



**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**  
**FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES**

**DEPARTMENT OF NATURAL RESOURCES SCIENCES**

<b>QUALIFICATION: BACHELOR OF NATURAL RESOURCES MANAGEMENT HONOURS</b>	
<b>QUALIFICATION CODE: 08BNRH</b>	<b>LEVEL: 8</b>
<b>COURSE CODE: RMC811S</b>	<b>COURSE NAME: RESEARCH METHODS FOR NATURAL SCIENCES</b>
<b>DATE: JUNE 2025</b>	
<b>DURATION: 3 HOURS</b>	<b>MARKS: 150</b>

<b>FIRST OPPORTUNITY EXAMINATION QUESTION PAPER</b>	
<b>EXAMINER(S)</b>	Dr Tendai Nzuma (Section A: Scientific Writing) Dr Meed Mbidzo (Section B: Statistics)
<b>MODERATOR:</b>	Prof M. Mwale

<b>INSTRUCTIONS</b>
1. Answer ALL the questions. 2. Write clearly and neatly. 3. Number the answers clearly.

**PERMISSIBLE MATERIALS**

1. Examination question paper
2. Answering book
3. Calculator

**THIS QUESTION PAPER CONSISTS OF 9 PAGES** (Excluding this front page)

**SECTION A: SCIENTIFIC WRITING**

**[50]**

**QUESTION 1**

- a) Describe the structure and content of a scientific report. Explain the role of each major section. (10)
- b) List and explain any five ethical considerations in scientific writing and reporting. (10)

**QUESTION 2**

- a) Using the information below, write an appropriate Results section (including at least one sentence summary and a table): "A field experiment compared plant height in three maize varieties (Variety A, B, and C) treated with the same compost. After 12 weeks, the average plant heights were: A = 142.3 cm, B = 135.7 cm, and C = 147.9 cm. An ANOVA test revealed significant differences ( $p < 0.05$ )."
- b) Draft a brief Methods section suitable for the study in (a), making appropriate assumptions. (10)
- c) Identify four common writing problems in undergraduate scientific reports and propose practical strategies to overcome them. (10)

**SECTION B: STATISTICS**

**[100]**

**QUESTION 3**

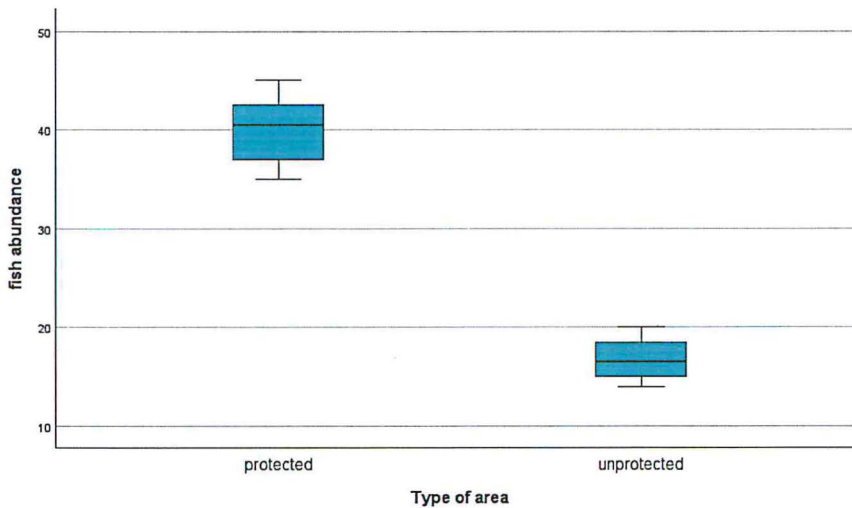
- What statistical procedure would you use for the following research questions and/or scenarios? **[10]**
- a) A researcher is studying the effect of light exposure and altitude on plant chlorophyll content. They have three light exposure levels: full sun, partial shade and full shade, while altitude is categorised as low and high. What statistical test should be used to determine if light exposure and altitude impact chlorophyll content in leaves? (2)
  - b) A researcher determined the presence of a specific intestinal parasite in each animal from a random selection of mice of each of two species. You want to determine if there is a relationship between mice species and occurrence of the parasite. (2)
  - c) You take a sample of the weights of 20 male elephant tusks from Etosha National Park (ENP) and a sample of 18 male elephant tusks from the Bwabwata National Park (BNP). You want to test if there is a difference in tusk weights between elephants from ENP and BNP. *Note: You find that the tusk weights for BNP were not normally distributed and that there were significant outliers in the data.* (2)
  - d) Concentrations of nitrogen oxides was determined in two urban suburbs. You want to test the hypothesis that the air pollutant was present in the same concentrations in the two suburbs. (2)
  - e) Based on an anxiety score, students are divided into three groups: "low-stressed students", "moderately-stressed students" and "highly-stressed student. Exam performance is measured from 1 to 100. You want to test the hypothesis that exam performance differs based on exam anxiety levels amongst students? The data are non-normally distributed because of high variability among samples. What test should be used to compare the exam performance of students across the three anxiety levels, and why is this test appropriate? (2)

