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MST-005

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

00226

June, 2016

MST-005 : STATISTICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 50*

Note :

(i) *Question no. 1 is **compulsory**. Questions no. 2 to 5 have internal choices.*

(ii) *Use of scientific calculator is allowed.*

(iii) *Use of Formulae and Statistical Tables Booklet for PGDAST is allowed.*

(iv) *Symbols have their usual meaning.*

1. State whether the following statements are *true* or *false*. Give reasons in support of your answers. *5×2=10*

(a) In cluster sampling, $s_w^2 > s_b^2$, where s_w^2 represents the variance within clusters and s_b^2 between clusters.

(b) When population size N is not a multiple of sample size n, linear systematic sampling is appropriate.

(c) If the sum of squares of errors in a two-way ANOVA having 4 rows and 5 columns is given as 48, the mean sum of squares will be 4 for the same.

(d) If there is one missing value in Randomised Block Design with 3 blocks and 4 treatments, the total degrees of freedom will be 10.

(e) Pseudo Random Numbers (PRN) are not the random numbers.

2. The table given below presents the summary of data of complete census of all the 450 farms of wheat in a region. The farms were stratified according to farm size (in acres) into 2 strata. The population values of strata means ($\bar{X}_i$) and standard deviation (σ_i) for the area under wheat are given as follows :

Strata No.	Farm Size (in Acres)	No. of Farms	Strata Means	Standard Deviation
1.	0 – 100	300	45	15
2.	100 – 200	150	90	60

How would you draw the sample of size 45 using (i) Proportional allocation; (ii) Neyman allocation ? Also obtain the variance of the estimate of the population mean for the proportion allocation and compare its efficiency with simple random sampling without replacement. *10*

OR

Distinguish between linear and circular systematic sampling with an example. The information regarding production of wheat (in thousand kg) in 25 districts are collected for a particular reason. Select all possible systematic random samples of 7 units from the data given below (using appropriate method) : *10*

23, 20, 30, 37, 76, 36, 13, 36, 16, 58, 53, 83, 10, 15, 13, 17, 12, 16, 17, 21, 20, 18, 61, 31, 71.

3. (a) Describe the assumption of randomness in ANOVA. *2*

(b) A manufacturer wishes to determine the effectiveness of four types of machines A, B, C and D in the production of bolts. To accumulate this, the number of defective bolts produced for each of two shifts are shown in the following table :

Machine	I Shift	II Shift
A	24	30
B	41	44
C	32	31
D	28	38

Perform an Analysis of Variance method to determine whether there is a difference (a) between machines, and (b) between the shifts, at 5% level of significance. *8*

OR

(a) Describe the mathematical model used in Two-way Analysis of Variance. Mention the hypotheses employed. 3

(b) The following data represents the production (in kg) of three varieties of wheat P, Q and R shown as :

P	14	16	18		
Q	14	13	15	22	
R	18	16	19	15	20

Is there any significant difference in the production of these varieties at 5% level of significance ? 7

4. In the following design, the letters A, B, C and D represent 4 varieties of wheat; the rows represent 4 different fertilizers; and the columns represent 4 different years. The data are the yields for the 4 varieties of wheat measured in kilograms per plot. Under the assumption that various sources of variation don't interact, test at $\alpha = 0{\cdot}05$, the hypothesis that there is no difference in the (i) average yields of the 4 varieties of wheat, (ii) fertilizers and (iii) years : 10

Fertilizers \ Year	2001	2002	2003	2004
1	A 70	B 75	C 68	D 81
2	D 66	A 59	B 55	C 63
3	C 59	D 66	A 39	B 42
4	B 41	C 57	D 39	A 55

OR

A 2^2 experiment was conducted in order to obtain an idea of the interaction : spacing × number of seedlings per hole, along with the effects of different types of spacing and different number of seedlings per hole while adopting the Japanese method of cultivation.

The levels of two factors are :

s (8″ spacing in between; 10″ spacing in between) and n (3 seedlings per hole; 4 seedlings per hole). The field plan and yield of dry Aman paddy (in kg) for each plot are given below :

Block 1 :	(1)	(s)	(ns)	(n)
	117	106	109	114
Block 2 :	(ns)	(1)	(s)	(n)
	114	120	117	114
Block 3 :	(1)	(n)	(s)	(ns)
	111	117	114	106
Block 4 :	(ns)	(n)	(s)	(1)
	93	121	112	108
Block 5 :	(ns)	(s)	(1)	(n)
	75	97	73	38
Block 6 :	(n)	(1)	(ns)	(s)
	58	81	105	117

Analyse the data to find out if there are any significant treatment effects – main or integration. *10*

5. (a) Explain Lottery method of generation of random numbers with an example. 3

(b) Generate a complete cycle for the Linear Congruential Generator given below :

$x_i = (5x_{(i-1)} + 3) \bmod(16)$, with $x_0 = 5$.

Also obtain a sequence of heads and tails using them. 7

OR

The following table gives the frequency distribution of 100 random numbers generated from N(0, 1) distribution :

Class Interval	Frequency
$\leq (-2{\cdot}5)$	02
$(-2{\cdot}5) - (-1{\cdot}5)$	04
$(-1{\cdot}5) - (-1{\cdot}0)$	08
$(-1{\cdot}0) - (-0{\cdot}5)$	18
$(-0{\cdot}5) - 0$	19
$0 - 0{\cdot}5$	12
$0{\cdot}5 - 1{\cdot}0$	14
$1{\cdot}0 - 1{\cdot}5$	14
$1{\cdot}5 - 2{\cdot}0$	05
$2{\cdot}0 - 2{\cdot}5$	02
$2{\cdot}5 - 3{\cdot}0$	02

Using chi-square test of randomness determine whether the fit is satisfactory. 10