



**RAJARATA UNIVERSITY OF SRI LANKA**  
**FACULTY OF APPLIED SCIENCES**

**Bachelor of Science in Applied Sciences**  
**First Year - Semester II Examination-January/February 2023**

**BIO 1202 - STATISTICAL METHODS IN BIOLOGY**

**Time: Two (02) hours**

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**Answer ALL questions.**

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1. a) The average number of calories in a 1.5-ounce chocolate bar is 225. Suppose that the distribution of calories is approximately normal with  $\sigma = 10$  calories. Calculate the probability that a randomly selected chocolate bar will have,
  - i. Between 200 and 220 calories.
  - ii. Less than 200 calories. **(40 marks)**
- b) The average number of milligrams (mg) of sodium in a certain brand of low-salt food item is 660 mg, and the standard deviation is 35 mg. Assume the variable is normally distributed.
  - i. If a single item is selected, find the probability that the sodium content will be more than 670 mg. **(30 marks)**
  - ii. If a sample of 10 items is selected, find the probability that the mean of the sample will be larger than 670 mg. **(30 marks)**
2. a) The average monthly income of 415 households was found to be Rs 5000 per month. The sample standard deviation of the population is Rs 900 per month.
  - i. Find the 95% and 99% confidence level of the mean for all students and comment on your answers. **(30 marks)**
  - ii. An individual claims that his household earns 4000 Rs per month. Is this claim realistic? Give reasons for your answer. **(10 marks)**
- b) A sample of six cows had an average weight of 276 kg with a sample standard deviation of 12 kg.
  - i. Find the 90% confidence interval of the true mean weight of cows. **(30 marks)**
  - ii. Suggest a method to increase the precision of the 90% confidence interval. Give reasons for your answer. **(30 marks)**

3. a) The average length of "short hospital stays" for men is slightly longer than that for women, 5.2 days versus 4.5 days. A random sample of recent hospital stays for both men and women revealed the following.

	Men	Women
Sample size	32	30
Sample mean	5.5 days	4.2 days
$\sigma$	1.2 days	1.5 days

At  $\alpha = 0.01$ , is there sufficient evidence to conclude that the average hospital stay for men is longer than the average hospital stay for women? **(40 marks)**

- b) A samples of body lengths from two populations of a reptile species that inhabit forests in Mihintale and Kandy are shown below. A researcher suspects that these two populations differ in their mean body length.

Mihintale	Kandy
83 60 75 58	77 59 72 58
78 59 70 58	37 57 66 55
62 61 59	61

- Propose a suitable statistical method that the researcher could use to test this claim and give reasons for your choice. **(10 marks)**
  - Carry out the proposed test at  $\alpha = 0.05$  and comment on your answer. **(50 marks)**
4. A researcher studying a species of albatross (marine bird), recorded the number of hours adults were away from the nest and the percentage of surviving chicks in each nest. The data is given in the table below.

Nest ID	Number of hours away from nest	% Survival of chicks
A	6	82
B	2	86
C	15	43
D	9	74
E	12	58
F	5	90
G	8	78

- Construct a scatter plot for the data set given above and comment on your answer. **(15 marks)**
- Carry out a statistical test to determine the relationship between the two variables. **(50 marks)**
- Carry out the necessary statistical analysis to predict the percentage of surviving chicks if adults were away for 13 hours. **(35 marks)**

5. A biologist hypothesizes that the abundance of two primate species is influenced by habitat disturbance. To further explore this issue, the investigator carries out a survey of the two species across three different habitats representing different disturbance regimes and records the number of groups of each species encountered in each habitat.

Species	Habitat disturbance level		
	Low	Moderate	High
<i>Semnopithecus sp.</i>	10	9	8
<i>Macaca sp.</i>	13	16	12

- a) Propose a suitable statistical method that the researcher could use to test this claim and give reasons for your choice. **(20 marks)**
- b) Carry out the proposed test at  $\alpha = 0.10$  and comment on your answer. **(80 marks)**

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## Equation sheet

$$s^2 = \frac{\sum (X - \bar{X})^2}{n - 1}$$

$$z = \frac{X - \mu}{\sigma}$$

$$z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$

$$\bar{X} - z_{\alpha/2} \left( \frac{\sigma}{\sqrt{n}} \right) < \mu < \bar{X} + z_{\alpha/2} \left( \frac{\sigma}{\sqrt{n}} \right)$$

$$\bar{X} - t_{\alpha/2} \left( \frac{s}{\sqrt{n}} \right) < \mu < \bar{X} + t_{\alpha/2} \left( \frac{s}{\sqrt{n}} \right)$$

$$\hat{p} - z_{\alpha/2} \sqrt{\frac{\hat{p}\hat{q}}{n}} < p < \hat{p} + z_{\alpha/2} \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$z = \frac{\hat{p} - p}{\sqrt{pq/n}}$$

$$z = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$$(\bar{X}_1 - \bar{X}_2) - z_{\alpha/2} \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} < \mu_1 - \mu_2 < (\bar{X}_1 - \bar{X}_2) + z_{\alpha/2} \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

$$(\bar{X}_1 - \bar{X}_2) - t_{\alpha/2} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} < \mu_1 - \mu_2 < (\bar{X}_1 - \bar{X}_2) + t_{\alpha/2} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n(\sum x^2) - (\sum x)^2][n(\sum y^2) - (\sum y)^2]}}$$

$$t = r \sqrt{\frac{n-2}{1-r^2}}$$

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

$$a = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2}$$

$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

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