



THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
SCHOOL OF FORESTRY

FIRST SEMESTER EXAMINATION
FR 312 RESEARCH METHODOLOGY, DESIGN AND ANALYSIS

Monday, 27th JUNE 2024

TIME ALLOWED: 3 HOURS

TIME: 8:20 – 12:00 PM

VENUE: Philip Siaguru Room 1 (PSR1).

INFORMATION FOR STUDENTS:

1. SWITCH OFF ALL THE MOBILE PHONES.
2. WRITE YOUR NAME and STUDENT NUMBER correctly on the first page of the answer booklet and also on the examination attendance slip. DO IT NOW!
3. The Examination questions have marks that are indicated beside each question.
4. You have 10 minutes to read this paper. You may make notes during this time if you so wish.
5. There should be one answer booklet. All answers must be written in the examination booklet provided. Written materials other than examination booklets will not be accepted.
6. This is a closed-book examination. Any notes that you have should be given to the examination supervisor.
7. Calculators are allowed in the examination.

TOTAL MARKS:/100 Marks

All the Best!

Part A: Topics: Types of Research Designs, Hypotheses Setting, Experimental Designs, and Statistical Basis of Experimental Design and Selection of Appropriate Variables. (30 Marks)

1. Which of the following are the four common types of scientific research designs discussed in the lecture notes? (3 Marks)
 - A) Experimental studies, surveys, case studies, and naturalistic observation
 - B) Longitudinal studies, surveys, case studies, and ethnographies
 - C) Experimental studies, longitudinal studies, case studies, and surveys
 - D) Naturalistic observation, surveys, longitudinal studies, and ethnographies
2. How do experimental studies differ from naturalistic observations regarding research methodology? (3 Marks)
 - A) Experimental studies involve manipulating variables, while naturalistic observations involve observing subjects in their natural environment without manipulating variables.
 - B) Naturalistic observations involve manipulating variables, while experimental studies do not manipulate variables.
 - C) Both experimental studies and naturalistic observations involve manipulating variables.
 - D) Neither experimental studies nor naturalistic observations involve manipulating variables.
3. What is the definition of a hypothesis? (3 Marks)
 - A) A hypothesis is a theory proven true through experimentation.
 - B) A hypothesis explains a phenomenon or a reasoned proposal suggesting a possible correlation between multiple phenomena, testable based on previous observations or scientific theories.
 - C) A hypothesis is a random guess about the outcome of an experiment.
 - D) A hypothesis is a scientific fact that does not require testing.
4. Which of the following correctly describes a research experiment's two types of hypotheses? (3 Marks)
 - A) Null hypothesis (H_0) and alternative hypothesis (H_1)
 - B) Experimental hypothesis (E_0) and observational hypothesis (O_1)
 - C) Primary hypothesis (P_0) and secondary hypothesis (S_1)
 - D) Simple hypothesis (S_0) and complex hypothesis (C_1)
5. What are experimental designs, and why are they important in research? (3 Marks)
 - A) Experimental designs are methods of collecting data without manipulating variables, which is important for observing natural behavior.
 - B) Experimental designs are research designs that allow researchers to test cause-and-effect relationships between variables. They involve manipulating independent variables to observe the effects on dependent variables.
 - C) Experimental designs are theoretical frameworks for understanding research questions without empirical testing.
 - D) Experimental designs are statistical tools for analyzing data without consideration of the research context.
6. Which of the following are the four most common types of experimental trials used for diagnosing nutritional problems? (3 Marks)
 - A) Addition trial, omission trial, factorial trial, site potential trial
 - B) Random, controlled, longitudinal, and cross-sectional trials

- C) Field, laboratory, clinical, and pilot trials
- D) Comparative trial, diagnostic trial, exploratory trial, confirmatory trial

7. Which of the following are common predictors of yield in forestry? (3 Marks)
- A) Soil type, management practices, tree height, stand age
 - B) Site quality, stand density, tree species, and management practices
 - C) Precipitation, temperature, tree species, soil type
 - D) Stand density, tree height, precipitation, soil type
8. Which of the following describes the four levels of measurement (data types) of variables? (3 Marks)
- A) Nominal, Ordinal, Interval, Ratio
 - B) Qualitative, Quantitative, Binary, Continuous
 - C) Independent, Dependent, Control, Extraneous
 - D) Descriptive, Inferential, Parametric, Non-parametric
9. The nominal level of measurement is best described as: (3 Marks)
- A) Data is categorized by labeling in mutually exclusive groups without order.
 - B) Data ranked in order but without equal intervals between ranks.
 - C) Data is categorized and ranked at equal intervals but with no true zero point.
 - D) Data is categorized and ranked with equal intervals and a true zero point.
10. A researcher conducts a study on the effect of insect plant damage on understory tree species. From the table provided below, which of the following variables are categorized correctly according to their type of measurement (data types)? (3 Marks)
- A) Nominal: Tree number and Plant species; Ratio: Defoliation Rate, Height, DBH; Ordinal: Relative Humidity
 - B) Nominal: Plant species and Height; Ratio: Tree number, Defoliation Rate, DBH; Ordinal: Relative Humidity
 - C) Nominal: Relative Humidity and Plant species; Ratio: Tree number, Height, DBH; Ordinal: Defoliation Rate
 - D) Nominal: Tree number and DBH; Ratio: Plant species, Defoliation Rate, Height; Ordinal: Relative Humidity

