Seat No.	

Set P

M.Sc. (Statistics) (Semester - I) (New) (NEP CBCS) Examination: March/April - 2025
Distribution Theory (2329101)

Day & Date: Thursday, 15-May-2025 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative. **08**

1) Let X has $B(1,p)$ distribution. The distribution of $y = 1 - x$ is _____
   a) One point b) Discrete uniform
   c) Bernoulli d) Cannot be determined

2) The joint cumulative distribution function is defined as _____
   a) $P(X = x, Y = y)$ b) $P(X \leq x, Y = y)$
   c) $P(X \geq x, Y \geq y)$ d) $P(X \leq x, Y \leq y)$

3) Let $X_1, X_2, \ldots\ldots X_n$ be a random sample from pdf $f_x(x)$ and $Y_1 \leq Y_2 \leq \cdots \leq y_n$ be its order statistics. If pdf of Z is $n[1 - F_x(z)]^{n-1} f_x(z)$ then Z is _____
   a) Y_n b) Y_1
   c) $Y_n - Y_1$ d) Sample median

4) Let $F(x)$ denotes the distribution function of random variable X. Then which of the following is not true?
   a) $0 \leq F(x) \leq \infty$ b) $F(x_1) \leq F(x_2)$ if $x_1 < x_2$
   c) $F(-\infty) = 0$ d) $F(+\infty) = 1$

5) Let X and Y are $\text{iid} N(0,1)$ variates. The distribution of $Z = Y/X$ is _____.
   a) Normal b) Cauchy
   c) Chi-square d) F

6) If $X > 0$ then _____
   a) $E[\log X] = \log[E(X)]$ b) $E[\log X] \geq \log[E(X)]$
   c) $E[\log X] \leq \log[E(X)]$ d) None of these

7) A random variable X is said to be symmetric about point α if _____
   a) $P(X \geq \alpha + x) = P(X \geq \alpha - x)$
   b) $P(X \geq \alpha + x) = P(X \leq \alpha - x)$
   c) $P(X \leq \alpha + x) = P(X \leq \alpha - x)$
   d) $P(X \leq \alpha + x) = P(X \geq \alpha - x)$

8) Let $X_1, X_2, \ldots X_n$ be iid $U(0,1)$ variates and $X_{(n)} = \text{Max}\{X_1, X_2, \ldots., X_n\}$ then $E[X_{(n)}] =$ _____

a) $n/(n+1)$ b) $(n+1)/n$

c) $1/n$ d) $1/(n+1)$

B) Fill in the blanks. **04**

1) The variance of continuous uniform distribution over $(0, b)$ is _____
2) If X is symmetric about α then $(X - \alpha)$ is symmetric about _____
3) If X and Y are two independent random variables then $E(XY) =$ ___
4) Let X and Y be two iid random variable with *pdf* $f(x) = 2e^{-2x}$, $x \geq 0$. The distribution of $Z = X - Y$ is _____

Q.2 Answer the following (any six) **12**

a) Define moment generating function of a random variable X.
b) Define scale family. Give an example.
c) State Markov inequality.
d) Define multinomial distribution with k cells.
e) Define order statistic. Write the pdf of smallest order statistic.
f) Define a symmetric random variable. State any two properties of the same.
g) Define non-central F distribution.
h) Define convolution of distribution functions.

Q.3 Answer the following (any three) **12**

a) Let x has $B(n, p)$ distribution. Obtain the PGF of X
b) Write a note moment generating function.
c) Let X has exponential distribution with mean θ, Find the distribution of $Y = X/\theta$
d) Derive the *pdf* of largest order statistic based on a random sample of size n form a continuous distribution with *pdf* $f(x)$ and *cdf* $F(x)$

Q.4 Answer the following (any two) **12**

a) Define distribution function of bivariate random variate (X, Y). State and prove its important properties.
b) State and prove Jensen's inequality.
c) If X and Y are jointly distributed with probability density function (p.d.f)
$f(x, y) = 24xy, x \geq 0, y \geq 0$ and $x + y \leq 1$
Find i) Marginal distributions of X *and* Y
ii) Conditional distribution of Y given $X = x$
iii) $E(Y/X = x)$

Q.5 Answer the following (Any two) **12**

a) Define multinomial distribution. Obtain its MGF. Hence or otherwise obtain its variance-convariance matrix.

b) Let $Y_1 < Y_2 < \cdots < Y_n$ be the order statistics corresponding to n observations form a distribution with probability density function

$$f(x) = \begin{cases} 1, & 0 < x < 1 \\ 0, & \text{otherwise} \end{cases}$$

Show that the k^{th} order statistics, Y_k has Beta distribution of first kind with parameters k and $n - k + 1$

c) Let (X, Y) has $BVN(\mu_1, \mu_2, \sigma_1^2, \sigma_2^2, \rho)$. Obtain the condition of X given $Y = y$

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M.Sc. (Statistics) (Semester - I) (New) (NEP CBCS) Examination: March/April - 2025
Estimation Theory (2329102)

Day & Date: Saturday, 17-May-2025 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative **08**

1) A statistic which does not contain any information about the parameter is called _____
   a) Sufficient statistic b) Minimal sufficient statistic
   c) Ancillary statistic d) Complete statistic

2) Let $X_1, X_2 \ldots..X_n$ be iid from $B(1, \theta)$. Then $\bar{X}$ is _____
   a) Sufficient statistic
   b) Unbiased estimator
   c) Complete sufficient statistic
   d) All the above

3) If T_1 is sufficient statistic for and T_2 is an unbiased estimator of θ, then an improved estimator of in terms of its efficiency is _____
   a) $E(T_2/T_1)$ b) $E(T_1T_2)$
   c) $E(T_1+T_2)$ d) $E(T_1/T_2)$

4) An unbiased estimator of θ based on random sample of size n from a $U(0, \theta)$ distribution is _____
   a) sample mean b) sample median
   c) largest observation d) double of sample mean

5) The denominator of Cramer-Rao inequality gives _____
   a) lower bound b) upper bound
   c) amount of information d) none of the above

6) Bayes estimator of a parameter under absolute error loss function is _____
   a) posterior mean b) posterior median
   c) posterior mode d) posterior variance

7) Let T_n be an unbiased and consistent estimator of θ then T_n^2 for θ^2 is _____
   a) unbiased and consistent both
   b) unbiased only
   c) consistent only
   d) neither unbiased nor consistent

