Roll No. ....................................

O. M. R. Serial No. | | | | | | | |

| Question Booklet Number |
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# M. Sc. (Fourth Semester)
# (NEP) EXAMINATION, 2025-26

## STATISTICS

## (Stochastic Processes)

| Paper Code | | | | | | | |
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| B | 0 | 6 | 1 | 0 | 0 | 2 | T |

| Questions Booklet Series |
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*Time : 1:30 Hours* ] [ *Maximum Marks : 75*

**Instructions to the Examinee :**

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

**परीक्षार्थियों के लिए निर्देश :**

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

**(Remaining instructions on the last page)**

**(शेष निर्देश अन्तिम पृष्ठ पर)**

***(Only for Rough Work)***

1. In a pure death process with initial population N, the process eventually reaches :
   (A) Infinity
   (B) N again
   (C) Zero
   (D) Negative values

2. In demography, birth-death processes help model :
   (A) Age distribution
   (B) Population growth
   (C) Rainfall trends
   (D) Crop production

3. The birth-death process can be represented graphically by :
   (A) Linear regression line
   (B) State transition diagram
   (C) Scatter diagram
   (D) Histogram

4. In a pure birth process with constant rate $\lambda$, the waiting time between births follows :
   (A) Exponential distribution
   (B) Binomial distribution
   (C) Normal distribution
   (D) Geometric distribution

5. The birth-death model is frequently used in :
   (A) Chemical reaction kinetics
   (B) Traffic flow modelling
   (C) Ecological population studies.
   (D) All of the above

6. In a birth-death process, if $\lambda_n = 0$, the process reduces to :
   (A) Pure birth process
   (B) Branching process
   (C) Pure death process
   (D) Poisson process

7. In reliability theory, component failures over time can be modelled by :
   (A) Pure birth process
   (B) Pure death process
   (C) Branching process
   (D) Renewal process

8. In queueing theory, arrival of customers is analogous to :
   (A) death
   (B) birth
   (C) migration
   (D) absorption

9. In a pure birth process starting with one individual, the probability distribution of population size after time *t* is often :

(A) Geometric distribution

(B) Binomial distribution

(C) Poisson distribution

(D) None of the above

10. In epidemiology, birth-death models are used to study :

(A) Disease spread

(B) Agricultural yield

(C) Rainfall patterns

(D) Geological changes

11. In a birth-death process, the transition probability depends mainly on :

(A) Future states

(B) Past history

(C) Present state

(D) Random guess

12. The birth-death process is widely applied in :

(A) Demography

(B) Queueing theory

(C) Population dynamics

(D) All of the above

13. In a pure death process, the state 0 is usually :

(A) Absorbing state

(B) Transient state

(C) Recurrent state

(D) Periodic state

14. In population biology, a pure birth process can represent :

(A) Extinction of species

(B) Growth of bacterial colonies

(C) Radioactive decay

(D) Failure of machines

15. The probability distribution governing births in many birth-death models is often :

(A) Binomial distribution.

(B) Normal distribution

(C) Poisson distribution

(D) Uniform distribution

16. A birth-death process with constant birth rate $\lambda$ and death rate $\mu$ is often used in :

(A) Inventory theory

(B) Queueing models

(C) Regression analysis

(D) Experimental design

17. In a pure death process with death rate $\mu_n$, the expected population size generally :

(A) Increases

(B) Decreases

(C) Remains constant

(D) Oscillates

18. The Yule process is an example of :

(A) Pure death process

(B) Pure birth process

(C) Branching process

(D) Renewal process

19. In a pure birth process, the rate at which births occur in state $n$ is called :

(A) Death rate

(B) Transition probability

(C) Birth rate

(D) Survival rate

20. The birth-death process is a special case of :

(A) Deterministic process

(B) Stationary process

(C) Renewal process

(D) Continuous-time Markov process

21. A pure death process allows transitions :

(A) $n \to n+1$

(B) $n \to n+2$

(C) $n \to n-1$

(D) $n \to n$

22. In a pure birth process, the transition possible from state $n$ is :

(A) $n \to n-1$

(B) $n \to n+1$

(C) $n \to n+2$

(D) $n \to 0$

23. A pure birth process is a stochastic process in which :

(A) Only births occur and no deaths occur

(B) Births and deaths occur simultaneously

(C) Only deaths occur

(D) Population remains constant

24. The Poisson process is widely used in modelling :

(A) Rainfall

(B) Number of customers arriving in a queue

(C) Exam marks

(D) Deterministic production

25. In Gambler's ruin with equal probabilities, the probability of reaching the goal before ruin equals to :

(A) Initial capital / target capital

(B) Target / initial capital

(C) 1/2

(D) 1

26. In a random walk, the expected position after $n$ steps (symmetric case) is :

(A) $n$

(B) $n/2$

(C) 1

(D) 0

27. The inter-arrival times in a Poisson process follow :

(A) Uniform distribution

(B) