 - \frac{\left(\sum X_i\right)^2}{n}}{n - 1}}$