8) let X_1, X_2 be iid *poisson* (θ) variables. then $X_1, +2\,X_2$ is _____
   a) sufficient statistic for θ
   b) not sufficient statistic for θ
   c) minimal sufficient statistic for θ
   d) complete sufficient statistic for θ

B) Fill in the blanks. **04**

1) An estimator T is said to be unbiased estimator of θ if _____

2) Prior distribution is the distribution of _____

3) For a random sampling from *N* (μ, σ^2) the MLE of μ when σ^2 known is _____

4) If for an estimator T_n of the parameter θ, $\lim_{n\to\infty} P[\,|\,T_n - \theta| < \varepsilon]$=1 for all $\epsilon > 0$, then T_n is _____ estimator of θ

Q.2 Answer the following.(Any Six) **12**

a) Define one parameter exponential family of distributions.

b) Show that one-to-one function of sufficient statistic is also sufficient.

c) Define UMVUE.

d) Define minimal sufficient statistic.

e) Define joint consistency of vector parameter θ. Does it imply marginal consistency?

f) Define prior distribution. Illustrate with one example.

g) State Cramer-Rao inequality with necessary regularity conditions.

h) Define maximum likelihood estimator.

Q.3 Answer the following (Any Three) **12**

a) Let $X_1, X_2, \ldots, X_n$ be a random sample of size n from exponential distribution with mean θ. Obtain maximum likelihood estimate of θ

b) Obtain minimal sufficient statistic for Poisson (λ), λ >0, family of distributions.

c) Define power series family of distributions. Obtain a sufficient statistic for a power series family of distributions.

d) Show that the family of discrete uniform distribution $\{f(x, N) = 1/N, N \geq 1, N$ integer$\}$ is complete.

Q.4 Answer the following (Any Two) **12**

a) State and prove Rao-Blackwell theorem.

b) Obtain UMVUE of $P(X = 0)$ based on a random sample of size n, where X has *Poisson* (λ) distribution.

c) Let $X_1, X_2, \ldots, X_n$ *be* a random sample from $N(\mu,\sigma^2)$, where both μ and σ^2 are unknown. Find MLE for (μ,σ^2)

Q.5 Answer the following (Any Two) **12**

a) Define consistent estimator. State and prove invariance property of consistent estimator of a real valued parameter θ

b) Let $X_1, X_2, \ldots, X_n$ be *iid* $N(\theta, 1)$, computing the actual probability show that $\bar{X}_n$ is consistent estimator of θ *.*

c) Let $X_1, X_2, \ldots, X_n$ is a random sample from $B(1, \theta)$ distribution and prior density of θ is $B_1(\alpha, \beta)$*.* Assuming squared error loss function, find the Bayes estimator of θ *.*

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Set | **P**

M.Sc. (Statistics) (Semester - I) (New) (NEP CBCS) Examination: March/April - 2025
Statistical Mathematics (2329107)

Day & Date: Monday, 19-May-2025 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative. **08**

1) The set of all integers is _____.
a) Countable b) Uncountable
c) both (a) and (b) d) none of these

2) Monotonic increasing bounded above sequence of real numbers is _____.
a) Always divergent b) Always convergent
c) May or may not converge d) Oscillatory

3) Riemann integral is a particular case of _____.
a) Riemann- John integral b) Riemann-Lebesgue integral
c) Riemann-Stieltje's integral d) None of the above

4) A superset of uncountable set is always _____.
a) Countable
b) Uncountable
c) May or may not be countable
d) None of these

5) If all the elements below the diagonal are zero, then such matrix is called as _____.
a) Lower triangular matrix b) Triangular matrix
c) Diagonal matrix d) Upper diagonal matrix

6) If number of column is less than number of rows, then the matrix is called as _____.
a) Horizontal matrix b) Vertical matrix
c) Row matrix d) Column matrix

7) A set of vectors containing a null vector is _____.
a) Not necessarily dependent
b) Necessarily dependent
c) Necessarily independent
d) A vector space

8) Integration of a product of functions can be solved using _____.

a) Leibnitz rule b) Integration by parts
c) Taylor's method d) None of these

B) Fill in the blanks. **04**

1) If A is subset of B and B is a countable set, then A is _____.
2) Countable union of countable sets is always _____.
3) If determinant of a square matrix is zero, then such matrix is called as _____.
4) If A is a 4×4 matrix with rank 3, then determinant of A is

Q.2 Answer the following. (Any Six) **12**

a) Define finite set.
b) Define countable union of countable sets.
c) Define upper triangular matrix.
d) Define limit of sequence of real numbers.
e) What do you mean by bounded sequence?
f) Define span of a set of vectors.
g) Define symmetric matrix.
h) Define multiplication of two matrices.

Q.3 Answer the following. (Any Three) **12**

a) Describe comparison test and ratio test for the convergence of a series of real numbers.
b) Discuss independence of vectors.
c) Define vector space, specifying all the necessary conditions.
d) Prove: If G is g-inverse of A, then $G_1 = GAG$ is also a g-inverse of A.

Q.4 Answer the following. (Any Two) **12**

a) Prove or disprove: A countable union of countable sets is always countable.
b) Discuss the convergence of geometric series.
c) Discuss Cauchy sequence in details. Also discuss its convergence.

Q.5 Answer the following. (Any Two) **12**

a) Discuss the Riemann integration in details.
b) Define Diagonal matrix. Prove any two properties of diagonal matrices.
c) Prove or disprove: For any vector in $\underline{u}$ vector space $V, 0.\underline{u} = \underline{0}$.

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Set P

M.Sc. (Statistics) (Semester - I) (New) (NEP CBCS) Examination: March/April - 2025
Research Methodology in Statistics (2329103)

Day & Date: Saturday, 24-May-2025 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose the most correct alternative. **08**

1) Which of the following is NOT a feature of Stratified Sampling?
a) The population is divided into homogeneous groups
b) Random samples are taken from each group
c) Each element of the population has an equal chance of selection
d) The groups are based on some characteristic relevant to the study

2) _____ is not a characteristic of good research.
a) Systematic b) Subjective
c) Logical d) Empirical

3) Midzuno Sampling is specifically used in _____.
a) Probability sampling
b) Non-probability sampling
c) Unequal probability sampling
d) Stratified sampling

4) Which of the following is not a key component of a sampling strategy?
a) Defining the population and sample size.
b) Identifying the sampling frame.
c) Selecting the survey questions.
d) Choosing the sampling method.

