BINDURA UNIVERSITY OF SCIENCE EDUCATION

BIOLOGICAL SCIENCES DEPARTMENT

HBScED

BIOMATHEMATICS (BZH209)/ BIOSTATISTICS (BTEC216)/RESEARCH METHODS FOR BIOLOGISTS (BZH216).

EXAMINATION

2 HOURS (100 MARKS) – AUG 2024

INSTRUCTIONS

Answer FOUR questions. You MUST answer QUESTION 1 (Section A) and any THREE questions from section B. Each question carries 25 MARKS. Where a question contains subdivisions, the mark value of each subdivision is given in brackets. Illustrate your answers where appropriate with large, clearly labelled diagrams. You should not spend more than thirty minutes on each question.

SECTION A (COMPULSORY)

1. (a) Differentiate between the following terms.

(i) Reliability and accuracy [2]

(ii) Continuous and discontinuous data [2]

(iii) Statistic and parameter. [2]

(iv) Qualitative and quantitative variables. [2]

(v) Simple random sampling and systematic sampling. [2]

(b) The data below show blood cholesterol level, in mg/cm^3, of 20 patients admitted at a provincial hospital.

210 217 208 215 202 209 207 210 221 218 212 210 210

213 200 208 203 199 218 214

(i) Construct a stem and leaf display for the data. [4]

(ii) Calculate skewness and kurtosis of the data and comment in each case. [5]

(iii) Determine all quartiles for the data. [6]

SECTION B (ANSWER ANY THREE QUESTIONS)

2. (a) A biologist claims that the pH level of soil in two geographic locations have equal standard deviations. Soil samples from each location were randomly selected and yielded the following results:

Location A	Location B
$n = 16$	$n = 22$
$s = 0.95$	$s = 0.78$

At 5% significance, is there enough evidence to reject the biologist's claim? Assume the variable is normally distributed. [10]

b). . A zoologist believes that the number of lion births by season is uniformly distributed. To test the claim, the zoologist recorded the season in which 2 247 births took place. The results are shown in table 2.

Table 2 Seasonal distribution of lion births

Season	Number of Births
Spring	564
Summer	603
Fall	555
Winter	525

Can the zoologist reject the claim that the distribution is uniform? ($\alpha = 0.05$). [15]

3. (a) In a study of the effect of two fertilisers on yield, summary statistics shown below were observed from randomly selected plots.

Fertiliser A	Fertiliser B
Mean harvest = 134 kg / ha	Mean harvest = 143 kg / ha
$s = 6.9$ kg / ha	$s = 2.6$ kg / ha
$n = 8$ plots	$n = 10$ plots

At 5% significance level, can you conclude that the fertilisers have different effects on yield? Assume population variances are equal. [10]

(b) It is proposed that animals with a northerly distribution have shorter appendages than animals from a southerly distribution. Test an appropriate hypothesis using wing length data, in millimetres, for the humming bird shown in table 1. Assume population variances are not equal. ($\alpha = 0.05$) [15]

Table 1 Wing length measurements

Northern Individuals	Southern Individuals
120	116
113	117
125	121
118	114
116	116
114	118
119	123
	120

4. (a) A research organisation claims that there is a difference in the number of macroinvertebrate species between wells upstream and those downstream of a river system. Results of a random experiment of 35 wells from each location yielded the results shown below.

Upstream Wells	Downstream Wells
$\bar{x}$ = 22.9 species	$\bar{x}$ = 23.7 species
σ = 7.5 species	σ = 8.0 species
n = 35	n = 35

Do the results support the research organisation's claim? ($\alpha = 0.05$) Assume the variable is normally distributed. [10]

(b) Nineteen rescued day old chimpanzees kept in a National Park were assigned randomly among four experimental groups. Each group was fed a unique diet. The data in table 3 show body weight gain, in kilograms per year, after the animals were raised on the diets for one year.

Table 3 Weight gain of chimpanzees raised on different feeds

Feed 1	Feed 2	Feed 3	Feed 4
60.8	68.7	102.6	87.9
57.0	67.7	102.1	84.2
65.0	74.0	100.2	83.1
58.6	66.3	96.5	85.7
61.7	69.8		90.3

At 5% significance level, test the claim that the feeds affect weight gain differently. [15]

5. On different days, a diabetic runs different distances and measures his blood sugar concentration. The data generated are shown in table 7.

Table 8 Diabetic's blood sugar concentration

Distance (km):	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Blood Sugar (mg/l)	146	136	131	125	104	95	83	75

(a) Construct a scatter diagram for the data. [10]

(b) Calculate the regression equation and fit in the regression line on the scatter diagram. [10]

(c) Calculate the correlation coefficient (r) and comment. [5]

6. (a) Red Blood Cell (RBC) count was determined at various dosage of the antiretroviral drug, Complera, in adult monkeys infected with HIV. The results of the study are shown in table 4.

Table 4 RBC counts at different dosage of an antiretroviral drug

Dosage (mg/ml)	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RBC Count (million cells/cm^3 blood)	2.33	2.21	2.14	1.48	1.46	1.22	1.14	1.13

Calculate the correlation coefficient and comment. [12]

(b). In an investigation to determine the effect of temperature on the number of chirps a cricket makes in a minute, the data in table 5 were obtained.

Table 5 Chirps of crickets at different temperatures

Chirps in 1 min	882	1188	1104	864	1200	1032	960	900
Temperature (°C)	23.2	46.7	42.2	38.2	44.3	41.3	35.8	39.8

Is there a linear relationship between the number of chirps in 1 minute and the temperature? [13]

END OF EXAMINATION PAPER