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(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

(MATHEMATICS)

COURSE CODE: STA 345

COURSE TITLE: EXPERIMENTAL DESIGN I

DATE: 08/01/18

TIME: 9 AM - 11 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (30 MARKS)

- a) Briefly discuss three principles of experimentation (6 mks)
- b) State the assumptions of any statistical experimental design model (4 mks)
- c) A soda processing firm wanted to test whether or not selling on different seasons in the year had any impact on the average number of sodas sold. The number of lots sold per season varied from 1 to 4. The data for one year was as shown below

Season	Sales ("000")			
Spring	4	4.5		
Autum	5	3.8	4	
Winter	2.5	2.8	2.9	3
Summer	2			

Taking the level of significance as 5% and assuming normality of the random elements, test the null hypothesis of no difference between the seasons (10mks)

- d) The following are marks obtained in a test by a sample of students in a BSc (Mathematics) class.

Female students sampled: 18 20 36 50 49 36 34 49 41

Male students sampled: 29 28 26 35 30 44 46

Examine at 1% level of significance if the two groups of students are drawn from the same class

QUESTION TWO (20 marks)

- a) A set of data involving 4 tropical feeds P, E, R and S are tried on 20 chickens, is given below. All the 20 chicken are treated a like in all respect except on feeding treatment and each feeding treatment is given to 5 chicks. Analyze this data and determine if the treatments have the same effect (use 5% level of significance)

P	55	49	42	21	52
Q	61	112	30	89	63
R	42	97	81	95	92
S	167	137	169	85	154

(10 mks)

- b) A manufacturer of steel is interested in improving the tensile strength of the product. Product engineers think that tensile strength is a function of the iron concentration in the alloy and that the range of iron concentrations of practical interest is between 5% and 20%. A team of engineers responsible for the study decide to investigate four levels of iron concentration: 5%, 10%, 15%, and 20%. They decide to make up six test specimens at each concentration level, using a pilot plant. All 24 specimens are tested on a laboratory tensile tester in a random order. The data from this experiment are shown in the table below

Hard	√	Observations
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concentration (%)						
	1	2	3	4	5	6
5	7	8	15	11	9	10
10	12	17	13	18	19	15
15	14	18	19	17	16	18
20	19	25	22	23	18	20

Test at 5% significance level whether or not the hard wood concentration causes a significant difference in the tensile strength. (10mks)

QUESTION THREE (20 MARKS)

- (a) Analyse the following randomized block design after estimating the missing value X at 5% significance level. (10 mks)

Blocks					
Treatments		I	II	III	IV
	1	9	X	13	16
	2	16	18	17	23
	3	10	19	12	16

- (b) In an agricultural station an experiment was performed to determine whether there was any difference in the yield of five varieties of maize. The design adopted was five randomized blocks of five plots each. The yield in kgs per plot obtained in the experiment is given below.

Maize seed varieties					
Plots		H614	H624	H530	H514
	A	20	13	24	15
	B	29	12	18	15
	C	46	33	33	21
	D	28	35	26	25
	E	34	41	13	48

Analyse the design and comment on your findings

(10mks)

QUESTION FOUR (20 MARKS)

Set up an analysis of variance for the following results in a Latin square design, taking $\alpha = 5\%$. (20mks)

A	C	B	D
5	10	5	4
C	B	D	A
7	6	4	3
B	D	A	C
15	10	5	10
D	A	C	B
10	4	20	8

QUESTION FIVE (20 MARKS)

Starting with a linear additive model of the form $y_{ij} = \mu + t_i + b_j + e_{ij}$, where μ is the grand mean yield t_i is the i^{th} treatment effect, b_j is the j^{th} block and e_{ij} is the random error effect

Show that $S^2_T = S^2_e + S^2_t + S^2_b$, where S^2_T is total sum of squares, S^2_e is sum of squares due to random error, S^2_t is sum of squares due to treatment and S^2_b is sum of squares due to treatment, and hence show that the mean sum of squares due to random error is an unbiased estimator of the error variance, δ^2_e (20 mks)