

MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES



FACULTY OF APPLIED SCIENCES & TECHNOLOGY

DEPARTMENT OF APPLIED STATISTICS

ASTA 225 - STATISTICAL INFERENCE II

April 2023

DURATION: 3 hours

INSTRUCTIONS TO CANDIDATE

1. Answer **ALL** Questions in Section A and any **THREE** Questions from Section B.
2. Start each question on a fresh page.
3. Show **All** your working.

SECTION A [40 marks]

Answer **ALL** Questions being careful to number them A1 to A4.

A1. When would one use the following tests:

- (a) Ansari-Bradley test, [2]
- (b) Wilcoxon- Matched pairs test, [2]
- (c) Runs test, [2]
- (d) Page's test, and [2]
- (e) Kendall's tau test? [2]

A2. Let $Y_1 < Y_2 < Y_3 < Y_4$ denote the order statistics for a random sample of size 4 from a distribution having a probability density function,

$$f(x) = \begin{cases} 1, & 0 < x < 1 \\ 0, & \text{otherwise.} \end{cases}$$

- (a) Find the joint *pdf* of the order statistics Y_1, Y_2, Y_3 and Y_4 . [4]
- (b) Find the density function of the order statistics,
 - (i) $X_{(1)}$ [2]
 - (ii) $X_{(4)}$ [2]
- (c) Find the density function of the range, $R = Y_4 - Y_1$. [7]

A3. Use the Jackknife procedure to find an estimate for σ^2 for the following data

7, 4.8, 3.9, 5.1, 9

[10]

A4. What is the difference between truly non- parametric and distribution free procedures?. [5]

SECTION B [60 marks]

Answer any **THREE** Questions being careful to number them B5 to B8.

- B5.** (a) What does the kolmogorov- smirnov test, test for ?Explain the rationale behind the test. [5]
- (b) A study was carried out to determine the age at which women start menstruating. A sample of 324 women was taken. The following data were obtained.

Age in years	10	11	12	13	14	15	16	17	18	19
Number of women	4	30	79	104	60	32	11	2	1	1

Use the Kolmogorov-Smirnov one sample procedure to test the hypothesis that these data follows a normal distribution. Use $\alpha = 0.05$. [15]

- B6.** (a) In a comparison of the effect on growth of two diets B and C, a number of growing rates were placed on these two diets and the following growth figures were observed after 7 weeks:

B	156	183	120	113	138	145	142			
C	109	107	119	162	121	123	76	111	130	115

Test for differences in diet at $\alpha = 0.05$ using the Mann - Whitney U-Test. [10]

- (b) Four different varieties (A, B, C and D) of seeds are applied for a small pivotal study to twenty- one with similar characteristics (soil, irrigation, slope e.t.c). The Yield obtained in suitable units are as follows:

A	2	4	3	4	6	
B	5	8	5	9	7	
C	8	10	9	8	10	11
D	14	15	13	9	11	

Apply the Kruskal- Wallis test at the 5% level of significance to test if the median yields of A,B, C and D are the same. [10]

- B7.** The weights of 4 people before they stopped smoking and 5 weeks after they stopped smoking in kilograms are as follows:

Individual	1	2	3	4	5
Before	66	80	69	52	75
After	71	82	68	568	73

Test the hypothesis, at the 0.05 level of significance, that one's weight increases if he or she quits smoking using:

- (a) sign test and find the p- value. [10]
- (b) Wilcoxon matched pair test. [10]
- B8.** (a) State the similarities and differences between Mcnemar test and Cochran test. [4]
- (b) Outline clearly how you would carry out the Siegel Turkey test for small samples. [6]
- (c) A University is considering the purchase of four buses for ferrying staff members. A test drive is done to determine acceptability of the buses to the staff members. A random sample of 10 drivers are selected, and each is assigned to drive each bus (in random order). Driver give each bus a score of 0 if they don't like the bus, or a 1 if they do like it. The results were tabulated as follows.

	Driver									
	1	2	3	4	5	6	7	8	9	10
Bus 1	1	1	0	0	1	1	1	0	1	0
Bus 2	1	1	1	0	1	1	1	0	1	1
Bus 3	1	1	0	1	0	1	1	0	0	0
Bus 4	0	0	1	1	0	0	0	1	0	0

- (i) Use Cochran's test at 5% level to test the hypothesis that the four buses have the same performance. [8]
- (ii) Deduce the interval containing the $p - value$. [2]

END OF EXAMINATION PAPER