THE OPEN UNIVERSITY OF SRI LANKA

B.I/D.I. Programme

ADU4319 – STATISTICS FOR AGICULTURE II

FINAL EXAMINATION 2017/2018

Duration: Two Hours.

Date: 01.04.2019	Time: 01.30p.m- 03.30p.m

Answer FOUR questions only.

Instructions:

- **This question paper consists of 06 questions and 04 pages.**
- **Statistical Tables are provided.**
- **Non-programmable calculators are permitted.**
- **Consider the level of significance as 0.05 for all the tests.**

(1) A pharmaceutical company has produced a new drug, say drug C for the treatment of headaches. Suppose there are another 2 drugs produced by 2 different companies also available in the market for the treatment of headaches at present, say A and B. A researcher wants to know whether three types of drugs have the same effect on the headache. He measures the effect as the time (in minutes) taken for a normal dose of drug to bring down the pain.

(a) Assume that the researcher has a sample of 18 male patients randomly selected from a homogeneous group of male patients suffering from headache.

   (i) What experimental design you would select to perform the study? Justify your answer.

   (ii) Briefly explain how you would design an experiment to solve the researcher's problem.

(b) Instead of having 18 male patients as in part(a), if male and female patients (each containing 9 patients) are available,

   (i) What experimental design you would select to perform the study? Justify your answer.

   (ii) Briefly explain how you would design an experiment to solve the researcher's problem.

(2) A biologist wished to study the effects of ethanol on sleep time. A sample of 20 rats, same for age and other characteristics, was selected and each rat was given an oral injection having a particular concentration of ethanol per body weight. The rapid eye movement (REM) sleep time for each rat was then recorded for a 24- hour period with the following results.

Concentration of ethanol	Observations					Total
0 (control)	88.6	73.2	91.4	68.0	75.2	**396.4**
1ml/kg	63.0	53.9	69.2	50.1	71.5	**307.7**
2ml/kg	44.9	59.5	40.2	56.3	38.7	**239.6**
4ml/kg	31.0	39.6	45.3	25.2	22.7	**163.8**

Total uncorrected sum of squares $= \sum y^2 = 68697.6$

(a) In relation to this study, identify

    (i) Response variable

    (ii) Experimental unit

    (iii)Treatments

(b) Identify the design used in this study. Justify your answer.

(c) Specify the hypotheses that are to be tested.

(d) Construct the complete analysis of variance (ANOVA) table and test your hypotheses in part (c).

(e) Based on the decision you have taken above, what can you conclude about the effect of ethanol on sleep time?

(3) A researcher wanted to compare 3 different rainfall measuring devices, say A, B, C to measure rainfall. He measured rainfall in a particular area in six rainy days using these 3 devices. The results of the measurements are given in the following table.

Device	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
A	1.38	9.69	0.39	1.42	0.54	5.94
B	1.42	10.37	0.39	1.46	0.55	6.15
C	1.49	10.59	0.41	1.45	0.65	6.36

Total uncorrected sum of squares $= \sum y^2 = 441.02$

(a) Identify the design structure used in this experiment. Justify your answer.

(b) Write down the equation of the model for the design in part(a). Clearly explain the parameters in the model.

(c) Write down the hypotheses to test whether the devices give same results on average.

(d) Construct the analysis of variance table.

(e) Test your hypotheses in part (b) and write down your conclusions.

(4) A researcher wanted to study whether there is an effect of shelf space on food sales. He selected 5 different shelf spaces, say A, B, C, D, E. The experiment was carried out over a 5-week period using five different stores, say P, Q, R,S,T, resulting in the following data on sales of powdered coffee:

Store	Week					Total
	1	2	3	4	5	
P	18(D)	17(C)	14(A)	21(B)	17(E)	87
Q	13(C)	37(B)	21(E)	16(A)	15(D)	102
R	7(A)	29(D)	32(B)	27(E)	13(C)	108
S	17(E)	13(A)	24(C)	31(D)	25(B)	110
T	21(B)	26(E)	26(D)	31(C)	7(A)	111
Total	76	122	117	126	77	518

Total uncorrected sum of squares = $\sum y^2$ = 12234

Shelf spaces	A	B	C	D	E
Total	57	136	98	119	108

(a) Identify the design used in this experiment. Justify your answer.

(b) Construct the ANOVA table and test appropriate hypotheses. Interpret your results.

(c) Test the hypothesis that effects of shelf spaces (A) and (B) are equal.

(d) The estimated error variance in an RCBD with the stores as blocks was 13.06. Which design do you prefer? Justify your answer.

(5) A scientist suspects that the yield of a chemical process is influenced by the pressure and the temperature. He selected two levels of each factor and performed the experiment having two replicates with each combination of pressure and temperature. The yield data (in grams) are presented in the following table.

Temperature	Pressure					
	200			230		
150	90.4	90.2	90.1	89.5	88.7	88.1
170	91.2	90.9	91.9	90.4	91.5	90.8

(a) Identify the treatment structure of the experiment. Justify your answer.

(b) Write down the model for the response measured on a randomly chosen chemical process. Clearly explain all the terms you use.

(c) Construct the complete analysis of variance table.

(d) Test whether the effects of pressure and temperature on the yield are significant or not. Clearly explain your answer.

(6) Four different designs for a digital computer circuit are being studied in order to compare the amount of noise present (low noise is best). The following data have been obtained:

Circuit Design	Noise Observed				
1	19	20	19	30	8
2	80	61	73	56	80
3	47	26	25	35	50
4	95	46	83	78	97

(a) Estimate the average noise level for *circuit design 1* along with its standard error.

(b) Construct a 95% confidence interval for the difference between the average noise level of *circuit designs 1* and *2*.

(c) Interpret the confidence interval that you obtained in part(d).

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4