

Assignment MST-020

for

M.Sc. (Applied Statistics) (MSCAST)

Valid from January 2025 to December 2025

SCHOOL OF SCIENCES

Indira Gandhi National Open University New Delhi - 110068

Dear Learner,

Welcome to the M.Sc. (Applied Statistics) Programme.

As per the university guidelines, you need to complete the assignment for each theory course. Note that there are no assignments for lab courses in the MSCAST programme, namely, MSTL-011, MSTL-012, MSTL-013, MSTL-014, and MSTL-015. You should remember that writing answers to an assignment's questions will improve your writing skills and prepare you for the term-end examination.

It is compulsory to submit the assignments within the stipulated time to be eligible to appear in the term-end examination. You will not be allowed to appear for the term-end examination for a course if you do not submit the assignment for that course by the due date. As per the University guidelines, if you appear in the term-end examination of a course without submitting its assignment, the result of the term-end examination is liable to be cancelled/ withheld.

The assignments constitute the continuous component of the evaluation process and have 30% weightage in the final grading.

Before you write the assignments, you are advised to first go through the self-learning material for that course and then prepare the assignments carefully by following the instructions pertaining to the assignments. Your responses should not be a verbatim reproduction of the textual materials provided for self-learning purposes, but it should be in your own words.

If you have any doubts or problems pertaining to the course material and assignments, contact the programme in charge or the academic counsellor at your study centre. If you still have problems related to this assignment, feel free to contact the course coordinator.

Wishing you all the best in successfully completing the programme.

(Prof. Manish Trivedi) Course Coordinator, MST-020 Email: manish_trivedi@ignou.ac.in

Instructions:

- Submit the assignments within the stipulated time. Otherwise, you will not be permitted to appear for the term-end examination.
- Solve the latest assignments uploaded for the current year/session.
- Read the instructions related to the assignments mentioned in the Programme Guide.
- Use only A-4 size paper to write your responses. It is mandatory to write all assignments neatly in your own handwriting. Typed or printed copies of the assignments will not be accepted. Note that you may use the printout only if a question specifically asks for the output of a program in MST-015 and MST-024.
- > All questions given in the assignments are compulsory for each course.
- Express your response in your own words. You are advised to restrict your response based on the marks assigned to it. This will also help you to distribute your time in writing or completing your assignments on time.
- Securely fasten multiple pages together (you can staple or tie them) and number them carefully for each assignment separately.
- Do not forget to enclose the assignment question sheet of that course after the cover page of the assignment response (answer sheets). It is not compulsory to write each question separately before answering the question. Mention the question number for each answer.
- The solved assignment must be submitted at the Study Centre allotted to you before the due date set by the University. Please check the IGNOU website for updated information regarding the due date of assignment submission.
- You are advised to mention all information on the first page of the assignment response sheet, given on the next page.
- Keep a copy of the assignment answer sheets with you before submission for future reference.

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ASSIG	AMENT CODE: MST-020/TMA/2025	
NAME:		
ENROLLMENT	NO:	
ADMISSION CYC	CLE:	
PROGRAMME (CODE: <u>MSCAST</u>	
COURSE CODE	: <u>MST-020</u>	
COURSE TITLE	: SURVEY SAMPLING AND DESIGN OF EXPERIMENTS-II	
REGIONAL CEN	TRE CODE:	
STUDY CENTRI	E CODE:	
ADDRESS:		
CONTACT NUM	IBER:	
EMAIL ID:		
DATE OF SUBMI	SSION:	
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	School of Sciences	

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TUTOR MARKED ASSIGNMENT

MST-020: Survey Sampling and Design of Experiments-II

Course Code: MST-020 Assignment Code: MST-020/TMA/2025 Maximum Marks: 100

Note: All questions are compulsory. Answer in your own words.

