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SCIENCE AND TECHNOLOGY**

UNIVERSITY EXAMINATIONS 2012 / 2013

EXAMINATION FOR THE DEGREE OF MASTER OF
SCIENCE IN APPLIED STATISTICS

SAS 810: DESIGN AND ANALYSIS OF EXPERIMENTS

Instructions:

- This paper consists of **FIVE** Questions
- Answer Any **THREE** Questions.
- Observe further instructions on the answer booklet.

QUESTION ONE

[20 Marks]

(a) What is meant by a Randomised Block Design? (2 Marks)

(b) The following table gives the gain in yields of 4 varieties of wheat arranged in Randomised blocks where A,B,C, and D are the varieties.

varieties	1	2	3	4	5
A	15.3	25.1	20.2	21.2	18.5
B	10.6	18.7	16.0	18.6	16.3
C	11.5	18.4	17.4	12.6	19.7
D	10.0	18.0	11.8	18.8	11.7

At 1% level, test whether;

- i. the four varieties of wheat differ in the field,
- ii. blocks are significantly different. If
- iii. the varieties of wheat are significantly different, which variety of wheat should be preferred?
- iv. Determine its efficiency relative to an equivalent Completely Randomised Design.

(18 Marks)

QUESTION TWO

[20 Marks]

(a) Construct a 2^4 design in which $A_1A_2A_3$ and $A_2A_3A_4$ are confounded.

(5 Marks)

(b) For a factorial experiment with three factors, each at two levels, obtain the estimates of the main effects, two-factor interactions and three-factor interactions.

(10 Marks)

(c) If the eight treatments in (b) above are denoted by (X_1, X_2, X_3) where $X_i = 0, 1 \quad i = 1, 2, 3$ are arranged in two replications having two blocks with the following field plan;

Replication 1

Block One:	(0,1,0)	(0,1,1)	(1,0,0)	(1,0,1)
Block Two:	(0,0,0)	(0,0,1)	(1,1,0)	(1,1,1)

Replication 2

Block One:	(0,1,0)	(1,1,0)	(0,0,1)	(1,0,1)
Block Two:	(0,0,0)	(1,0,0)	(0,1,1)	(1,1,1)

Find out the confounded treatment effects.

(5 Marks)

QUESTION THREE

[20 Marks]

- (a) Define a treatment contrast. When are two such contrasts said to be orthogonal?

(5 Marks)

- (b) An experiment was planned to study the effect of a solvent of Potash (P) and Super-Phosphate (K) on the yields of potatoes. All combinations of 2 levels of K and two levels of P were studied in a Randomised Block Design with 4 replications, given the following yields;

Block I: (1)=23;(k)=25;(p)=22;(pk)=38

Block II: (p)=40;(1)=26; (k)=36; (pk)=38

Block III: (1)= 29; (k)=20; (pk)=30; (p)=20

Block IV: (pk)=34; (k)=31; (p)=24; (1)=28

Analyse the data.

(15 Marks)

QUESTION FOUR

[20 Marks]

- (a) Describe a Balanced Incomplete Block Design. (3 Marks)
- (b) For a BIB design to exist, two conditions must be satisfied. What are these conditions? (2 Marks)
- (c) From equations of 2-flat in $PG(2,3)$ and $EG(3,2)$, construct BIB designs.

(15 Marks)

QUESTION FIVE

[20 Marks]

(a) Define a PBIB design. (2 Marks)

(b) Prove Fisher's inequality that states that in a BIB design, $b \geq v$.

(8 Marks)

(c) The number of Kilowatt hours of electricity used in a month by random samples of 12, 8, and 10 households in Town A, Town B, and Town C, respectively, are as follows;

Town A: 28,18,25,23,23,36,29,42,28,30,17,21

Town B: 30,34,36,33,26,24,25,28

Town C: 32,32,28,32,34,36,32,31,31,31

Construct an ANOVA table for this data and test whether the use of electricity in the 3 locations is the same.

(10 Marks)