GWANDA STATE UNIVERSITY

Faculty of Computational Sciences

DEPARTMENT OF MATHEMATICS AND STATISTICS

Applied Statistics

SMS 1202

Examination Paper

April 2024

This examination paper consists of 3 printed pages

Time Allowed: **3 hours**

Total Marks: **100**

Examiner's Name: Mr. E. Utete

INSTRUCTIONS

Answer **ALL** questions in Section A and **ANY THREE** questions in Section B

ADDITIONAL REQUIREMENTS

Scientific calculator

Graph papers

Statistical Tables

SECTION A : Answer ALL Questions 40 marks

A1 For what value of a is $\sum_{i=1}^{n}(x_i - a)^2$ minimum? [9]

A2 Suppose that we have a sample $x_1; x_2; ....; x_n$ and we have calculated $\bar{x}_n$ and s_n^2 for the sample. Now an $(n+1)^{th}$ observation becomes available. Let $\bar{x}_{n+1}$ and s_{n+1}^2 be the sample mean and sample variance for the sample using all $n+1$ observations.

(a) Show how $\bar{x}_{n+1}$ can be computed using $\bar{x}_n$ and x_{n+1}. [7]

(b) Show that

$$ns_{n+1}^2 = (n-1)s_n^2 + \frac{n(x_{n+1} - \bar{x}_n)^2}{n+1}.$$

[12]

A3 What is the difference between parameter and statistic ? [4]

A4 State and explain 4 components of a timeseries. [8]

SECTION B : Answer THREE QUESTIONS only : 60 marks

B5 The female students in an undergraduate statistics class at GSU self-reported their heights to the nearest inch. The data are

62 64 66 67 65 68 61 65 67 65
64 63 67 68 64 66 68 69 65 67
62 66 68 67 66 65 69 65 70 65
67 68 65 63 64 67 67

(a) Construct a stem-and-leaf diagram for the height data and comment on any important features that you notice. [8]

(b) Calculate the median and Interquartile range of height of this group. [5]

(c) Construct a box plot of the data. [5]

(d) What is an outlier ? [2]

B6 A mining company operates four machines three shifts each day. From production records, the following data on the number of breakdowns are collected: Test the hypothesis (using $\alpha = 0.05$) that breakdowns are independent of the shift. [20]

	Machines			
Shift	A	B	C	D
1	41	20	12	16
2	31	11	9	14
3	15	17	16	10

B7 Ten samples were taken from a plating bath used in an electronics manufacturing process, and the bath pH was determined.The sample pH values are 7.91, 7.85, 6.82, 8.01, 7.46, 6.95, 7.05, 7.35, 7.25, 7.42. Manufacturing engineering believes that pH has a median value of 7.0.

(a) Do the samples indicate that the solution has been contaminated? Use the sign test with $\alpha = 0.05$ to investigate this hypothesis. [15]

(b) What is the type II error probability of this test if $\widetilde{\mu} = 7.1$ [5]

B8 An electrical engineer must design a circuit to deliver the maximum amount of current to a display tube to achieve sufficient image brightness. Within her allowable design constraints, she has developed two candidate circuits and tests prototypes of each. The resulting data (in microamperes) are as follows:

Circuit 1	251	255	258	257	250	251	254	250	248
Circuit 2	250	253	249	256	259	252	260	251	

(a) Use the Wilcoxon Signed-Rank to test the hypothesis that the mean microamperes are equal. Use $\alpha = 0.025$. [15]

(b) What assumptions were made in performing the test above ? [5]