5) Which of the following best describes Quota Sampling?
a) A probability sampling technique where every unit has an equal chance of being selected
b) A non-probability sampling method where participants are selected to meet a specific quota.
c) A non-probability sampling technique where respondents recruit others.
d) A systematic method of selecting units from a population

6) _____ basic principles of experimental design.
a) Randomization, replication, and control
b) Objectivity, accuracy, and analysis
c) Flexibility, simplicity, and precision
d) Sampling, data collection, and interpretation

7) In Simple Random Sampling Without Replacement (SRSWOR), what happens after a unit is selected?
a) It is returned to the population for the possibility of being selected again.
b) It is not replaced, and cannot be selected again.
c) It is replaced with another random unit
d) It is replaced and can be selected again.

8) The _____ method selects a sample of size two for PPSWOR and provides an unbiased estimate of the population mean.
a) Des Raj b) Murthy's
c) Horvitz Thompson d) Lahiri's

B) Fill in the blanks. **04**

1) The procedure is generalized to three or more stages and is then termed as _____.
2) _____ research is aimed at solving a particular problem or addressing a specific issue using practical approaches and findings.
3) Report writing is significant because it helps to _____ research findings for stakeholders.
4) Regression estimators assume a _____ relationship between the auxiliary and study variables.

Q.2 Answer the following. (Any Six) **12**
a) Define stratified sampling.
b) Define double sampling.
c) Define population with example.
d) What is the need for sampling?
e) Define conceptual research.
f) Define sampling frame.
g) Define experiment.
h) Write the difference between SRS and varying probability.

Q.3 Answer the following. (Any three). **12**
a) Prove: With usual notations, in SRS the bias of regression estimator $\bar{y}_l$ is, $bias(\bar{y}_l) = -cov(\bar{x}, b)$
b) Differentiate briefly between Descriptive and Analytical research.
c) Explain in detail the literature survey.
d) Discuss sampling scheme and sampling strategy.

Q.4 Answer the following. (Any two) **12**
a) Explain in detail probability sampling and their types.
b) Describe the Probability Proportional to Size with Replacement (PPSWR) method in detail. Explain Cumulative Total Method and Lahiri's Method.
c) Discuss the meaning of the research in detail.

Q.5 Answer the following. (Any two) **12**

a) Explain in detail the types of research.

b) Obtain Des Raj estimator for population mean for PPSWOR method.

c) Prove: In simple random sample an approximate value of bias of $\hat{R} = \frac{\bar{y}}{\bar{x}}$ is given by

i) $B(\hat{R}) \approx RC.V(\bar{x})[C.V(\bar{x}) - \rho C.V(\bar{y})]$

ii) $B(\hat{R}) \approx \frac{1-F}{n}(C_{xx} - \rho C_{yx})R$

Where $C_{xx} = C_{x^2}, C_{yx} = C_y C_x, C_x = \frac{S_x}{\bar{x}}, C_y = \frac{S_y}{\bar{y}}$

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Set P

M.Sc. (Statistics) (Semester - II) (New) (NEP CBCS) Examination: March/April - 2025
Stochastic Processes (2329201)

Day & Date: Wednesday, 14-May-2025 Max. Marks: 60
Time: 11:00 AM To 01:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative. **08**

1) If stales i and j are such that $p_{ij}^{(n)} > 0, p_{ji}^{(m)} > 0,$ for some m, $n > 0$. then states i and j are called as ______.
a) Persistent states b) Transient states
c) Communicating states d) None of these

2) In a Markov chain, if for a state i, $P_{ii} = 1$, then state i is called as _____.
a) finite state b) absorbing state
c) complete state d) None of these

3) A non-null recurrent aperiodic state is also called as _____.
a) Transitive state b) Binomial state
c) Ergodic state d) None of these

4) Recurrent state is also called as _____.
a) Persistent b) Transient
c) Aperiodic d) None of these

5) If $\{N(t)\}$ is a Poisson process, then the inter-arrival times follow _____.
a) beta distribution of second kind
b) Poisson distribution
c) binomial distribution
d) exponential distribution

6) The state space and time domain for random walk model are _____ respectively.
a) discrete and discrete b) discrete and continuous
c) continuous and discrete d) continuous and continuous

7) Branching process is an example of _____.
a) Discrete time discrete state space stochastic process
b) Discrete time continuous state space stochastic process
c) Continuous time discrete state space stochastic process
d) Continuous time continuous state space stochastic process

8) A persistent state of a Markov chain is said to be null persistent if it's mean recurrent time is _____.

a) Finite b) Infinite
c) 0 d) 1

B) Fill in the blanks. **04**

1) In a Markov chain, if for a state i, $P_{ii} < 1$, then state i is called as ___.
2) Number of accidents because of high speed of vehicle by time $t\ (> 0)$ is an example of _____ time, _____ state space stochastic process.
3) If the probability of ultimate first return, $F_{ii} < 1$ then the state i is ____.
4) Yule-Furry process is also called as _____.

Q.2 Answer the following question (Any Six) **12**

a) Define stochastic process.
b) Define periodic and aperiodic state.
c) Define first return probability for a state.
d) Define transient state.
e) Define null recurrent state.
f) Define Markov process.
g) State Chapman-Kolmogorov equations for Markov chain.
h) Define Poisson process.

Q.3 Answer the following question (Any Three). **12**

a) Define and explain Markov property.
b) State and illustrate:
  i) State space
  ii) Stochastic Process
  iii) TPM
c) Write a note on counting process.
d) For Poisson process, obtain the distribution of inter-arrival times.

Q.4 Answer the following question (Any Two) **12**

a) Discuss stationary distribution of a Markov chain in detail. Illustrate with the help of example.
b) Define stochastic process. Prove that, Markov chain is completely specified by one step t.p.m. and initial Distribution.
c) If $\{N(t)\}$ is a Poisson process, then for $s < t$, obtain the distribution of $N(s)$, if it is already known that $N(t) = k$.

Q.5 Answer the following question (Any Two) **12**

a) Prove or disprove: Periodicity is a class property.
b) Prove that a state j of a Markov chain is recurrent if and only if $\sum p_{jj}{}^{(n)} = \infty$
c) Calculate the extinction probability for branching process.