**QUESTION 4**

A Marine biologist measures the abundance of fish species (number of fish per square meter) in protected vs. unprotected marine areas. Use the SPSS outputs provided to answer questions that follow, and provide evidence for your answers. **[16]**

- a) What statistical test would you use to determine whether the abundance of fish species differed between the two marine areas? (2)
- b) State the null and alternative hypotheses. (2)
- c) State whether the assumption of significant outliers in the test mentioned in (a) is met or not. (3)
- d) State whether the assumption of normality in the test mentioned in (a) is met or not. (3)
- e) State whether the assumption of homogeneity of variances is met or not. (3)
- f) Does fish abundance differ significantly between protected and unprotected marine areas? (3)

Tests of Normality							
	Type of area	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
fish abundance	protected	.126	8	.200*	.969	8	0.889
	unprotected	.170	8	.200*	.952	8	0.736



Independent Samples Test											
		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						One-Sided p	Two-Sided p			Lower	Upper
fish abundance	Equal variances assumed	1.836	.197	16.189	14	<.001	<.001	23.250	1.436	20.170	26.330
	Equal variances not assumed			16.189	11.603	<.001	<.001	23.250	1.436	20.109	26.391

Group Statistics					
	Type of area	N	Mean	Std. Deviation	Std. Error Mean
fish abundance	protected	8	40.00	3.464	1.225
	unprotected	8	16.75	2.121	.750

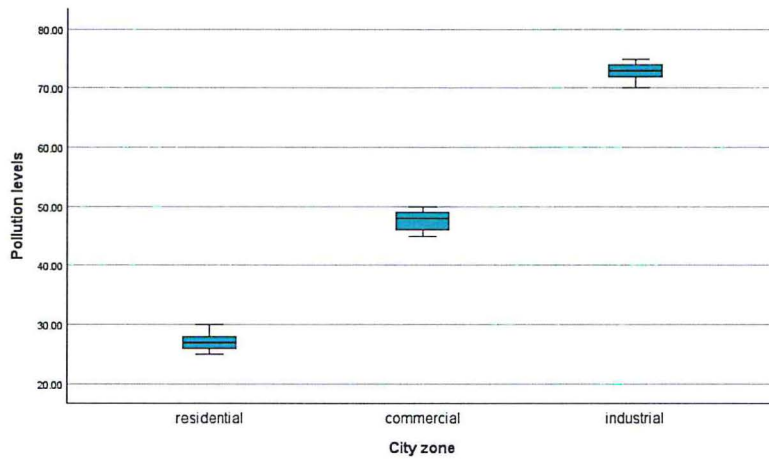
**QUESTION 5**

Environmental scientists measure air pollution levels (in  $\mu\text{g}/\text{m}^3$ ) in residential, commercial, and industrial zones of a city. Answer the questions that follow using the SPSS outputs provided below.

[30]

- a) What test would be appropriate to test the hypothesis that air pollution levels in all the three city zones are the same? (2)
- b) State the null and alternative hypotheses. (2)
- c) Name three assumptions related to how your data fits the test mentioned in (a) (6)
- d) State whether the three assumptions mentioned in (c) are met or not (provide evidence for your answers). (9)
- e) Report on the descriptive statistics of the air pollution levels for the different city zones. (4)
- f) Determine whether the air pollution levels are the same in the different city zones. (4)
- g) If air pollution levels differ significantly among different city zones, explain where the (3)

difference lies and provide evidence.



