No. of Printed Pages : 5

MST-005

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 2015

00827

MST-005 : STATISTICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 50*

Note :

(i) *Question no.* **1** *is* **compulsory**. *Question nos.* **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 meanings.*

1. State whether the following statements are **True** or **False**. Give reason in support of your answer. **5x2=10**

(a) The probability of selection of any one sample out of $\binom{N}{n}$ samples is $1/N^n$.

(b) For the validation of the F-test in ANOVA, the assumption is made that "the observations are dependent".

(c) If there are two missing values in a randomised block design with 4 blocks and 5 treatments, the error degree of freedom will be 10.

(d) When population size N is multiple of sample size n, circular systematic sampling is appropriate.

(e) If a random number 13 is generated by middle square method, then the next random number generated is 16.

2. (a) Consider a population of 6 units with values 1,2,3,4,5 and 6. Write down all possible samples of size 2 (without replacement) which can be drawn from the given population and verify that sample mean is an unbiased estimate of the population mean. Also calculate the sample variance and verify that : 7

$$\underset{\text{SRSWR}}{\text{Var}\ (\bar{x})} > \underset{\text{SRSWOR}}{\text{Var}\ (\bar{x})}$$

(b) What is a simple random sample ? Explain briefly the "Random Number Method" of drawing a simple random sample from a population of size N (<99). 3

OR

A sample of 30 students is to be drawn from a population consisting of 300 students belonging to colleges A and B. The means and standard deviations of their marks are given below : 10

	Total Number of Students (N_i)	Mean $(\bar{Y}_{N_i})$	Standard Deviation (σ_i)
College A	200	30	10
College B	100	60	40

How would you draw the samples using proportional and Neyman allocation techniques ? Obtain the variance of estimate of population mean for proportional allocation and compare its efficiency with simple random sampling without replacement.

3. (a) State the mathematical model used in ANOVA for two way classification. Mention the hypotheses employed. 3

(b) Three drying formulas for a glue were studied and the following drying times (in minutes) were observed : 7

Formula A : 13 10 8 11 8

Formula B : 13 11 14 14

Formula C : 04 01 03 04 02 04

At $\alpha = 0.01$, test the hypothesis that the average drying times for the three formulas are the same.

OR

(a) What is ANOVA ? Give the assumptions underlying it. 2

(b) In an experiment to study the performance of 4 different detergents for cleaning fuel injectors of 3 different models of engines, the following data were obtained : 8

Detergent	Engine		
	1	2	3
A	45	43	51
B	47	46	52
C	48	50	55
D	42	37	49

Construct the ANOVA table and test whether there are differences :

(i) in the detergents

(ii) in the engines, at 5% level of significance

4. In the following 3x3 design, the letters A,B and C represent the three methods for soldering copper electrical leads. The rows represent 3 different operators doing the soldering and the columns represent the 3 different solder fluxes used. The data is the number of pounds of tensile force required to separate the solder leads. Assuming that various sources of variation do not interact, test at 5% level of significance whether there are differences in : 10

(a) the methods,

(b) the operators and

(c) the fluxes

Operator \ Flux	Flux 1	Flux 2	Flux 3
Operator 1	A (14.0)	B (16.5)	C (11.0)
Operator 2	C (9.5)	A (17.0)	B (15.0)
Operator 3	B (11.0)	C (12.0)	C (13.5)

OR

An experiment was planned to study the effect of sulphate of potash and super phosphate on the yield of potatoes. All the combinations of 2 levels of super phosphate [0 cent (p_0) and 5 cent (p_1)/ acre] and two levels of sulphate of potash [0 cent (k_0) and 5 cent (k_1)/ acre] were studied in a randomised block design with 4 replications for each. The following yield (lb per plot = 1/70 acre) data were obtained : 10

Block				
I	(1)	(k)	(p)	(kp)
	23	25	22	38
II	(p)	(1)	(k)	(kp)
	40	26	36	38
III	(1)	(k)	(kp)	(p)
	29	20	30	20
IV	(kp)	(k)	(p)	(1)
	34	31	24	28

Analyse the data and give your conclusion.

5. (a) Explain Middle Square Method of generation of random numbers with an example. 5

(b) Give an algorithm using IPT method to generate variate from the following Beta probability density function : 5

$$f(x) = 6x\ (1-x) \qquad 0 \le x \le 1$$

Also find x when $u = 0.5$

OR

(a) Describe briefly the principal steps in simulation. 4

(b) The following V (0, 1) were generated by a generator. Apply chi-square goodness of fit test to test the fitting of the distribution as follows : 6

Class Interval	Class Frequency (n_j)
0.0 - 0.2	5
0.2 - 0.4	14
0.4 - 0.6	7
0.6 - 0.8	4
0.8 - 1.0	10