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Set P

M.Sc. (Statistics) (Semester - II) (New) (NEP CBCS) Examination: March/April - 2025
Theory of Testing of Hypotheses (2329202)

Day & Date: Friday, 16-May-2025 Max. Marks: 60
Time: 11:00 AM To 01:30 PM

Instructions: 1) All questions are compulsory
2) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative. **08**

1) A hypothesis is to be tested with possible rejection is known as _____
a) composite hypothesis
b) null hypothesis
c) simple hypothesis
d) alternative hypothesis

2) Uniform distribution $U(0, \theta)$ ______
a) has a MLR property.
b) belongs to one parameter exponential family.
c) both (a) and (b)
d) neither (a) nor (b)

3) Consider the testing problem for $N(\theta, 1)$
1. $P_1: H_0: \theta = \theta_0$ *against* $H_1: \theta > \theta_0$
2. $P_2: H_0: \theta = \theta_0$ *against* $H_1: \theta \neq \theta_0$
The UMP level a test exists
a) for P_1 but not for P_2 b) for P_2 but not for P_1
c) for both P_1 and P_2 d) neither P_1 nor P_2

4) Let X has a $B(n, p)$ distribution. Then a simple hypothesis will be _____
a) $H_0 : p \neq 1/2$ b) $H_0 : p = 1/2$
c) $H_0 : p \leq 1/2$ d) $H_0 : p \geq 1/2$

5) The variance stabilizing transformation for normal population is _____
a) $\sin^{-1}$ b) $\tan h^{-1}$
c) square root d) logarithmic

6) Which of the following test is used to investigate the significance of difference between variances of several normally distributed populations?
a) Wald b) Rao
c) Bartlett d) Pearson

7) The asymptotic distribution of Rao's statistic is _____
   a) normal b) t
   c) chi-square d) F

8) In Kruskal-Wallis test of k samples, the appropriate degrees of freedom are ______
   a) k b) $k-1$
   c) $k+1$ d) $n-k$

B) Fill in the blanks. **04**

1) If the test function is of the form

$$\emptyset(x) = \begin{cases} 1, \text{if } x > c \\ 0, \text{otherwise} \end{cases}$$

then the test is _____
2) Acceptance region of UMP test leads to an _____ confidence set.
3) Level of significance is the probability of ____ error.
4) Let $X_1, X_2, .., X_n$ be iid $N(\mu, \sigma^2)$, where μ is known. Then pivotal quantity for confidence interval of σ^2 is ____.

Q.2 Answer the following. (Any Six) **12**

a) Define non-randomized test. Give an example.
b) Define shortest length confidence interval.
c) Define null and alternative hypothesis. Give on example for each.
d) Explain probabilities of type I and type II errors.
e) Define $(1-\alpha)$ level confidence set.
f) Define monotone likelihood ratio (MLR) of probability distributions.
g) Describe variance stabilization transformation for a Binomial population.
h) Define uniformly most powerful (UMP) test.

Q.3 Answer the following. (Any Three) **12**

a) Define unbiased test. Show that MP level *a* test is always an unbiased test.
b) Define (i) similar test and (ii) test having Neyman structure. State the result connecting similar test with Neyman structure.
c) Examine whether the following family of density have MLR property or not.

$$f(x,\theta) = \frac{1}{2} e^{-| x-\theta|}, -\infty < x < \infty$$

d) A sample of size one is taken from Poisson distribution with parameter λ .
Let $H_0 : \lambda = 1$ and, $H_1 : \lambda = 2$. Consider the test function

$$\phi(x) = \begin{cases} 1, x \le 2 \\ 0, \text{otherwise} \end{cases}$$

Find the probability of type-I and type-II errors and also power of the test.

Q.4 Answer the following. (Any Two) **12**

a) Define most powerful (MP) test. Show that MP test need not be unique using suitable example.

b) Obtain MP test of level α for testing $H_0 : \mu = \mu_0$ against $H_1 : \mu = \mu_1$ $(> \mu_0)$ based on a random sample of size n from $N(\mu, \sigma^2)$, where σ^2 is known.

c) Using approximate pivotal quantity, derive $100(1-\alpha)\%$ confidence interval for μ of $N(\mu, \sigma^2)$, σ^2 is unknown based on sample of size n.

Q.5 Answer the following.(Any Two) **12**

a) State Neyman Pearson lemma for randomized tests and prove the sufficient part of the lemma.

b) Describe Bartlett's test for homogeneity of variances.

c) Let $X_1, X_2 \dots X_n$ be a random sample from normal density with variance 1 and unknown mean μ. Find out likelihood ratio test of hypothesis $H_0 : \mu = \mu_0$ against the alternative $H_1 : \mu \neq \mu_0$

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Set P

M.Sc. (Statistics) (Semester - II) (New) (NEP CBCS) Examination: March/April - 2025
Probability Theory (2329207)

Day & Date: Tuesday, 20-May-2025 Max. Marks: 60
Time: 11:00 AM To 01:30 PM

Instructions: 1) All questions are compulsory
2) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative. **08**

1) Distribution function of a random variable is always _____.
   a) Non-negative
   b) right continuous
   c) Monotone non-decreasing
   d) All of the above

2) If F is a σ-field, then which of the following is not always correct?
   a) F is a field.
   b) F is a class closed under countable unions.
   c) F is a class closed under complementation.
   d) F is a minimal sigma field.

3) If p is a measure defined on (Ω, A) such that $\mu(\Omega) = k$ (k is finite), then μ is called _____ measure.
   a) Good measure b) Finite measure
   c) Total finite measure d) Signed measure

4) Which of the following is an elementary random variable?
   a) Binomial b) Geometric
   c) Discrete uniform d) Bernoulli

5) Probability measure is continuous from _____.
   a) Above b) Below
   c) Both (a) and (b) d) Either above or below

6) If for a r.v. $X, X(\omega) = c$, a constant for all ω, then r.v. X is called _____.
   a) Good r.v. b) conjugate r.v.
   c) Degenerate r.v. d) Concave r.v.

7) Lebesgue measure of a singleton set $\{k\}$ is _____.
   a) 0 b) 1
   c) K d) None of these

8) The sequence of sets $\{(o,n), n = 1,2,3,\dots\}$ is _____.
   a) Convergent b) Divergent
   c) Oscillatory d) None of these

B) Fill in the blanks. **04**

1) If for two independent events A and B, $P(A) = 0.3, P(B) = 0.5$, then $P(A \cap B) =$ _____.
2) If p is a measure defined on (Ω, A) such that $\mu(\Omega) = k$ (k is finite), then μ is called _____ measure.
3) Convergence in probability always implies convergence in _____
4) If X and Y are independent variables, then $E(X + Y) =$ _____.