Tests of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Pollution levels	Based on Mean	.096	2	12	.909
	Based on Median	.051	2	12	.950
	Based on Median and with adjusted df	.051	2	12.000	.950
	Based on trimmed mean	.098	2	12	.907

Descriptives								
Pollution levels								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
residential	5	27.2000	1.92354	.86023	24.8116	29.5884	25.00	30.00
commercial	5	47.6000	2.07364	.92736	45.0252	50.1748	45.00	50.00
industrial	5	72.8000	1.92354	.86023	70.4116	75.1884	70.00	75.00
Total	15	49.2000	19.39146	5.00685	38.4614	59.9386	25.00	75.00

Tests of Normality							
	City zone	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pollution levels	residential	.141	5	.200*	.979	5	.928
	commercial	.180	5	.200*	.952	5	.754
	industrial	.141	5	.200*	.979	5	.928

ANOVA					
Pollution levels					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5217.600	2	2608.800	668.923	<.001
Within Groups	46.800	12	3.900		
Total	5264.400	14			

Multiple Comparisons							
Dependent Variable: Pollution levels							
	(I) City zone	(J) City zone	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	residential	commercial	-20.40000*	1.24900	<.001	-23.7322	-17.0678
		industrial	-45.60000*	1.24900	<.001	-48.9322	-42.2678
	commercial	residential	20.40000*	1.24900	<.001	17.0678	23.7322
		industrial	-25.20000*	1.24900	<.001	-28.5322	-21.8678
	industrial	residential	45.60000*	1.24900	<.001	42.2678	48.9322
		commercial	25.20000*	1.24900	<.001	21.8678	28.5322

\*. The mean difference is significant at the 0.05 level.

### QUESTION 6

A researcher is interested in determining whether the effects of deforestation on soil erosion rates were different based on soil type. Deforestation is categorized into three levels (none, partial and complete) and there are two types of soil (sand and clay). Use the SPSS outputs provided to answer the questions that follow.

[22]

- (a) What statistical test would you use to determine whether the effect of deforestation level on soil erosion rates is different for sandy and clay soils?

(2)

- (b) State whether the assumption of normality in the test mentioned in (a) is met or not. (4)
- (c) Discuss how you would deal with outliers resulting from data entry errors. (2)
- (d) State whether the assumption of homogeneity of variances is met or not. (4)
- (e) Explain how profile plots can be used to determine whether an interaction exists between two independent variables. (5)
- (f) Determine whether deforestation level, soil type or their interaction significantly influence soil erosion rates. (5)

Deforestation Level	Soil Type		Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
			Statistic	df	Sig.	Statistic	df	Sig.
none	sand	Residual for Erosionrate	.136	5	.200*	.987	5	.967
	clay	Residual for Erosionrate	.136	5	.200*	.987	5	.967
partial	sand	Residual for Erosionrate	.179	5	.200*	.984	5	.955
	clay	Residual for Erosionrate	.197	5	.200*	.943	5	.685
complete	sand	Residual for Erosionrate	.224	5	.200*	.914	5	.493
	clay	Residual for Erosionrate	.224	5	.200*	.912	5	.482

		Levene Statistic	df1	df2	Sig.
Erosion rate	Based on Mean	1.905	5	24	.131
	Based on Median	.941	5	24	.472
	Based on Median and with adjusted df	.941	5	9.409	.497
	Based on trimmed mean	1.795	5	24	.152

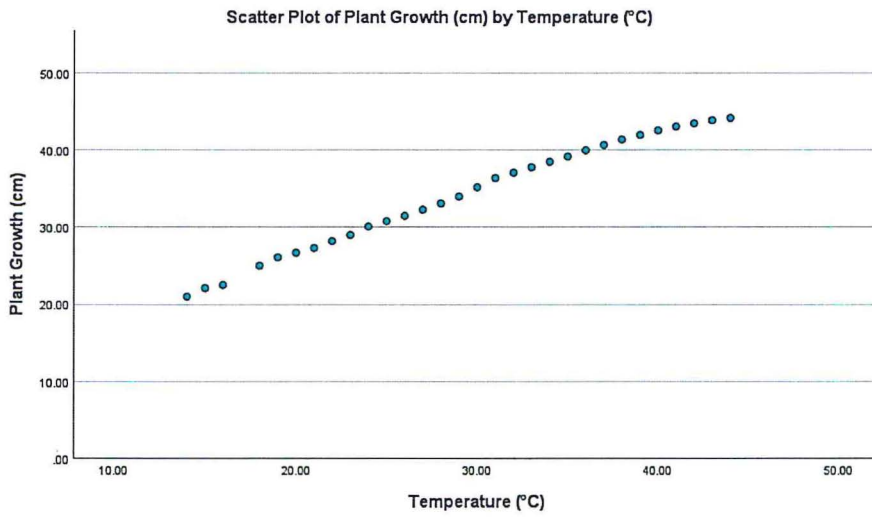
Tests of Between-Subjects Effects						
Dependent Variable: Erosion rate						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2515.771 <sup>a</sup>	5	503.154	5056.825	<.001	.999
Intercept	5169.281	1	5169.281	51952.576	<.001	1.000
DeforestationLevel	2028.329	2	1014.164	10192.606	<.001	.999
SoilType	361.921	1	361.921	3637.400	<.001	.993
DeforestationLevel * SoilType	125.521	2	62.760	630.757	<.001	.981
Error	2.388	24	.100			
Total	7687.440	30				
Corrected Total	2518.159	29				

a. R Squared = .999 (Adjusted R Squared = .999)

