NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES

DEPARTMENT OF NATURAL RESOURCES SCIENCES

QUALIFICATION: BACHELOR OF NATURAL RESOURCES MANAGEMENT HONOURS	
QUALIFICATION CODE: 08BNRH	**LEVEL:** 8
COURSE CODE: RMC811S	**COURSE NAME:** RESEARCH METHODS FOR NATURAL SCIENCES
DATE: JUNE 2024	
DURATION: 3 HOURS	**MARKS:** 150

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

INSTRUCTIONS
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)

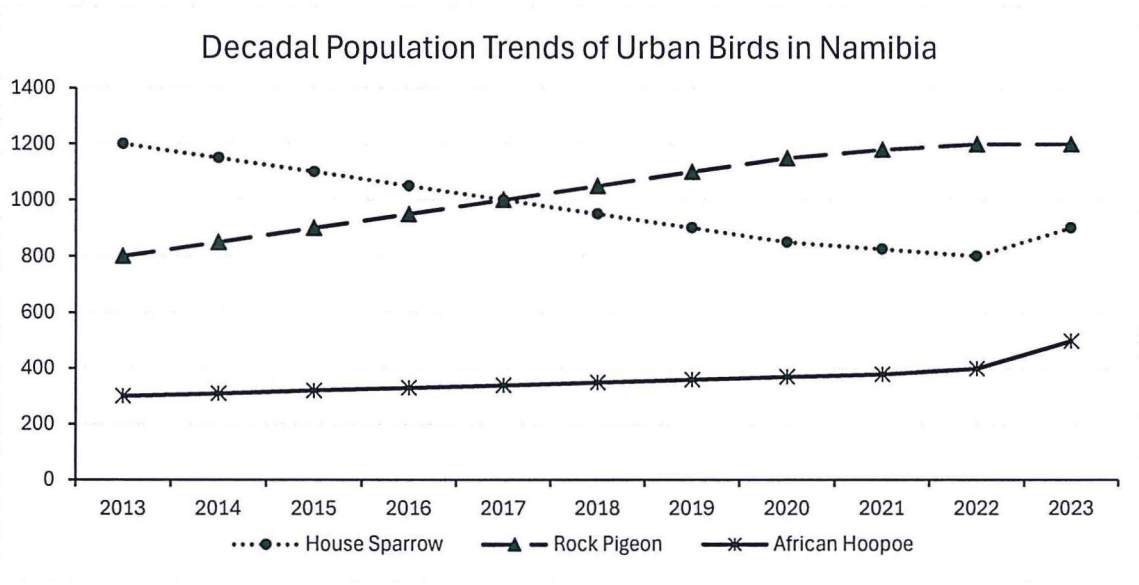
SECTION A: SCIENTIFIC WRITING [50]

QUESTION 1

Define the term "paraphrasing plagiarism" and explain how it can be avoided in academic writing. Provide an example to illustrate your point. (10)

QUESTION 2

Given a graph depicting the population trends of various bird species in an urban area over a decade (graph shown below), analyse the impact of urban development on biodiversity. Discuss all three species showing different trends and suggest possible ecological or urban developmental reasons for these trends. (10)



QUESTION 3

Explain how audience analysis can influence the technicality and language of scientific documents. Provide examples of how you would adjust a document when addressing different audiences. (10)

QUESTION 4

Design a short research proposal that evaluates the role of wetland restoration as a strategy for adapting to climate change and improving water security in arid areas. In your proposal, include the following components: (20)

1. **Introduction:** Clearly define the problem statement and outline the objectives of your study.
2. **Methodology:** Describe the methods you will use to conduct your research.
3. **Expected Outcomes:** Discuss the potential results and implications of your study.

Ensure each section is detailed and specific to the focus of your research.

SECTION B: STATISTICS [100]

QUESTION 5

What statistical procedure would you use for the following research questions and/or scenarios? **[11]**

a) A researcher is studying the effect of a new fertilizer on plant growth. They have three groups of plants: one with no fertilizer, one with the standard fertilizer, and one with the new fertilizer. What statistical test should be used to compare the average growth rates among these groups? (2)

b) An ecologist wants to determine if there is a relationship between the number of predators and the size of prey populations in a closed ecosystem. Which statistical test is most appropriate? (2)

c) A biologist records the mating calls of frogs before and after the introduction of a noise pollution source near their habitat. What statistical test should be used to compare the frequency of calls before and after the pollution? (2)

d) It is generally believed that males tend to be taller than females. However, you do not believe that this hypothesis holds for the NRM honours class of 2024 at NUST. So, you take a sample of the heights of 20 male students and 30 female students. You want to test if there is a difference in height between male and female students. Note: You find that the heights for both males and female were not normally distributed and that there were significant outliers in the data. (2)

e) A researcher is studying the salinity tolerance of three different coastal plant species by measuring their growth rates under the same controlled salinity conditions. The growth data are non-normally distributed because of high variability among samples. What test should be used to compare the growth rates across the three plant species, and why is this test appropriate? (3)

