

THE OPEN UNIVERSITY OF SRI LANKA
 B.Sc. Degree Programme
 OPEN ELECTIVE - LEVEL 05
 ADU5319 - DESIGN AND ANALYSIS OF EXPERIMENTS
 NO BOOK TEST 2017/2018
Duration: One Hour



Date: 31.01.2019

Time: 04.15 p.m- 05.15 p.m

Answer all questions

Instructions:

- **This question paper consists of 02 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.**
- **Handover first 3 pages of the question paper and your answer sheets.**

- (1) A manager of a company wishes to determine whether 5 kinds of desk calculators, say *A*, *B*, *C*, *D*, *E*, are equally effective. He designed an experiment involving 5 different operators. Since operator variability was believed to be a significant factor, each of the 5 operators was trained on each of the 5 calculators in random order. The efficiency data (in seconds) are recorded. A part of the ANOVA table related to this study is given below and use it to answer part (i) to (x).

ANOVA Table

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F value
Calculator	***	309.84	***	***
Operator	***	3173.44	***	34.67
Error	***	***	***	
Total	24	3849.44		

In the following multiple-choice questions, select the best answer.

- (i) What is the design used in this study?
- a. CRD
 - b. RCBD
 - c. Latin Square
 - d. None of the above

- (ii) What is the response variable in this study?
- Calculators
 - Operators
 - Efficiency data
 - None of the above
- (iii) The null hypothesis for this study is:
- At least one type of calculator has a different mean.
 - $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$
 - $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = 0$
 - None of the above
- (iv) Degrees of freedom of calculator, operator and errors are
- 5,5,14
 - 4,5,15
 - 5,4,15
 - 4,4,16
- (v) Mean squares of calculator, operator and errors are:
- 61.9, 634.7, 26.2
 - 77.5, 634.7, 24.4
 - 61.9, 793.4, 24.4
 - 77.5, 793.4, 22.9
- (vi) The $F_{\text{calculated}}$ value of calculator for this test is:
- 3.18
 - 3.38
 - 2.38
 - 2.58
- (vii) The value of F_{table} for this test is:
- 3.48
 - 3.06
 - 2.78
 - 2.90
- (viii) The $F_{\text{calculated}}$ value of operator for this test is 34.67. Which of the following statement is more correct?
- There is no difference between operator effects
 - There is a difference between operator effects
 - At least one operator effect is significant
 - None of the above

- (ix) What is the appropriate interpretation of this test?
- Reject H_0 : All five calculators have different average efficiency time.
 - Reject H_0 : At least one of the calculators differs from the others in terms of their average efficiency time
 - Fail to reject H_0 : There is no significant difference between average efficiency time of 5 calculators.
 - Fail to reject H_0 : There is insufficient evidence for differences in average efficiency time of calculators.
- (x) Ninety five percent (95%) confidence interval for the difference between the average efficiency level for calculator A and calculator B is $(-3.64, 9.24)$. Which statement of the following is correct?
- Calculator A and calculator B are not equally effective.
 - Calculator A and calculator B are equally effective.
 - There is insufficient evidence for difference in average efficiency time of calculator A and calculator B .
 - None of the above.

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- (2) In an experiment to study the effects of different types of background music on the productivity of bank tellers, five types of music *A*, *B*, *C*, *D* and *E* were tested for five working days within five weeks. Following results were obtained.

Week	Day					Total
	Mon	Tue	Wed	Thu	Fri	
1	18(D)	17(C)	14(A)	21(B)	17(E)	87
2	13(C)	37(B)	21(E)	16(A)	15(D)	102
3	7(A)	29(D)	32(B)	27(E)	13(C)	108
4	17(E)	13(A)	24(C)	31(D)	25(B)	110
5	21(B)	26(E)	26(D)	31(C)	7(A)	111
Total	76	122	117	126	77	518

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

Treatment	A	B	C	D	E
total	57	136	98	119	108

- (a) Construct the ANOVA table and test appropriate hypotheses.
 (b) Clearly state the findings based on the results obtained from part(a).

