BINDURA UNIVERSITY OF SCIENCE EDUCATION

STATISTICS AND MATHEMATICS

SWE103/CSH204/ SFM 224: APPLIED STATISTICS 1

APR 2025

Time: 3 hours

Candidates may attempt any **ALL** questions. Each question should start on a fresh page.

1. (a) Differentiate categorical from continuous variables giving 4 examples of each. [8]

   (b) Define the following terms:

      i. target population [2]

      ii. undercover [2]

   (c) A study is run to evaluate the effectiveness of an exercise program in reducing systolic blood pressure in patients with pre-hypertension (defined as a systolic blood pressure between 120 – 139 mmHg or a diastolic blood pressure between 80 – 89 mmHg). A total of 15 patients with pre-hypertension enroll in the study, and their systolic blood pressures are measured. Each patient then participates in an exercise training program where they learn proper techniques and execution of a series of exercises. Patients are instructed to do the exercise program 3 times per week for 6 weeks. After 6 weeks, systolic blood pressures are again measured. The data are shown below.

Patient	Systolic BP Before Exercise	Systolic BP After Exercise
1	70	36
2	78	20
3	78	20
4	78	20
5	78	20
6	78	20
7	78	20
8	78	20
9	78	20
10	78	20
11	78	20
12	78	20
13	78	20
14	78	20
15	78	20

Is there is a difference in systolic blood pressures after participating in the exercise program as compared to before? [8]

Hint: Use the Wilcoxon Signed Ranks Test.

2. (a) Distinguish between measures of central tendency and measures of dispersion giving two examples of each. [4]

   (b) Define the term kurtosis and describe any three types of kurtosis you are familiar with. You may include diagrams in your description. [5]

   (c) Given the data 23, 54, 87, 42, 29, 19, 57, 38, 50, 26, 32, 20, 14, 3, 36, 44, 51, 16. Evaluate:

   i. the harmonic mean. [2]
   ii. the geometric mean. [2]
   iii. the median. [2]
   iv. $q_{0.42}$ [3]
   v. the interquartile range. [3]
   vi. determine with justification whether there are any outliers. [4]
   vii. state with justification if there is any type of skew. [2]

viii. draw a suitably labelled box plot. [3]

3. (a) State the four components of a time series. [4]

(b) The demand for a given month of a particular commodity for the years 2014-2017 is given in the table below.

Month	2014	2015	2016
Jan	82	85	90
Feb	71	85	80
Mar	80	93	85
Apr	90	95	100
May	113	125	123
Jun	110	115	115
Jul	100	102	105
Aug	88	102	100
Sept	85	90	90
Oct	77	78	80
Nov	75	72	80
Dec	82	78	80

Calculate:

i. the 3-point moving averages. [3]

ii. the 4-point moving averages. [3]

iii. the seasonal indices for each quarter. [5]

iv. the de-seasonalised values for the demand. [4]

v. the trendline equation. [4]

4. (a) Define the following terms:

i. Critical region. [2]

ii. Type II error. [2]

iii. Significance level. [2]

iv. The power of a statistical test. [2]

(b) It is claimed that a new drug is effective in the prevention of sea sickness. A large number of people that went on boat cruises were surveyed, and the results for a random sample of 100 individuals are summarized in the table below:

	Sickness	No Sickness
Drug Taken	26	49
No Drug Taken	14	11

i. Use a χ^2 test at the 5% level of significance to investigate whether there is evidence to support the claim made. [10]

ii. State your conclusion clearly. [2]

5. A general insurance company is debating introducing a new screening programme to reduce the claim amounts that it needs to pay out. The programme consists of a much more detailed application form that takes longer for the new client department to process. The screening is applied to a test group of clients as a trial whilst other clients continue to fill in the old application form. It can be assumed that claim payments follow a normal distribution. The claim payments data for samples of the two groups of clients are (in \$100 per year):

With Screening	24.5	21.7	35.2	15.9	23.7	34.2	29.3	21.1	23.5	28.3
Without Screening	22.4	21.2	36.3	15.7	21.5	7.3	12.8	21.2	23.9	18.4

(a) Calculate a 95% confidence interval for the difference between the mean claim amounts. [6]

(b) Comment on your answer. [1]

END OF EXAM