Q.2 Answer the following. (Any Six) **12**

a) Define measure or set function.
b) Define elementary function.
c) Define indicator function.
d) Define a field.
e) Define convergence in probability.
f) Define Lebesgue measure.
g) Define almost sure convergence.
h) Show that, if $P(.)$ is a probability measure, then $P(\Phi) = 0$.

Q.3 Answer the following. (Any Three) **12**

a) Define a monotonic sequence of sets. Show that monotonic non-decreasing sequence converges to the union of all the sets.
b) Prove that probability measure is continuous from below as well as above.
c) Prove that the arbitrary intersection of fields is also a field.
d) Let $X: \Omega \to \Omega'$. Suppose $A, B \subset \Omega'$ such that $A \cap B = \Phi$. Prove or disprove $X^{-1}(A) \cap X^{-1}(B) = \Phi$.

Q.4 Answer the following. (Any Two) **12**

a) Show that a collection of subsets whose inverse images belongs to a σ-field is also a σ-field.
b) Define, explain and illustrate the concept of limit superior and limit inferior of a sequence of sets.
c) Define expectation of simple random variable. If X is a non-negative discrete random variable, then prove that

$$E(X) = \sum_{k=0}^{\infty} P(X > k)$$

Q.5 Answer the following. (Any Two) **12**

a) Find limit inferior and limit superior for the sequence $\{A_n\}$, where-

$$A_n = \left(2 - \frac{(-1)^n}{n}, 3\right), \qquad \text{if } n \text{ is odd}$$

$$= \left(2 - \frac{(-1)^n}{n}, 3 + \frac{1}{n}\right), \qquad \text{if } n \text{ is even.}$$

b) State and prove monotone convergence theorem.

c) Define and illustrate positive and negative part of a random variable.

Seat No.	

Set P

M.Sc. (Statistics) (Semester - III) (New) (NEP CBCS) Examination: March/April - 2025
Multivariate Analysis (2329301)

Day & Date: Thursday, 15-May-2025 Max. Marks: 60
Time: 11:00 AM To 01:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative. **08**

1) The _____ distribution is a multivariate generalization of chi-square distribution
a) Hotelling's T^2 b) Multivariate Normal
c) Wishart distribution d) None of these

2) To classify a given multivariate observation to either of two populations, we use ____
a) Principle components analysis
b) Discriminant analysis
c) Cluster analysis
d) None of these

3) Total variation explained by all principal components is _____ that by the original variables.
a) equal to b) greater than
c) less than d) none of these

4) Generalised variance is _____ of covariance matrix
a) trace+ determinant b) Trace
c) Determinant d) none of these

5) While applying _____ clustering algorithm, the distance between two clusters is taken to be the smallest distance between observations from two clusters.
a) average linkage b) complete linkage
c) single linkage d) none of these

6) Let vector $\underline{Y}$ has $N_p(\mu, \Sigma)$ distribution. For a constant matrix A_{qxp} and vector $b_{q\times 1}$ the distribution of $\underline{X} = A\underline{Y} + b$ is _____
a) $N_p(A\mu, A\Sigma A')$ b) $N_q(A\mu, A\Sigma A')$
c) $N_p(A\mu+b, A\Sigma A')$ d) $N_q(A\mu+b, A\Sigma A')$

7) Principal Component Analysis is a multivariate method that _____
a) Reduces skewness of data
b) Reduces heterogeneity of data
c) Reduces dimension of data
d) Reduces multicollinearity of data

8) Let $\underline{X}$ is multivariate normal, then $\underline{a}' \underline{X}$ is univariate normal, only if _____
a) $\underline{a}$ is zero vector b) $\underline{a}$ is unit vector
c) for all $\underline{a}$ d) none of these

B) Fill in the blanks. 04
1) The diagonal elements of variance-covariance matrix represent _____
2) If there are p variables in the random vector $\underline{X}$, then _____ number of principal components are obtained from it.
3) In case of complete linkage, the _____ distance between various units of two clusters is taken to be the distance among these clusters.
4) The range for canonical correlation is _____

Q.2 Answer the following question (Any Six) 12
a) Define multivariate normal distribution.
b) State moment generating function of multivariate normal distribution.
c) State characteristic function of multivariate normal distribution.
d) Define canonical correlation.
e) Obtain MLE of mean vector for normal distribution.
f) Define single linkage.
g) State Fisher's discriminant function.
h) What is the need of reducing the data dimensions?

Q.3 Answer the following question (Any Three) 12
a) Obtain characteristic function of multivariate normal distribution.
b) Write a note on divisive clustering.
c) Obtain the distribution of linear combination of components of a multivariate normal vector.
d) Discuss agglomerative clustering in detail.

Q.4 Answer the following question (Any Two) 12
a) Describe Wishart distribution. State and prove additive property of Wishart distribution.
b) Explain, in detail, complete linkage and average linkage methods of calculating distance.
c) Describe the mechanism of k-means clustering in detail.

Q.5 Answer the following question (Any Two) **12**

a) Obtain the rule for discrimination for two multivariate populations with densities $f_1(\underline{x})$ and $f_2(\underline{x})$

b) Discuss the concept of clustering. Also explain, in detail, hierarchical and non-hierarchical clustering.

c) Find the mean vector and variance covariance matrix of multivariate normal density.

Seat No.	

Set P

M.Sc. (Statistics) (Semester - III) (New) (NEP CBCS) Examination: March/April - 2025
Regression Analysis (2329302)

Day & Date: Saturday, 17-May-2025 Max. Marks: 60
Time: 11:00 AM To 01:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative **08**

1) Which of the following is true about coefficient of determination (R^2)?
   a) $0 \leq R^2 \leq 1$
   b) $R^2 = 1$ indicates the best fit of the model
   c) $R^2 = 0.95$ indicates the model is 95% good
   d) all the above

2) Which of the following concept is concerned with correlation among error terms?
   a) Partial correlation b) Autocorrelation
   c) Multicollinearity d) none of these

3) If we use unit length scaling for regressor variables then $(X'X)$matrix of scaling regressors will be in the form of
   a) correlation matrix b) covariance matrix
   c) identity matrix d) none of these

4) If distribution of Y is Poisson, then variance stabilizing transformation used is ______
   a) Y' =(1/Y) b) Y = Y
   c) $Y'=\sqrt{Y}$ d) Y = logY

