

3 (Sem-6) STS M 4

2019

STATISTICS

(Major)

Paper : 6.4

(Computer Programming and
Multivariate Analysis)

Full Marks : 60

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Answer the following as directed : 1×7=7

(a) Let $\underline{X} \sim N_3(\underline{\mu}, \underline{\Sigma})$ with

$$\underline{\Sigma} = \begin{pmatrix} 4 & 1 & 0 \\ 1 & 3 & 0 \\ 0 & 0 & 2 \end{pmatrix}$$

Are X_1 and X_3 independent?

- (b) State the built-in mathematical function in Fortran 77 to find the square root of x .
- (c) Marginal distribution of any x_j of a multinomial distribution with parameters $(n, p_1, p_2, \dots, p_k)$ follows binomial distribution. (State True or False)

- (d) Let $(X, Y) \sim \text{BVND}(\mu_x, \mu_y, \sigma_x^2, \sigma_y^2, \rho)$. Then the conditional variance of $X/Y = y$ is _____. (Fill in the blank)
- (e) Write the decimal equivalent of octal number 2534_8 .
- (f) What is the value of M in the following Fortran 77 expression?

$$M = 2 * 7 / 5$$

- (i) $M = 2 \cdot 8$
(ii) $M = 3$
(iii) $M = 2$
(iv) None of the above

(Choose the correct option)

(g) Define Hotelling's T^2 statistic.

2. Answer the following questions : 2×4=8

- (a) State any two properties of multivariate normal distribution.
- (b) Write equivalent FORTRAN 77 statements for each of the following expressions :

(i) $e^{-x} x^{kx}$

(ii) $e^{-\left(\frac{x-a}{b}\right)^2}$

- (c) Let $\underline{X} \sim N_p(\underline{\mu}, \underline{\Sigma})$. Then find $\text{var}(C\underline{X})$ where C is a $p \times p$ non-singular matrix.
- (d) Write an algorithm to find the arithmetic mean of three numbers A, B, C .

3. Answer any *three* of the following questions :

5×3=15

(a) Let $(X, Y) \sim \text{BVND}(0, 0, 1, 1, \rho)$. Then show that

$$Q = \frac{X^2 - 2\rho XY + Y^2}{(1 - \rho^2)}$$

is distributed as chi-square with $n = 2$ d.f.

(b) What is the final value of a in the following sequence of statements in FORTRAN 77?

$$a = 2.45$$

$$a = (a + 0.06) * 10$$

$$k = a$$

$$a = k$$

$$a = a / 10.0$$

If $a = 2.45$ is replaced by $a = 2.43$ above, what is the final value of a ?

3+2=5

(c) Obtain the probability-generating function of multinomial distribution with parameters $(n, p_1, p_2, \dots, p_k)$.

(d) Draw a flowchart to find the largest among three numbers M, N, P .

(e) Examine if Hotelling's T^2 is invariant under changes in the unit of measurement.

4. Answer the following questions : 10×3=30

(a) State the pdf of BVND $(\mu_1, \mu_2, \sigma_1^2, \sigma_2^2, \rho)$.

Derive bivariate normal density as a particular case of multivariate normal distribution.

1+9=10

Or

(b) If $\underline{X} \sim N_p(\underline{\mu}, \Sigma)$, then prove that the quadratic form in the multivariate normal density function

$$Q = (\underline{X} - \underline{\mu})' \Sigma^{-1} (\underline{X} - \underline{\mu})$$

follows χ^2 distribution with pdf.

(c) Write a FORTRAN 77 program to find the regression coefficient of Y on X.

Or

(d) (i) Write an explanatory note on 'Arithmetic IF' statement used in FORTRAN 77.

(ii) Explain briefly about WHILE-DO statement.

5+5=10

(e) Derive mean and variance of multinomial distribution. Also compute the variance, covariance matrix Σ .

4+4+2=10

Or

(f) (i) Let $X \sim N_5(\underline{\mu}, \Sigma)$. Then find the distribution of $(X_2, X_4)'$.

(ii) Write a FORTRAN 77 program to calculate harmonic mean of n observations x_1, x_2, \dots, x_n .

4+6=10

★ ★ ★