University of Ruhuna

Bachelor of Science Special Degree Level II (Semester I)

Examination 2017

Unit: ZOO4184 **Time: Two (2) hours**

Instructions: Answer Four (04) Questions only.

1.

A normally distributed population of tilapia fish has a mean body weight of 250 g and standard deviation of 20 g.

(i) What proportion of this population is 275g or larger body weights?

(ii) What proportion of this population is 240g or smaller body weights?

(iii) What proportion of this population is between 260g and 230g body weights?

(iv) What is the probability that the average body weight of a random sample of 4 tilapia fish will be between 220g and 270g?

2.

(a) A market gardener decides to test a new pesticide, which the manufacturer claims increases the yields, by applying it to one of his two orchards. The treated orchard contains eighteen trees and the mean and standard deviation of the yield per tree are 98 kg and 10 kg respectively. The untreated orchard contains fourteen trees and the corresponding values are 94 kg and 8 kg.

(i) State the null and alternative hypotheses to test the manufacturer's claim.

(ii) Test the null hypothesis at the 5% level of significance.

(iii) State the assumption made for answering the part (ii).

(b) A random sample of six eggs taken from a day's production of a poultry farm had the following masses, measured in grams: 51.2, 52.6, 53.1, 53.2, 53.3, 54.7. Assuming that the data are normally distributed, find 95% confidence limits for the mean mass of the eggs produced that day.

3. In a biological experiment, three concentrations of a certain chemical are used to enhance the growth of a certain type of plant over time. Five plants are used at each concentration, and the growth in each plant is measured in centimeters. The following growth data are taken. A control (no chemical) is also applied.

	Concentration		
Control	1	2	3
6.8	8.2	7.7	6.9
7.3	8.7	8.4	5.8
6.3	9.4	8.6	7.2
6.9	9.2	8.1	6.8
7.1	8.6	8.0	7.4

(a) State the assumptions you would need to make in order to carry out an analysis of variance on these data

(b) State the null and alternative hypotheses for a one-way analysis of variance test.

(c) Construct the analysis of variance table.

(d) Assuming that the assumptions in the Part (a) above are satisfied, test the hypothesis in the Part (b) at 5% level of significance. State your conclusions.

4.

(a) The following table gives information on the amount of sugar (in grams) and the calorie count in one serving of a sample of 13 varieties of cereal.

Sugar (grams)	4	15	12	11	8	6	7	2	7	14	20	3	13
Calories	120	200	140	110	120	80	190	100	120	190	190	110	120

(i) Find the correlation coefficient.

(ii) Test at the 5% significance level whether the linear correlation coefficient between the two variables listed in the table is positive.

(b) Many industrial air pollutants adversely affect plants. Sulphur dioxide causes leaf damage in the form of intraveinal bleaching in many sensitive plants. In a study of the effect of a given concentration of Sulphur dioxide in the air on three types of garden vegetables, 40 plants of each type are exposed to the pollutant under controlled greenhouse conditions. The frequencies of severe leaf damage are recorded in the following table:

	Leaf Damage		
	Severe	Moderate or None	Total
Lettuce	32	8	40
Spinach	28	12	40
Tomato	19	21	40
Total	79	41	120

Analyze these data to determine if the incidence of severe leaf damage is alike for the three types of plants. In particular

(i) Formulate the null hypothesis

(ii) Test the null hypothesis with $\alpha = 0.05$.

5.

(a) Briefly explain the following designs:
   (i) Completely randomized design,
   (ii) Randomized block design

(b) Write down the mathematical model and the relevant null hypotheses for the fixed effects two-factor model.

(c) A study is made of amino acids in the hemolymph of millipedes. For a sample of four males and four females of each of three species, the following concentrations of amino acid, alanine (in mg/100ml), are determined:

	Species 1	Species 2	Species 3
Male	21.5	14.5	16.0
	19.6	17.4	20.3
	20.9	15.0	18.5
	22.8	17.8	19.3
Female	14.8	12.1	14.4
	15.6	11.4	14.7
	13.5	12.7	13.8
	16.4	14.5	12.0

The following two-factor analysis of variance is carried out and the SPSS outputs are as follows:

Between-Subjects Factors

		Value Label	N
Gender	1	Male	12
	2	Female	12
Species	1	Species 1	8
	2	Species 2	8
	3	Species 3	8

Tests of Between-Subjects Effects

Dependent Variable: Concentration

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	200.872[a]	5	40.174	19.021	.000
Intercept	6321.260	1	6321.260	2992.903	.000
Gender	138.720	1	138.720	65.679	.000
Species	55.261	2	27.630	13.082	.000
Gender * Species	6.891	2	3.445	1.631	.223
Error	38.017	18	2.112		
Total	6560.150	24			
Corrected Total	238.890	23			

a. R Squared = .841 (Adjusted R Squared = .797)

(i) Test the hypothesis that there is no difference in mean hemolymph alanine concentration among the three species.

(ii) Test the hypothesis that there is no difference between males and females in mean hemolymph alanine concentration.

(iii) Test the hypothesis that there is no interaction between sex and species in the mean concentration of alanine in hemolymph.