

UNIVERSITY OF SWAZILAND
SUPPLEMENTARY EXAMINATION PAPER 2016/2017

TITLE OF PAPER: BIostatISTICS

COURSE CODE: B305

TIME ALLOWED: THREE (3) HOURS

- INSTRUCTIONS:
1. QUESTION 1 IN SECTION A IS COMPULSORY AND IT CARRIES 50 MARKS.
 2. ANSWER ANY TWO QUESTIONS IN SECTION B
 2. EACH QUESTION IN SECTION B CARRIES TWENTY FIVE (25) MARKS.
 3. ILLUSTRATE YOUR ANSWERS WITH LARGE AND CLEARLY LABELED DIAGRAMS WHERE APPROPRIATE.
 4. CLEARLY STATE YOUR NULL AND ALTERNATIVE HYPOTHESES AND YOUR CONCLUSIONS WHERE APPROPRIATE.
 5. SHOW ALL WORKING WHERE APPLICABLE.

SPECIAL REQUIREMENTS:

1. CALCULATORS (CANDIDATES MUST BRING OWN).
2. GRAPH PAPER.
3. STATISTICAL TABLES (TO BE SUPPLIED BY THE INSTRUCTOR).

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

SECTION A (Compulsory)

Question 1

- (a) Fifty-eight percent of Swazi adults say that they never wear a helmet when riding a bicycle. You randomly select 200 adults in Swaziland and ask them if they wear a helmet when riding a bicycle. What is the probability that at least 120 adults will say they never wear a helmet when riding a bicycle? (6 marks)
- (b) You randomly select 20 gum trees from the same plantation and determine the height of each tree at the age of 2 years. The sample mean is 9.75m, with a sample standard deviation of 2.39m. Construct a 99% confidence interval for the population mean height of gum trees. Assume the heights in this plantation are normally distributed. (6 marks)
- (c) Certain types of mining operations release mildly radioactive by-products. These by-products may be released into the freshwater supply during the processing of ores. The Swaziland Environmental Authority (SEA) has issued a regulation that sets the maximum level for naturally occurring radiation in drinking water at 5 picocuries per litre (5 pcu/L). To see if a Mbabane city's water supply is safe, 16 water specimens, X, were randomly selected from the residential and industrial areas, and the radiation, R, in each specimen was measured in pcu/L. The results are as shown below.

X	1	2	3	4	5	6	7	8
R	4.76	4.21	5.35	4.26	3.93	5.14	4.40	4.11

X	9	10	11	12	13	14	15	16
R	4.84	6.18	4.85	4.70	3.72	4.79	3.83	5.24

- (i) Using $\alpha = 0.01$ and a suitable H_0 , is there sufficient evidence to indicate the mean level of radiation is safe (below the SEA's maximum level)? (10 marks)
- (ii) Explain what type I and type II errors could be. (6 marks)
- (iii) Examine the dangers of making a Type II error in this case. (3 marks)
- (iv) Considering your answers to (i) and (ii) above, would you want type I error or type II error or both to be near zero? Justify your answer. (4 marks)
- (d) A feeding test is conducted on a herd of 25 milking cows to compare two diets, X and Y. A sample of 12 cows randomly selected from the herd is fed diet Y (dehydrated alfalfa), the remaining 13 cows are fed diet X (field-wilted alfalfa). From observations made over a 3-week period the average daily milk production is given in the table below.

Average daily milk after Diet X (L):	44, 44, 56, 46, 47, 38, 58, 49, 35, 46, 30, 53, 41
Average daily milk after Diet Y (L)	35, 47, 55, 29, 40, 39, 32, 41, 42, 57, 51, 39

Using a suitable statistical test, determine if diet has a significant effect on the average daily milk production. (15 marks)

[TOTAL MARKS = 50]

SECTION B (Answer any 2 questions from this section)

Question 2

- (a) The following table shows the wing lengths (cm) of 4 populations of *Drosophila*.

A	B	C	D
1.2	0.8	1.2	0.9
1.5	0.9	1.8	0.8
1.3	1.4	1.9	0.7
1.8	1.4	2.1	1.0
0.9	1.1	2.0	1.1
1.2	1.0	1.9	1.2

Given that homoscedasticity among populations is not guaranteed, Decipher whether or not these data suggest that that *Drosophila* in the 4 different populations have significantly different wing lengths. (15 marks)

- (b) Discuss in detail the various components of a good proposal. (10 marks)
[TOTAL MARKS = 25]

Question 3

The following data on student performance (%) and time (min) taken by a student to study were collected by a psychologist.

Test Score (%)	88	80	76	83	55	62	67
Time studied (min)	120	105	106	108	98	97	99

- (a) Determine if there is a significant correlation between the amount of time a student studied and his/her test score. (15 marks)
- (b) Present these data in an appropriate graph (10 marks)
[TOTAL MARKS = 25]

Question 4

The table below shows times to mating (hours) for female sagebrush crickets (*Cyphoderris strepitans*) that were recently starved and fed.

	Time to mating (hours)
Starved	1.9, 2.1, 3.8, 9.0, 9.6, 13.0, 14.7, 17.9, 21.7, 29.0, 72.3
Fed	1.5, 1.7, 2.4, 3.6, 5.7, 22.6, 22.8, 39.0, 54.4, 72.1, 73.6, 79.5, 88.9

- (a) Draw histograms for each group to check if the distribution is normal. (8 marks)
- (b) As a follow-up to your conclusion above, use a suitable test statistic to determine whether time to mating for female *C. strepitans* is the same in these two groups. (17 marks)

Question 5

Bias and sampling error have been observed to reduce accuracy and precision when estimating and testing effects of one variable on another.

Discuss experimental procedures that can be done to minimize bias and sampling error.

(25 marks)

[TOTAL MARKS = 25]

END OF EXAM PAPER