



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCE

DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY

BACHELOR OF SCIENCE (HONOURS) DEGREE IN APPLIED BIOTECHNOLOGY

RESEARCH METHODS AND STATISTICS (SBT2201)

Main Examination Paper

MARCH 2025

This Examination Paper consists of 5 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Graph Paper, Statistical Tables, Calculators

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### INSTRUCTIONS

1. Answer (4) Questions. Where a question contains subdivisions, the mark value for each subdivision is given in brackets.
2. Illustrate your answer where appropriate with large, clearly labelled diagrams.

### MARK ALLOCATION

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5	25
6	25
<b>TOTAL</b>	<b>100</b>

1. It is hypothesized that there are fluctuations in norepinephrine (NE) levels which accompany fluctuations in affect with bipolar affective disorder (manic-depressive illness). Thus, during depressive states, NE levels drop; during manic states, NE levels increase. To test this relationship, researchers measured the level of NE by measuring the metabolite 3-methoxy-4-hydroxyphenylglycol (MHPG) in micro gram per 24 hour in the patient's urine experiencing varying levels of mania/depression. Increased levels of MHPG are correlated with increased metabolism (thus higher levels) of central nervous system NE. Levels of mania/depression were also recorded on a scale with a low score indicating increased mania and a high score increased depression. The data is provided below.

<u>MHPG</u>	<u>Affect</u>
980	22
1209	26
1403	8
1950	10
1814	5
1280	19
1073	26
1066	12
880	23
776	28

- (a) Compute the correlation coefficient. (12 marks)
- (b) Explain the meaning of this statistic concerning the relationship between MHPG levels and affect. (2 marks)
- (c) Determine the regression equation based on this data. (8 marks)

(d) Predict the affect score if the individual had an MHPG level of:

- (i) 1100. (1 mark)
- (ii) 950. (1 mark)
- (iii) 700. (1 mark)

2. An experiment in northwest Iowa compared the yield of a corn hybrid planted at three plant densities to determine the optimum planting rate (Table 1).

Table 1 Yield Data (t/ha) for corn planted at three plant populations in Northwest Iowa.

Population (plants/m <sup>2</sup> )	1 (t/ha)	2 (t/ha)	3 (t/ha)	mean (t/ha)
7.5	8.64	7.84	9.19	8.56
10	10.46	9.29	8.99	9.58
12.5	6.64	5.45	4.74	5.61

Conduct an analysis of these data and determine if there is a difference in the treatment means.

3. Frequency data are often tabulated according to two criteria, with a view toward testing whether the criteria are associated. Consider the following analysis of machine breakdowns during a given period.

	Machine			
	A	B	C	D
Shift 1	10	6	13	13
Shift 2	10	12	19	21
Shift 3	13	10	13	18

Using an appropriate test determine whether the same percentage of breakdown occurs on each machine during each shift or whether there is some difference due perhaps to untrained operators and/or other factors peculiar to a given shift.

4. In certain food experiment to compare two types of baby foods A and B, the following results of increase in weight (lbs) were observed in 8 children:

	Child 1	Child 2	Child 3	Child 4	Child 5	Child 6	Child 7	Child 8
<b>Food A(x)</b>	49	53	51	52	47	50	52	53
<b>Food B(y)</b>	52	55	52	53	50	54	54	53

Examine the significance of increase in weight of children due to food B.

5. The following data related the rubber percentage in two types of rubber plants, where the samples have been drawn independently. Test for their mean difference.

<b>Type I</b>	6.21	5.70	6.04	4.47	5.22	4.45	4.84	5.84	5.88	5.82	6.09	5.59
	6.06	5.59	6.74	5.55								

<b>Type II</b>	4.28	7.71	6.48	7.71	7.37	7.20	7.06	6.40	8.93	5.91	5.51	6.36
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6. (a) Explain the following terms as used in research:

- (i) Population. (1 mark)
- (ii) Sample. (1 mark)
- (iii) Sampling. (1 mark)
- (iv) Variable. (1 mark)
- (v) Parameter. (1 mark)
- (vi) Descriptive statistics. (1 mark)
- (vii) Inferential statistics. (1 mark)

- (b) Outline the major steps in research (7 marks)

(c) Below is a sequence of code written in R-programming on the RStudio IDE:

```
StrainTypes <- read_excel("D:/research methods and stats/Strain
Types.xlsx")
StrainTypes <- as.data.frame(StrainTypes)
nrow(StrainTypes)
meanStrain1 <- mean(StrainType$Strain1)
meanStrain2 <- mean(StrainType$Strain2)
sdStrain1 <- sd(StrainType$1)
sdStrain2 <- sd(StrainType$2)
F <- (sdStrain2 * sdStrain2)/(sdStrain1*sdStrain1)
var.test(StrainType$1, StrainType$2)
StrainTypeT_Test <- t.test(StrainType$1,StrainType$2,var.equal =
FALSE, paired = FALSE, conf.level = 0.95)
```

For each line of code in the sequence, describe what the programmer is doing.

(11 marks)

**END OF EXAMINATION PAPER**