5) $E(C_p/Bias = 0) =$ ______
   a) $\frac{p+1}{2}$ b) p
   c) $\frac{p-1}{2}$ d) $\frac{p(p-1)}{2}$

6) To test significance of an individual regression coefficient in multiple linear regression model ______ is used.
   a) F test b) X^2 test
   c) Z test d) t test

7) Multicollinearity is concerned with _____
   a) correlation among error terms
   b) correlation between response and predictors
   c) correlation among predictors
   d) none of these

8) If a response variable in a GLM follows Poisson distribution, then _____ link function is suitable.
   a) θ b) log θ
   c) -log θ d) $\log\left(\frac{\theta}{1-\theta}\right)$

B) Fill in the blanks. **04**

1) In classical linear regression model, the distribution of response variable is _____

2) A nonlinear model that can be linearized by using a suitable transformation is called _____

3) If e_i is the i^{th} ordinary residual then $e_{(i)} = \frac{e_{(i)}}{1-hii}$ is called _____

4) In simple linear regression model, Y = β_0+ β, X + ε, the β_0 is called _____

Q.2 Answer the following. (Any Six) **12**

a) Define residual in regression analysis and obtain its variance.
b) Define intrinsically linear model. Give an example.
c) Explain nonlinear regression model.
d) State the primary sources of multicollinearity.
e) Define Variance Inflation Factors (VIF).
f) Explain the concept of ridge regression.
g) Give formal structure of Generalized Linear Model (GLM).
h) What is cubic spline?

Q.3 Answer the following. (Any Three) **12**

a) In the usual notations, outline the procedure of testing a general linear hypothesis Tβ = 0.
b) Outline the procedure of construction of normal probability plot and procedure for checking normality assumption.
c) Describe the detection of multicollinearity using eigen value analysis of matrix $X'X$.
d) Obtain the prediction interval for future observation in the context of multiple linear regression.

Q.4 Answer the following (Any Two) **12**

a) Describe multiple linear regression model. Stating the assumptions, obtain mean and variance of least squares estimators of β.
b) Describe backward elimination methods of subset selection in linear regression.
c) Discuss Durbin-Watson test for detecting autocorrelation. What are its limitations?

Q.5 Answer the following (Any Two) **12**

a) Explain the following plots:
  i) Normal probability plot
  ii) Residual against the fitted values

b) Discuss the logistic regression model. Give a real-life situation where this model is appropriate.

c) Explain the concept of non-linear regression model. Discuss least squares method for estimation of parameters for non-linear regression model.

Seat No.	

Set P

M.Sc. (Statistics) (Semester - III) (New) (NEP CBCS) Examination: March/April - 2025
Design and Analysis of Experiments (2329306)

Day & Date: Monday, 19-May-2025 Max. Marks: 60
Time: 11:00 AM To 01:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Fill in the blanks by choosing correct alternatives given below. **08**

1) In a two-way ANOVA without interaction, which of the following is true?
a) Interaction effects are considered
b) There are no main effects
c) The model only includes main effects of two factors
d) The number of observations per cell must be unequal

2) In a one-way ANOVA, the null hypothesis assumes that _____.
a) All treatment means are different
b) All treatment means are equal
c) There is no error term
d) The treatment means are significantly different from each other

3) In a 2^2 factorial experiment, which of the following is considered a higher-order interaction?
a) Two-factor interaction b) Three-factor interaction
c) Main effects d) Replication

4) In fractional factorial designs, a contrast refers to _____.
a) The difference between the means of two treatment levels
b) The multiplication of all treatment combinations
c) A test to check for the significance of interactions
d) A tool for randomizing the treatment effects

5) Every balanced design is _____.
a) Orthogonal b) Disconnected
c) Complete d) Connected

6) In a 2^4 factorial experiment, how many treatment combinations are there?
a) 4 b) 2
c) 8 d) 16

7) Which of the following is one-way ANOCOVA model with single covariate?

a) $Y_{ij} = \mu + \alpha_i + \beta\left(X_{ij} - \bar{X},,\right) + \epsilon_{ij}$; for all $i = 1,2, \dots p, j = 1,2 \dots n_i$

b) $Y_{ijk} = \mu + \alpha_i + \beta\left(\bar{X}_{ijk} - \bar{X},,\right) + \epsilon_{ijk}$; for all $i = 1,2, \dots p, j = 1,2 \dots n_i$

c) $Y_{ij} = \mu - \alpha_i + \beta\left(X_{ij} - \bar{X},,\right) + \epsilon_{ij}$; for all $i = 1,2, \dots p, j = 1,2 \dots n_i$

d) $Y_{ij} = \mu + \alpha_i - \beta\left(X_{ij} - \bar{X},,\right) + \epsilon_{ij}$; for all $i = 1,2, \dots p, j = 1,2 \dots n_i$

8) Covariance between vector of adjusted treatment totals and vector of block total $(Cov(Q, B))$ is ______.

a) 0 b) 1

c) 3 d) 2

B) Fill in the blanks. **04**

1) ANVOCA is a combination of _____ Statistical techniques.
2) In a 3^n factorial experiment, the number of experimental units required for a full factorial design is _____.
3) In a two-way classification with equal number of observations per cell, the assumptions of ANOVA include homogeneity of variance and _____ for each factor.
4) In total confounding, every effect is confounded in _____ replicates.

Q.2 Answer the following. (Any Six) **12**

a) Explain in brief analysis of variance.
b) Explain in brief partial confounding.
c) Define resolution IV design.
d) Explain in brief orthogonal block design.
e) What is inter block analysis?
f) Check whether the given design is connected or not.

Block	Treatments
I	1,2,3,4
II	4,5
III	10,11

g) What is incomplete block design?
h) Define resolution V design.

Q.3 Answer the following. (Any Three) **12**

a) Explain total confounding with example.
b) Explain Yates procedure to compute factorial effect in 2^3 factorial experiments.
c) Define two-way ANOVA model without interaction. Obtain the least square estimates of parameters of the same model.
d) Show that $c = R^{\delta} - Nk^{-\delta}N'$

Q.4 Answer the following. (Any Two) **12**

a) Derive the test for testing hypothesis of equality of all treatment effects in two-way classification model with interaction.

b) Derive the necessary and sufficient condition for orthogonality of a connected block design and hence show that RBD is connected as well as orthogonal.

c) Describe the analysis of 3^2 factorial experiments.