QUESTION 6

A vet wants to test a new drug that improves running performance in cheetah. The researcher would like to know whether this new drug leads to a difference in performance compared to the old drug. To do this, the vet sampled a group of cheetahs in captivity who each performed two trials in which they had to run as far as possible in 3 minutes. In one of the trials, they got a shot of the old drug and in the other trial they got a shot of the new drug. The distance they ran in both trials was recorded. determine whether the new drug improves performance compared to the old drug. **[15]**

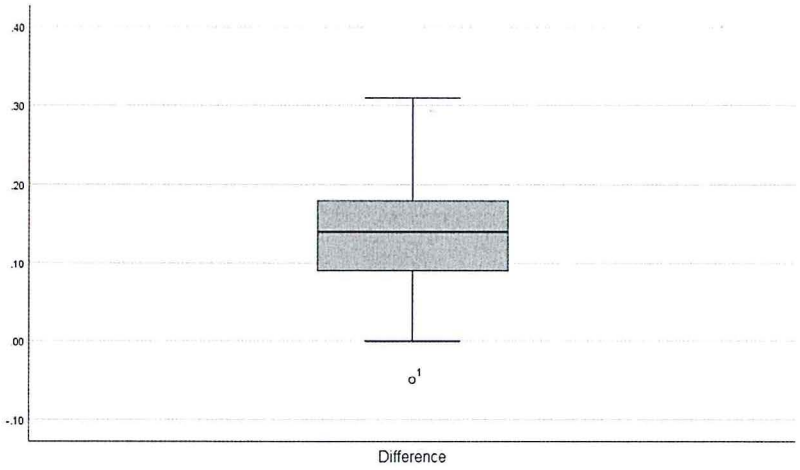
a) What statistical procedure or test would you use to determine whether the new drug improves running performance compared to the old drug? (2)

b) What are the two main data assumptions of the statistical procedure/test mentioned in (a)? (4)

c) Based on the SPSS output (tables and graphs) provided below, has the two data assumptions in (b) been met or violated? Explain in detail. (4)

d) Using the two tables below, report on the descriptive statistics and fully explain whether the new drug improves running performance of cheetah. (5)

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Difference	.123	20	.200*	.970	20	.754



Descriptive Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	New_Drug	11.3045	20	.71379	.15961
	Old_Drug	11.1685	20	.72661	.16247

Test Statistics									
		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	New_Drug - Old_Drug	.13600	.09594	.02145	.09110	.18090	6.340	19	.000

QUESTION 7

Two controlled fires were initiated to investigate the response of *Acacia mellifera* shrubs/trees over a period of 10 years. Stem heights were recorded from 15 randomly selected trees/shrubs from each of the two fire treatments, including an area that was not burnt (control). Answer the questions that follow using the SPSS outputs provided below. **[30]**

a) What test would be appropriate to test the hypothesis that all four plant varieties reach the same maximum height? (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)

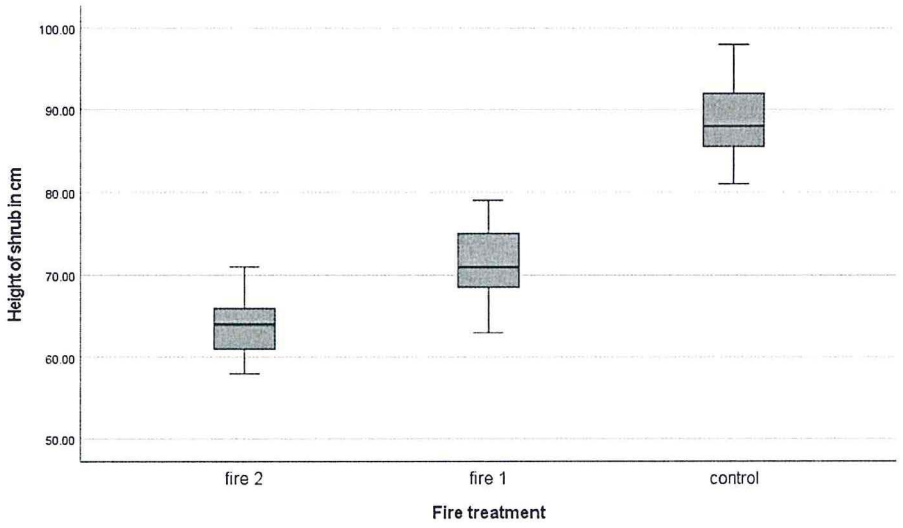
d) State whether the three assumptions mentioned in (c) are met or not (provide evidence for your answers). (9)

e) Report on the descriptive statistics of the plant heights for the different plant varieties. (4)

f) Determine whether the four plant varieties reach the same maximum height? (4)

g) If there is a statistically significant difference in plant heights of the four varieties, explain where the difference lies by providing evidence. (3)