- 1. State whether the following statements are true or false and also give the reason in support of your answer: $(2\times5=10)$
 - a) If X and Y are uncorrelated, the $V(\overline{Y}_{Reg})$ reduces to that of Variance of Ratio Estimator of Population mean
 - b) Among all the members of the General Class of the estimators only Regression estimator is an unbiased estimator of the Population mean.
 - c) An Incomplete Block Design with the following parameters b = 8, k = 3, 9 = 8, r = 3 is found to be a Balanced Incomplete Block Design.
 - d) A One-half fractional factorial design of a 2^4 full factorial design will be denoted by a 2^2 Factorial design.
 - e) The Cluster estimator $\overline{\overline{y}}_{n_{\bullet}}$ becomes an unbiased estimator of population mean only if M_i and $\overline{Y}_{i_{\bullet}}$ are uncorrelated
- 2. Suppose we wish to estimate the total number of Cows in 2026 in certain state. The total number of cows for 2024 was X = 5000. The Sampling unit was the farm, and it is assumed that there has been no change in the number of farms which we shall assume to be N=500. A sample of n=20 farms is selected, and the data is as follows:

Farm	2024	2026	Farm	2024	2026
1	12	14	11	11	14
2	22	25	12	17	19
3	38	37	13	12	12
4	15	18	14	22	23
5	18	20	15	14	16
6	31	30	16	26	28
7	15	15	17	08	09
8	20	21	18	16	15
9	10	12	19	13	15
10	25	28	20	19	20

Estimate the average number of cows for 2026 by Ratio Method of estimation and obtain the estimate of the MSE of Ratio estimator of Population Mean. (15)

- 3. Define the difference estimator for the population mean. Show that it is an unbiased estimator and its variance is given by $V(\overline{Y}_D) = \frac{N-n}{Nn}S_Y^2(1-\rho^2)$, where symbols have their usual meanings. (10)
- 4. A population consisting of 6 clusters, each of size 6 is given below. The values of the study variable Y, noted on each of the units within each cluster are also provided. A random sample of size 3 clusters was selected from the population and 3 elementary units from the selected clusters were randomly chosen.

Cluster	Y - values	Cluster	Y - values
1	2, 4, 6, 1, 3, 5	4	3, 2, 5, 1, 6, 4
2	2, 5, 3, 4, 7, 4	5	2, 4, 6, 8, 3, 5
3	4, 3, 6, 2, 1, 5	6	4, 1, 2, 7, 5, 3

Let the 2nd, 4th and 6thclusters be selected randomly in the first-stage sample. Further, let the y-values 2, 7, 3 of the 2nd cluster; 6, 3, 1 of the 4th cluster and 7, 4, 3 of the 6th cluster be selected randomly for the second-stage sample.

Estimate the population mean on the basis of the suggested estimator and compare it with the actual value of the population mean. (10)

- 5. Suggest an estimator of population mean in cluster sampling with unequal size clusters, which is based upon the means of selected clusters. Determine whether it is an unbiased estimator? (10)
- 6. Below is given the plan and yields of 2²-Factorial Experiment involving 2 factors A and B each at two levels 0 and 1. Analyse the design.

Block I				
117 (1)	106 b	129 ab	124 a	
Block II				
124 ab	120 (1)	117 b	124 a	
Block III				
111 (1)	127 a	114 b	126 ab	
Block IV				
125 ab	131 a	112 b	108 (1)	
Block V				
95 ab	97 b	73 (1)	128 a	
Block VI				
158 a	81 (1)	125 ab	117 b	

Does treatment effect A differs from treatment effect B?

(15)

7. Explain what is meant by a one-quarter fractional factorial experiment of a 2^k factorial experiment. Give a notation which denotes the one-quarter fractional factorial design.

(10)

8. Let us consider the following Balanced Incomplete Block Design (B.I.B.D.) with parameters $\vartheta = b = 7$, r = k = 4, $\lambda = 2$:

Block Label	Design
I	1345
I	1467
II	1257
IV	3 5 6 7
v	2347
VI	1236
VII	2 4 5
	6

Obtain a derived design from the above Balanced Incomplete Block Design (B.I.B.D.) and find the parameters of the obtained design. (10)

9. Define the Residual B.I.B.D. and Derived B.I.B.D. of a given symmetric B.I.B.D. Mention the rule of constructing a residual B.I.B.D. corresponding to a specific B.I.B.D.

Let $X = \{1, 2, 3, 4, 5\}$ and $A = \{\{1, 2, 3,\}, \{1, 2, 4\}, \{1, 2, 5\}, \{1, 3, 4\}, \{1, 3, 5\}, \{1, 4, 5\}, \{2, 3, 4\}, \{2, 3, 5\}, \{2, 4, 5\}, \{3, 4, 5\}\}$; then (X, A) is a (5, 3, 3)- B.I.B.D. Find the incidence matrix of this B.I.B.D. (10)