

UNIVERSITY OF SWAZILAND



FINAL EXAMINATION PAPER 2017/2018

TITLE OF PAPER:	GENERAL LINEAR MODELS
COURSE CODE:	STA 215 / ST 204
TIME ALLOCATED:	2 (TWO) HOURS
REQUIREMENTS:	STATISTICAL TABLES AND CALCULATOR
INSTRUCTION:	ANSWER ANY 3 (THREE) QUESTIONS OF YOUR CHOICE. ALL QUESTIONS CARRY THE MARKS AS INDICATED WITHIN THE PARENTHESIS

THIS PAPER IS NOT TO BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE
INVIGILATOR

QUESTION ONE**[6+8+3+2+1]**

An article in the Tappi Journal (March, 1986) presented data on green liquor Na_2S concentration (in grams per liter) and paper machine production (in tons per day). The data is shown as follows:

(x)	825	830	890	895	890	910	915	960	990	1010	1012	1030	1050
(y)	40	42	49	46	44	48	46	43	53	52	54	57	58

- 1.1 Fit a simple linear regression model with y = green liquor Na_2S concentration and x = production.
- 1.2 Test for significance of regression.
- 1.3 Find a 95% C.I on the slope β_1 .
- 1.4 Find the fitted value of y corresponding to $x = 910$ and the associated residual.
- 1.5 Find the mean green liquor Na_2S concentration when the production rate is 950 tons per day.

QUESTION TWO**[6+7+7]**

Some fairly used cars were displayed for sales in an automobile sales compound and the data below shows the prices and the year in which the car was first used.

Price (000)	80	57	58	55	70	88	43	60	69	63	118
Year of 1 st use	2005	2007	2006	2006	2005	2004	2007	2006	2005	2005	2002

- 2.1 Using the observed data calculate the estimates of the slope and intercept parameter of the regression model.
- 2.2 Test for significance of regression.
- 2.3 Analyze the regression model adequacy using the Lack of fit method and comment on model adequacy.

QUESTION THREE**[8+8+4]**

The response time in milliseconds was determined for three different types of circuits in an electronic calculator. The results are recorded here.

Circuit Type	Response				
1	19	22	20	18	25
2	20	21	33	27	40
3	16	15	18	26	17

- 3.1 Using $\alpha = 0.01$, test the hypothesis that the 3 circuit types have the same response time.
- 3.2 Analyze the residuals from this experiment.
- 3.3 Find a 95% confidence interval on the response time for circuit three.

QUESTION FOUR**[3+8+5+4]**

An experiment was performed to determine the effect of 4 different chemicals on the strength of a fabric. These chemicals are used as part of the permanent press finishing process. Five fabric samples were selected, and a randomized complete block design was run by testing each chemical type once in random order on each fabric sample. The data is shown below:

Chemical Type	Fabric Sample				
	1	2	3	4	5
1	1.3	1.6	0.5	1.2	1.1
2	2.2	2.4	0.4	2	1.8
3	1.8	1.7	0.6	1.5	1.3
4	3.9	4.4	2	4.1	3.4

- 4.1 Identify the dependent variable, factor studied and factor levels.
- 4.2 Compute the ANOVA table, showing all workings.
- 4.3 Use $\alpha = 0.01$ in determining whether the four different chemicals could be equally effective. Clearly state all steps in the test between the hypotheses and the conclusion.
- 4.4 Which chemical concentration would you prefer? Explain.

QUESTION FIVE**[11+8+1]**

A study was performed on wear of a bearing Y and its relationship to X_1 oil viscosity and X_2 load. The following data were obtained.

293	1.6	851
230	15.5	816
172	22.0	1058
91	43.0	1201
113	33.0	1357
125	40.0	1115

- 5.1 Fit a multiple linear regression model to these data.
- 5.2 Estimate σ^2 and the standard errors of the regression coefficients.
- 5.3 Use the model to predict wear when $X_1 = 25$ and $X_2 = 1000$.

END OF EXAMINATION