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Fire treatment		Statistic	df	Sig.	Statistic	df	Sig.
Height of shrub in cm	fire 2	.122	15	.200*	.973		
	fire 1	.111	15	.200*	.973		
	control	.116	15	.200*	.977		



Descriptives								
Height of shrub in cm								
					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
fire 2	15	63.8000	3.54965	.91652	61.8343	65.7657	58.00	71.00
fire 1	15	71.6667	4.49868	1.16155	69.1754	74.1580	63.00	79.00
control	15	89.0000	4.81070	1.24212	86.3359	91.6641	81.00	98.00
Total	45	74.8222	11.45205	1.70717	71.3816	78.2628	58.00	98.00

Tests of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Height of shrub in cm	Based on Mean	.859	2	42	.431
	Based on Median	.716	2	42	.495
	Based on Median and with adjusted df	.716	2	39.549	.495
	Based on trimmed mean	.836	2	42	.441

ANOVA					
Height of shrub in cm					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4986.844	2	2493.422	133.622	.000
Within Groups	783.733	42	18.660		
Total	5770.578	44			

Multiple Comparisons							
Dependent Variable: Height of shrub in cm							
(I) Fire treatment	(J) Fire treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval		
					Lower Bound	Upper Bound	
Tukey HSD	fire 2	fire 1	-7.86667*	1.57735	.000	-11.6988	-4.0345
		control	-25.20000*	1.57735	.000	-29.0322	-21.3678
	fire 1	fire 2	7.86667*	1.57735	.000	4.0345	11.6988
		control	-17.33333*	1.57735	.000	-21.1655	-13.5012
	control	fire 2	25.20000*	1.57735	.000	21.3678	29.0322
		fire 1	17.33333*	1.57735	.000	13.5012	21.1655
Games-Howell	fire 2	fire 1	-7.86667*	1.47960	.000	-11.5387	-4.1947
		control	-25.20000*	1.54365	.000	-29.0379	-21.3621
	fire 1	fire 2	7.86667*	1.47960	.000	4.1947	11.5387
		control	-17.33333*	1.70061	.000	-21.5423	-13.1244
	control	fire 2	25.20000*	1.54365	.000	21.3621	29.0379
		fire 1	17.33333*	1.70061	.000	13.1244	21.5423
*. The mean difference is significant at the 0.05 level.							

QUESTION 8

A researcher is interested in determining whether the effect of education level on conservation interest was different for males and females. Use the SPSS outputs provided to answer the question that follow. **[22]**

(a) What statistical test would you use to determine whether the effect of education level on interest in conservation is different for males and females (i.e. different depending on gender)? (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 error. (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 there is a statistically significant interaction effect between gender and education level. (5)

Gender	Level of education		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
			Statistic	df	Sig.	Statistic	df	Sig.
Male	School	Residual for conservation_interest	.143	9	.200*	.981	9	.971
	College	Residual for conservation_interest	.157	9	.200*	.957	9	.761
	University	Residual for conservation_interest	.213	10	.200*	.915	10	.320
Female	School	Residual for conservation_interest	.112	10	.200*	.963	10	.819
	College	Residual for conservation_interest	.112	10	.200*	.963	10	.819
	University	Residual for conservation_interest	.139	10	.200*	.950	10	.668

		Levene Statistic	df1	df2	Sig.
Conservation interest	Based on Mean	2.269	5	52	.061
	Based on Median	2.205	5	52	.068
	Based on Median and with adjusted df	2.205	5	27.511	.083
	Based on trimmed mean	2.263	5	52	.062

Tests of Between-Subjects Effects						
Dependent Variable: Conservation interest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5645.998[a]	5	1129.200	78.538	.000	.883
Intercept	132091.906	1	132091.906	9187.227	.000	.994
gender	8.420	1	8.420	.586	.448	.011
education_level	5446.697	2	2723.348	189.414	.000	.879
gender * education_level	210.338	2	105.169	7.315	.002	.220
Error	747.644	52	14.378			
Total	140265.750	58				
Corrected Total	6393.642	57				
a. R Squared = .883 (Adjusted R Squared = .872)						

QUESTION 9

A biologist investigates the effect of applying different amounts of fertilizer on the biomass of grass on a rehabilitation site. Grass seed is sown uniformly over the land. Ten 1 m^2 plots are located randomly and a different mass of fertilizer is applied to each plot. After two months, grass is harvested from each plot, dried and weighed. Use the SPSS outputs provided to answer the question that follow. **[22]**

a) Describe the general relationship that exists between grass biomass and mass of fertilizer. Provide evidence for your answer. (2)

b) Did the data meet the assumption of homoscedasticity? Explain your answer. (4)

