

Assignment MSTE-012

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, MSTE-012 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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NAME:		
ENROLLMENT NO:		
ADMISSION CYCLE:		
PROGRAMME CODE: MS	CAST	
COURSE CODE: MSTE-012	2	
COURSE TITLE: STOCHA	STIC PROCESSES	
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TUTOR MARKED ASSIGNMENT MSTE-012: STOCHASTIC PROCESSES

Course Code: MSTE-012 Assignment Code: MSTE-012/TMA/2025 Maximum Marks: 100

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

- State whether the following statements are true or false and also give the reason in support of your answer: (2×5=10)
 - a) if the coin is tossed independently 6 times, then the sequence of random variables $\{X_n, n \ge 1\}$ is a stochastic process with discrete parameter space T and discrete state space S.
 - b) A Markov chain X_0, X_1, X_2, \dots has the transition probability matrix

 $\mathbf{P} = \begin{bmatrix} 0.1 & 0.1 & 0.8\\ 0.2 & 0.2 & 0.6\\ 0.3 & 0.3 & 0.4 \end{bmatrix}$

Then the conditional probabilities $P[X_1 = 1, X_2 = 1|X_0 = 0] = 0.02$.

- c) Suppose that customers arrive at a facility according to a Poisson process having rate $\lambda = 2$. If N(t) be the number of customers that have arrived up to time t. Then the probability P{N(1)=2} = 2e^{-2}.
- d) In the classical gambler's ruin problem, with total stake *a* and gambler's stake *k*, and the gambler's probability of winning at each play is *p*. Then the probability of ruin if given that a = 100, k = 5 and p = 6 is 0.868.
- e) The number of customers at time t waiting in the queue including the one being served, if any, is called arrival rate.
- 2(a) State the Chapman-Kolmogorov equation and mention the relation between higher and lower transition probabilities, it establishes.
 Civen the following transition matrix of a Markov chain with three states 1, 2 and 2;

Given the following transition matrix of a Markov chain with three states 1, 2 and 3:

 $\mathsf{P} = \begin{bmatrix} \frac{1}{10} & \frac{1}{10} & \frac{4}{5} \\ \frac{1}{5} & \frac{1}{5} & \frac{3}{5} \\ \frac{3}{10} & \frac{3}{10} & \frac{2}{5} \end{bmatrix},$

find the matrix of three-step transition probabilities and, hence, obtain the transition probability $p_{32}^{(3)}$. (12)

- (b) A symmetric random walk starts at x = 0. Find the probabilities that the walk:
 - (i) is at x = 0 after 10 steps;
 - (ii) is at x = 1 after 5 steps;
 - (iii) is at x = -3 after 9 steps.

- (12)
- 3. A fire and emergency rescue service receives calls for assistance at a rate of ten per day. Teams man the service in twelve hour shifts. Assume that requests for help form a Poisson process.
 - (i) What is the probability that a team would receive six requests for help in a shift?
 - (ii) What is the probability that a team has no requests for assistance in a shift? (12)
- 4. In the standard gambler's ruin problem, with total stake a and gambler's stake k, and the gambler's probability of winning at each play is p, calculate the probability of ruin in the following cases;

(i) a = 80, k = 70, p = 0.45;

(ii)
$$a = 50$$
, $k = 40$, $p = 0.5$.

Also find the expected duration in each case.

- (12)
- 5. Define the Ordinary, modified and equilibrium renewal processes with examples. Also, differentiate between modified and equilibrium renewal processes. (10)
- 6. Define Martingales, Sub-Martingales and Super-Martingales with examples. (10)
- 7. Describe the Branching processes with examples and explain some properties of generating functions of branching processes. (12)
- 8. Describe the finite and infinite M/M/1 queuing models with examples and their waiting time distributions. (10)