Q.5 Answer the following. (Any Two) **12**

a) Derive the test for testing treatment in one-way ANCOVA model.

b) Describe the analysis of 2^3 factorial experiments.

c) Define BIBD. Show that in a BIBD (b, k, v, r, λ)

i) $bk = vr$

ii) $\lambda(v-1) = r(k-1)$

iii) $b \geq v$

Seat No.	

Set P

M.Sc. (Statistics) (Semester - IV) (New) (NEP CBCS) Examination: March/April - 2025
Reliability and Survival Analysis (2329402)

Day & Date: Wednesday, 14-May-2025 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative. **08**

1) The censoring time for every censored observation is identical in _____ censoring.
a) type I b) type II
c) Random d) both in a and b

2) The survival function ranges between _____.
a) 0 and 1 b) 0 and ∞
c) -1 and +1 d) -∞ and +∞

3) Which of the following is an example of right censored observation?
a) patient decided to move elsewhere
b) patient become non-cooperative
c) person may not experience the event before the study ends
d) all the above

4) Which of the following is not true?
a) K-M estimator is parametric in nature.
b) K-M estimator is generalized maximum likelihood estimator.
c) K-M estimator is consistent.
d) K-M estimator is also known as product limit estimator.

5) Nonparametric estimator of survival function under complete data is _____.
a) unbiased estimator
b) biased estimator
c) unbiased and consistent estimator
d) biased and consistent estimator

6) In type II censoring _____.
a) the number of failures is fixed
b) the time of an experiment is fixed
c) both time and number of failures is fixed
d) none of these

7) As the number of components n increases, the reliability of parallel system _____.

a) increases b) decreases
c) remains unchanged d) nothing can be said

8) Censoring technique is used for reducing _____.

a) time of experiment b) cost of experiment
c) number of failures d) none of the above

B) Fill in the blanks. **04**

1) The ______ distribution has no ageing property.
2) In type I censoring, the number of uncensored observations has _____ distribution.
3) Green-Wood's formula is used for estimating approximate value of _____ of Kaplan-Meier estimator.
4) NBUE stands for _____.

Q.2 Answer the following question (Any Six) **12**

a) Define parallel system.
b) State structure function for k-out-of-n system.
c) Obtain structure function for series system.
d) Define NBU class.
e) What is meant by cut vector?
f) Define NWUE class.
g) Define minimal cut vector.
h) Define IFR distribution.

Q.3 Answer the following question (Any Three). **12**

a) Discuss bathtub failure rate in details.
b) Discuss mean residual life (MRL) in detail.
c) Show that if F belongs to IFR class, then it also belongs to IFRA class.
d) Discuss the need of censoring.

Q.4 Answer the following question (Any Two) **12**

a) Obtain the maximum likelihood estimate of parameter for exponential distribution in case of complete observations.
b) Define cumulative hazard function. Show that the cumulative hazard function of a continuous non-negative r.v. is exponential with parameter 1.
c) What is type-I censoring. Obtain the likelihood under the type-I censoring.

Q.5 Answer the following question (Any Two) **12**

a) Discuss Kaplan-Meier estimator in detail.
b) Describe Type-II censoring. Obtain MLE of mean of exponential distribution under Type I censoring.
c) Obtain all the path sets, cut sets, minimal path sets, minimal cut sets for
  i) A series system of 5 components
  ii) A parallel system of 5 components

Seat No.	

Set P

M.Sc. (Statistics) (Semester - IV) (New) (NEP CBCS) Examination: March/April - 2025
Industrial Statistics (2329401)

Day & Date: Friday, 16-May-2025 Max. Marks: 60
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Choose correct alternative. **08**

1) Normality assumption of population data values is made for index.
a) C_p b) C_{pk}
c) C_{pm} d) all the above

2) Usually 3-sigma limits are called ______.
a) warning limits b) specification limits
c) action limits d) none of these

3) The type II error occurs when _______.
a) good lot is rejected
b) a bad lot is accepted
c) the number of defectives are very large
d) the population is worse than the AQL

4) V-mask method is used to implement ______ chart.
a) EWMA b) CUSUM
c) Moving average d) CRL

5) The OC function of a control chart gives probability _______.
a) of detecting a shift
b) that point falling on the control limits
c) that point falling on the center line
d) that point falling within the control limits

6) In a demerit system, the unit will cause personal injury or property damage is classified as _______ defect.
a) class B b) class C
c) class A d) class D

7) For a centered process _______.
a) $C_P < C_{PK}$ b) $C_P = C_{PK}$
c) $C_P > C_{PK}$ d) none of these

8) The statistical process control chart used to control number of nonconformities of output is ________.
a) $\bar{X}$ chart
b) R chart
c) p chart
d) c chart

B) Fill in the blank. **04**

1) The curve showing the probability of acceptance of a lot of quality p is known as _______.
2) Quality is inversely proportional to _______.
3) CUSUM and EWMA charts are developed specially for detecting _______ shifts efficiently.
4) 'Vital few and trivial many' is the principle of the _______.

Q.2 Answer the following. (Any Six) **12**

a) Define ARL and OC function of control chart.
b) Define chance and assignable causes of variation.
c) State the control limits of $\bar{X}$ and R charts when standards are unknown.
d) Explain the need of acceptance sampling in industry.
e) Discuss the use of Ishikawa diagram in relation to the process control.
f) Explain the construction of moving average control chart.
g) What is sampling plan? What it is used for?
h) Define Hotelling T^2 statistic.

Q.3 Answer the following. (Any Three) **12**

a) Define process capability index C_{PK}. Also explain the procedure of estimating the same.
b) Describe Pareto chart with illustration.
c) What is an EWMA chart? Explain the procedure of obtaining control limits for the same.
d) Explain Deming's PDCA cycle for continuous improvement.

Q.4 Answer the following. (Any Two) **12**

a) Discuss R chart in detail. Discuss advantages of R chart over S chart. When do you prefer S chart?
b) Define the process capability index C_P. Give its interpretation in terms of probability of non-conformance.
c) Discuss CUSUM chart in detail. When does CUSUM work better than $\bar{X}$ chart?

Q.5 Answer the following. (Any Two) **12**

a) Explain the assumptions, construction and operation of Hotelling's T^2 chart.
b) Define double sampling plan and obtain ASN of the same.
c) Explain variable sampling plan when both lower and upper specification limits are given and σ is known.

Seat No.	