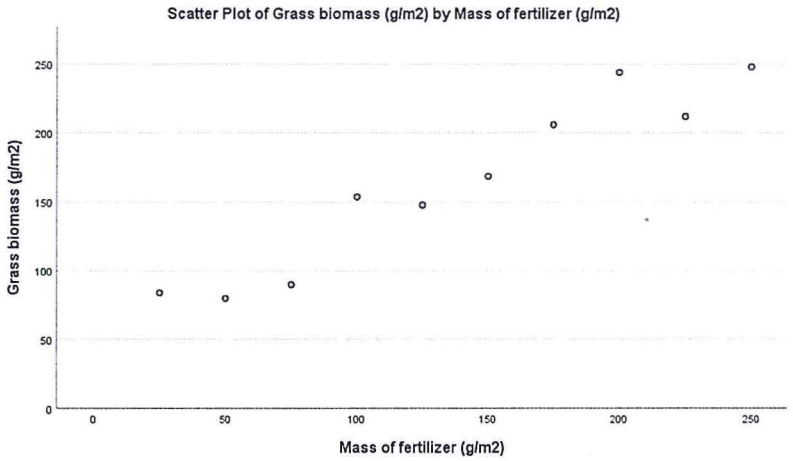
c) Did the data meet the assumption of normality? Explain your answer. (3)

d) Did the data meet the assumption of no significant outliers? Explain your answer. (2)

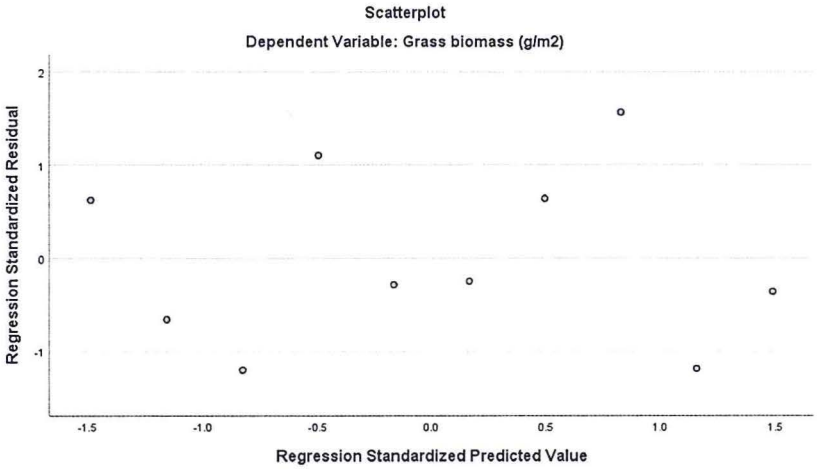
e) What proportion of the variance in the response variable is explained by the predictor variable? Explain fully. (4)

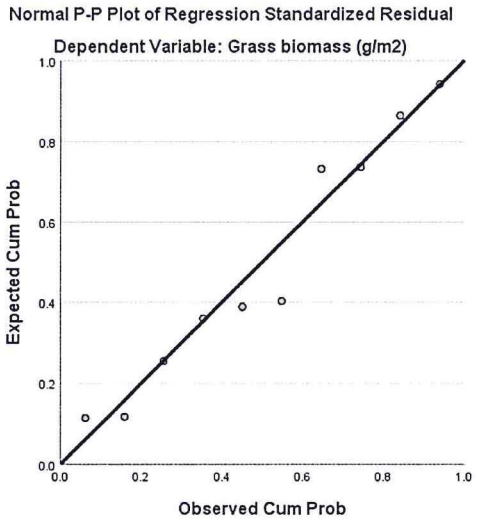
f) Determine whether the regression model results in a statistically significantly better prediction of the dependent variable than if we just used the mean of the dependent variable. Provide evidence for your explanation. (4)

g) Compute a regression equation using the SPSS output provided to predict the grass biomass at the following fertilizer masses 95, 285 and 300 (g/ m^2) (5)



Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.960[a]	.922	.912	18.999	2.380
a. Predictors: (Constant), Mass of fertilizer (g/m2)					
b. Dependent Variable: Grass biomass (g/m2)					





ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33946.694	1	33946.694	94.041	<.001[b]
	Residual	2887.806	8	360.976		
	Total	36834.500	9			
a. Dependent Variable: Grass biomass (g/m2)						
b. Predictors: (Constant), Mass of fertilizer (g/m2)						

Coefficients[a]								
		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	51.933	12.979		4.001	.004	22.004	81.863
	Mass of fertilizer (g/m2)	.811	.084	.960	9.697	<.001	.618	1.004
a. Dependent Variable: Grass biomass (g/m2)								