Tree #	Plant Species	Total Defoliation Rate (%)	Height (cm)	DBH (cm)	Relative Humidity (rank = low, medium, high)
1	A	0	120	12.5	low
2	B	89	130	14	low
3	C	50	110	10	medium
4	D	0	250	17.2	high
5	E	10	260	17	high
6	F	50	250	19	medium

Part B: Topic: Population and Sampling and Introduction to Statistical Analysis and Statistical Interpretation. (50 Marks)

- 1. Differentiate the terms Parameter and Statistic. (4 Marks)
- 2. Why is it not feasible to measure the whole population when conducting research? (5 Marks)
- 3. What are the differences between probability sampling and non-probability sampling? (8 Marks)
- 4. How can researchers address violations of assumptions in parametric tests? (5 Marks)
- 5. Inferential statistical methods fall into two categories, known as parametric and non-parametric tests. Explain these two categories. (8 Marks)
- 6. List and explain the four (4) parametric assumptions. (8 Marks)
- 7. What is the key concept behind statistical variation analysis (ANOVA)? (5 Marks)
- 8. You are conducting a study using an independent t-test to compare the average height of two tree species, Species A and B, planted in two different forest plots. You collected the following data on the trees' heights (in meters). Follow the analytical steps and clearly show your calculations on the answer sheet. (15 Marks)

○ **Steps:**

- i. State the hypotheses (provided).
- ii. Calculate each species' mean and standard deviation (standard deviations provided).
- iii. Calculate the t-statistic.
- iv. Determine the degrees of freedom.
- v. Find the critical t-value from the t-distribution table for a significance level 0.05.
- vi. Compare the t-statistic to the critical t-value and conclude.

○ **Hypotheses:**

- i. Null Hypothesis (H_0): Species A and B have no significant difference in the average height of trees.
- ii. Alternative Hypothesis (H_1): Species A and B significantly differ in the average height of trees.

○ **Data:**

- i. Species A Heights: 15.2, 14.8, 15.5, 15.0, 14.9
- ii. Species B Heights: 13.5, 13.8, 14.1, 13.9, 13.6

○ **Calculations:**

- Calculate the Mean and Standard Deviation:

○ Species A:

■ Sample Mean ($\bar{x}_1$) = $(15.2 + 14.8 + 15.5 + 15.0 + 14.9) / 5$

- Formula:

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$

Where:

- $\bar{x}$ is the mean,
- and x_i represents each value in the set.
- n is the number of values in the set.

- Σ Denotes the summation symbol, indicating that you sum all the values from $i=1$ to $i=n$.

■ Standard Deviation (s_1) formula:

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

- Sample Standard Deviation has been calculated for you: (s_1) ≈ 0.28

○ Species B:

- Sample Mean ($\bar{x}_2$) = $(13.5 + 13.8 + 14.1 + 13.9 + 13.6) / 5$
- Sample Standard Deviation (s_2) ≈ 0.24

- Calculate the t-Statistic using the formula:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where:

- $\bar{x}_1$ and $\bar{x}_2$ are the means for species A and B, respectively,
- s_1 and s_2 are the standard deviations, and
- n_1 and n_2 are the sample sizes of the two groups.

- Determine Degrees of Freedom:

- $df = n_1 + n_2 - 2$

- Find the Critical t-Value:

- From the t-distribution table for df and $\alpha = 0.05$, the critical value is **1.860**.

***** Compare the *t-statistic* to the *Critical t-value* and Conclude whether there is a significant difference between the mean heights of the tree species A and B.**

Part C: Topics: Research Writing and Publication, Elements of Academic Research Writing, and Presentation of the Results. (20 Marks)

1. What are the key components of a research proposal? (4 Marks)
2. How should the introduction section of a research proposal be structured? (4 Marks)
3. What are the components of a research manuscript? (4 Marks)
4. Describe the process of conceiving a research idea in forestry research. What key steps should a researcher take to identify a viable research question? (4 Marks)
5. List and briefly describe three essential skills for delivering an effective oral presentation in forestry research. (4 Marks)

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END of EXAMINATION