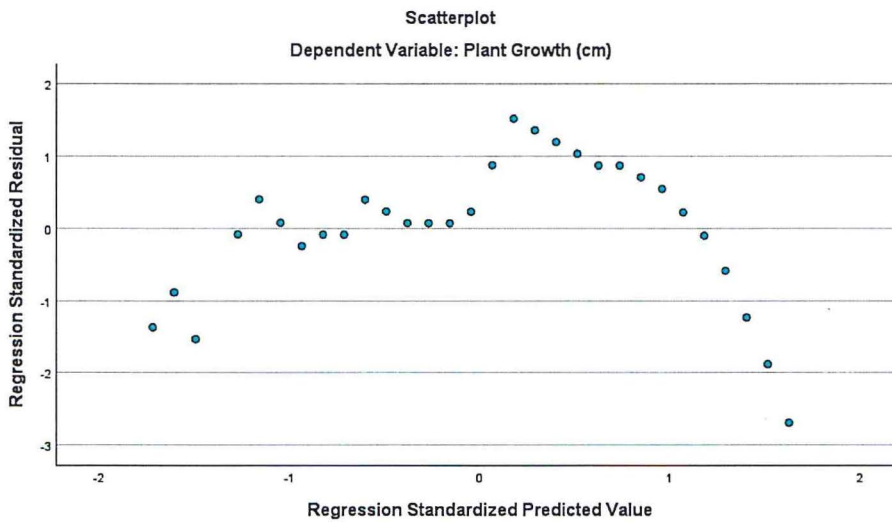
#### QUESTION 7

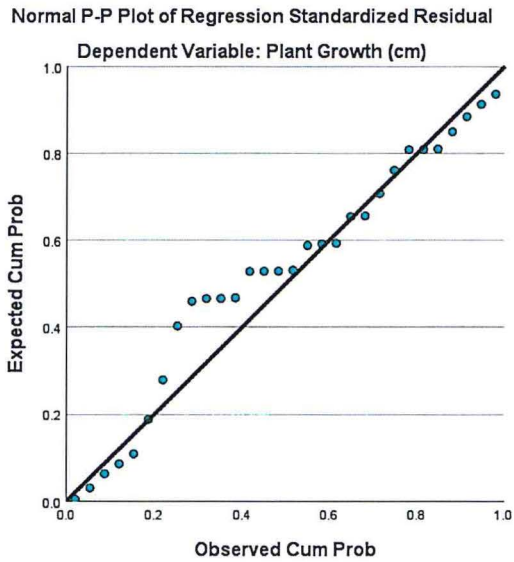
Suppose we want to investigate the relationship between site temperature (in °C) and plant growth (in cm). A sample of 30 sites with varying temperatures were selected and plant heights were recorded. Use the SPSS outputs provided to answer the questions that follow. [24]

- Describe the general relationship that exists between site temperature and plant heights. Explain your answer fully. (2)
- Did the data meet the assumption of homoscedasticity? Explain your answer. (4)
- Did the data meet the assumption of normality? Explain your answer. (3)
- Did the data meet the assumption of no significant outliers? Explain your answer. (2)
- What proportion of the variance in plant height is explained by the site temperature? Explain fully. (4)
- Determine whether the regression model results are a statistically significantly better prediction of plant height than if we just used the mean of the dependent variable. Provide evidence for your explanation. (4)
- Compute a regression equation using the SPSS output provided to predict the plant height for the following site temperatures: 25°C, 15°C and 35°C. (5)



Model Summary <sup>b</sup>					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.996 <sup>a</sup>	.993	.993	.61913	.206
a. Predictors: (Constant), Temperature (°C)					
b. Dependent Variable: Plant Growth (cm)					





ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1494.081	1	1494.081	3897.752	<.001 <sup>b</sup>
	Residual	10.733	28	.383		
	Total	1504.814	29			
a. Dependent Variable: Plant Growth (cm)						
b. Predictors: (Constant), Temperature (°C)						

Coefficients <sup>a</sup>								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	10.640	.394		27.034	<.001	9.834	11.446
	Temperature (°C)	.801	.013	.996	62.432	<.001	.774	.827
a. Dependent Variable: Plant Growth (cm)								