Assignment MST-018

for

M.Sc. (Applied Statistics) (MSCAST)

Valid from January 2026 to December 2026

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.

(Dr. Taruna Kumari)
Course Coordinator, MST-018
Email: tarunakumari@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.**

ASSIGNMENT CODE: MST-018/TMA/2026

NAME: ____________________

ENROLLMENT NO: ____________________

ADMISSION CYCLE: ____________________

PROGRAMME CODE: MSCAST

COURSE CODE: MST-018

COURSE TITLE: MULTIVARIATE ANALYSIS

REGIONAL CENTRE CODE: ____________________

STUDY CENTRE CODE: ____________________

ADDRESS: ____________________

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CONTACT NUMBER: ____________________

EMAIL ID: ____________________

DATE OF SUBMISSION: ____________________

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School of Sciences

Indira Gandhi National Open University

Maidan Garhi, New Delhi-110068 (INDIA)

TUTOR MARKED ASSIGNMENT

MST-018: Multivariate Analysis

Course Code: MST-018
Assignment Code: MST-018/TMA/2026
Maximum Marks: 100

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

1. State whether the following statements are True or False. Give reasons in support of your answer: **5×2=10**

(a) The eigenvalues of a positive definite matrix are less than zero.

(b) $A = \begin{pmatrix} 1/\sqrt{2} & 1/\sqrt{2} \\ 1/\sqrt{2} & -1/\sqrt{2} \end{pmatrix}$ is an orthogonal and idempotent matrix.

(c) A factor model postulates that a random vector $\underset{\sim}{X}$ is linearly dependent upon a few observable common factors.

(d) A given px1 vector $\underset{\sim}{\mu}_0$ is a plausible value for the mean of a multivariate normal distribution can be tested using Student's t test.

(e) In single linkage method, we find the minimum distance in the distance matrix and merge the minimum distanced clusters.

2 (a) Let $\underset{\sim}{X}_{px1}$, $\underset{\sim}{\mu}_{px1}$ and Σ_{pxp} be partitioned as $\underset{\sim}{X}_{px1} = \begin{pmatrix} \underset{\sim}{X}^{(1)}_{kx1} \\ \underset{\sim}{X}^{(2)}_{(p-k)x1} \end{pmatrix}$, $\underset{\sim}{\mu}_{px1} = \begin{pmatrix} \underset{\sim}{\mu}^{(1)}_{kx1} \\ \underset{\sim}{\mu}^{(2)}_{(p-k)x1} \end{pmatrix}$ and

$\Sigma_{pxp} = \begin{pmatrix} \Sigma_{11\ kxk} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{pmatrix}$. Then derive the conditional distribution of $\underset{\sim}{X}^{(2)} \big| \underset{\sim}{X}^{(1)} = \underset{\sim}{x}^{(1)}$.

(b) Let $\underset{\sim}{X} = \begin{pmatrix} \underset{\sim}{X}^{(1)} \\ \underset{\sim}{X}^{(2)} \end{pmatrix} \sim N_4\left(\underset{\sim}{\mu}, \Sigma\right)$, where $\underset{\sim}{\mu} = \begin{pmatrix} -4 \\ 1 \\ \hline 4 \\ 0 \end{pmatrix}$ and $\Sigma = \left(\begin{array}{cc|cc} 2 & 0 & 1 & 0 \\ 0 & 2 & 2 & 0 \\ \hline 1 & 2 & 6 & 1 \\ 0 & 0 & 1 & 1 \end{array}\right)$.

Then find $E\left(\underset{\sim}{X}^{(2)} \big| \underset{\sim}{X}^{(1)} = \underset{\sim}{x}^{(1)}\right)$ and $\text{Cov}\left(\underset{\sim}{X}^{(2)} \big| \underset{\sim}{X}^{(1)} = \underset{\sim}{x}^{(1)}\right)$.

15+10

3 (a) Let two independent samples of size $N_1 = 10$ and $N_2 = 12$ from trivariate normal populations have following mean vectors and variance-covariance matrices:

$$\bar{\underset{\sim}{x}}_1 = \begin{pmatrix} 2 \\ 3 \\ 4 \end{pmatrix} \text{ and } S_1 = \begin{pmatrix} 1.2 & 0.3 & 0.2 \\ 0.3 & 1.5 & 0.4 \\ 0.2 & 0.4 & 1.8 \end{pmatrix}$$

$$\bar{\underset{\sim}{x}}_2 = \begin{pmatrix} 5 \\ 6 \\ 7 \end{pmatrix} \text{ and } S_2 = \begin{pmatrix} 1.0 & 0.2 & 0.3 \\ 0.2 & 1.4 & 0.3 \\ 0.3 & 0.3 & 1.6 \end{pmatrix}, \text{ respectively.}$$

If $S_p^{-1} = \begin{pmatrix} 1.138 & -0.152 & -0.181 \\ -0.152 & 0.837 & -0.125 \\ -0.181 & -0.125 & 0.740 \end{pmatrix}$ is the inverse of the pooled covariance matrix

$S_p = \begin{pmatrix} 1.09 & 0.245 & 0.255 \\ 0.245 & 1.445 & 0.345 \\ 0.255 & 0.345 & 1.69 \end{pmatrix}$, then test whether the mean vectors of the two samples are significantly different from each other at 5% level of significance or not.

(Use $F_{3,\,18}(0.05) = 3.16$)

(b) Let $\underset{\sim}{X} \sim N_4(\mu, \Sigma)$, where $\underset{\sim}{\mu} = \begin{pmatrix} 4 \\ -1 \\ 6 \\ -1 \end{pmatrix}$ and $\Sigma = \begin{pmatrix} 5 & 0 & 0 & 0 \\ 0 & 4 & 0 & 0 \\ 0 & 0 & 2 & -1 \\ 0 & 0 & -1 & 1 \end{pmatrix}$. Check the independence of (i) X_2 and X_1 (ii) (X_2, X_4) and (X_1, X_3) (iii) (X_1, X_2) and (X_3, X_4).

15+10

4 (a) Obtain the square root matrix corresponding to a matrix $A = \begin{pmatrix} 3 & -1 & 0 \\ -1 & 2 & 1 \\ 0 & 1 & 3 \end{pmatrix}$. Also verify that $A^{1/2} A^{1/2} = A$.

(b) If $\underset{\sim}{X} \sim N_3(\underset{\sim}{\mu}, \Sigma)$ with $\underset{\sim}{\mu} = \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix}$ and $\Sigma = \begin{pmatrix} 5 & 3 & 0 \\ 3 & 3 & -2 \\ 0 & -2 & 5 \end{pmatrix}$. Then find the joint distribution of $X_1 + 2X_2$, $2X_1 - X_2$ and X_3.

10+10

5 (a) Define clustering. Differentiate between single linkage and complete linkage method of clustering.

(b) Consider the following partitioned sample variance-covariance matrix S, obtained from a sample of size 10.

$$S = \left(\begin{array}{cc|cc} 4.8 & 2.9 & 0.2 & -0.2 \\ 2.9 & 7.9 & 0.0 & 0.7 \\ \hline 0.2 & 0.0 & 7.1 & 7.2 \\ -0.2 & 0.7 & 7.2 & 11.3 \end{array}\right)$$

If $|S| = 799.13$, then test for the independence of the sub-vectors $\underset{\sim}{X}^{(1)}_{2x1}$ and $\underset{\sim}{X}^{(2)}_{2x1}$.

(Use $\Lambda_{2,\,2,\,7}(0.05) = 0.230$)

10+10