Set P

M.Sc. (Statistics) (Semester - IV) (New) (NEP CBCS) Examination: March/April - 2025
Data Mining (2329405)

Day & Date: Tuesday, 20-May-2025
Time: 03:00 PM To 05:30 PM

Max. Marks: 60

Instructions: 1) All Questions are compulsory.
3) Figures to the right indicates full marks.

Q.1 A) Choose correct alternative. **08**

1) Which of the following is the not a type of clustering?
a) K-means b) Hierarchical
c) Non-hierarchical d) Splitting

2) If ANN model contains one or more hidden layers, then it is called _____.
a) Feedforward network b) Feedbackward network
c) Multilayer network d) All of these

3) The final output of data mining is _____.
a) Data b) Clean data
c) Information d) All of these

4) Artificial Neural Network is _____.
a) Unsupervised learning b) Supervised learning
c) Reinforcement learning d) Genetic algorithm

5) Classification of new species to one of the earlier known families of species is _____.
a) Supervised learning b) Unsupervised learning
c) Traditional learning d) None of these

6) Which of the following is a type of activation function?
a) Linear b) Non- Linear
c) Sigmoid d) All of these

7) In k- nearest neighbor algorithm, k stands for _____.
a) Number of neighbors that are investigated
b) Number of Iterations
c) Number of total records
d) Random number

8) Unlike in regression problem, the class label in classification problem is _____.
   a) numeric (ratio scale)   b) Categorical
   c) Integer only   d) Rational only

B) Fill in the blanks. **04**

1) The part of the entire data, which is used for building the model is called as _____.
2) In data mining, SVM stands for _____.
3) The _____ algorithm of supervised learning is known as 'Lazy learning algorithms'.
4) The data used for realizing the parameter values of the classifier model is known as _____

Q.2 Answer the following. (Any Six) **12**

a) Define accuracy of a classifier.
b) Define precision of a classifier.
c) Why supervised learning is called supervised?
d) Explain the need of data cleaning.
e) Define sensitivity of a classifier.
f) Define unsupervised learning.
g) Define specificity of a classifier.
h) What is meant by True positives.

Q.3 Answer the following. (Any three) **12**

a) Discuss the data cleaning in details.
b) Describe the problem of imbalanced data.
c) Discuss:
   i) Sigmoid activation function
   ii) ReLU activation function
d) How logistic regression is used as a classification tool?

Q.4 Answer the following. (Any Two) **12**

a) Discuss k-nearest neighbor classifier in detail.
b) Write down the algorithm for Bayesian classifier.
c) Discuss information gain in decision tree.

Q.5 Answer the following. (Any Two) **12**

a) Discuss the different metrics for Evaluating Classifier Performance.
b) Explain in detail, market basket analysis.
c) Explain artificial neural network in detail.

Seat No.	

Set P

M.Sc. (Statistics) (Semester - IV) (New/Old) (CBCS) Examination: March/April - 2025
Time Series Analysis (MSC16407)

Day & Date: Tuesday, 27-May-2025 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

Instructions: 1) All questions are compulsory.
2) Attempt any three questions from Q.No.3 to Q.No.7
3) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternative. **10**

1) In time series analysis, the term ARCH means _____
   a) Autoregressive conditionally hetero-scedastic
   b) Autoregressive conditionally hypergeometric
   c) Autoregressive clearly heteroscedaustic
   d) None of these

2) The purpose of smoothing a time series is _____
   a) To estimate noise components
   b) To estimate and remove noise components
   c) To magnify noise components
   d) None of these

3) The MA process is invertible if _____
   a) $|\theta| < 1$ b) $|\theta| > 1$
   c) $|\theta| > 3/2$ d) None of these

4) The value of autocovariance function for IID noise is _____
   a) 0 b) 1
   c) 2 d) 3

5) A time series model $X_t = m_t + s_t + Y_t$ is called as _____
   a) Standard model b) Classical decomposition model
   c) Time model d) Hypothetical model

6) Autocovariance function of a stationary time series model has _____ number of arguments.
   a) 1 b) 2
   c) 3 d) 4

7) A sequence of uncorrelated random variable, each with zero mean and variance σ^2 is called _____
   a) IID noise b) White noise
   c) MA (1) d) AR (1)

8) Moving average method is used for measurement of trend when _____
   a) Trend is linear   b) Trend is curvilinear
   c) Trend is non linear   d) None of them

9) A real-valued function defined on the integers is the autocovariance function of a stationary time series if and only if it is _____
   a) Even   b) Non-negative definite
   c) Both (a) and (b)   d) None of these

10) Random walk is not a weakly stationary series, because _____
   a) Its mean function depends on t
   b) Its covariance function depends on t
   c) Both mean and covariance function depends on t
   d) None of these

B) Fill in the blanks. **06**

1) The IID noise process is _____ stationary process
2) The term ACVF in time series stands for ____
3) If for every t, X_t is expressible in terms of present and past values of the series, then the process is called as ____ process.
4) If X_s and X_t are independent whenever |t - s| > q, then the process is called as ______
5) If mean and covariance functions are both independent of time t, then the process is called as _____
6) If all the variables of a time series are independent, then ACVF (2) = _____

Q.2 Answer the following. **16**

a) Define an invertible process. What is necessary and sufficient condition for invertibility?
b) Discuss Causality of a time series.
c) Write a note on auto-covariance function.
d) What is difference between ARMA(p, q) and ARIMA(p, d, q)?

Q.3 Answer the following. **16**

a) Define ARMA (1, 1) process. Also obtain the auto-covariance function of ARMA (1, 1) process.
b) Explain moving average smoothing in the absence of seasonality.

Q.4 Answer the following **16**

a) What are the different methods of diagnostic checking in time series? Explain the role of residual analysis in model checking.
b) Explain the method of estimating and eliminating trend and seasonal component from a time series using differencing method.

Q.5 Answer the following. **16**

a) Discuss ARIMA process in detail.

b) Explain in brief ARCH and GARCH models.

Q.6 Answer the following. **16**

a) Describe Yule-Walker method of estimating the parameters of an AR(p) process. Obtain the same for AR(2) process.

b) Define MA(1) process. Obtain the autocorrelation function of a stationary AR(1) process.

Q.7 Answer the following. (Any Two) **16**

a) Define:

i) Weakly stationary time series

ii) Strictly stationary time series

iii) IID Noise

iv) White Noise

b) Define an ARMA (p,q) process and state conditions for its invertibility. Examine the process $X_t - 0.5X_{t-1} + 0.3\,X_{t-2} = Z_t + 0.2Z_{t-1}$ for invertibility.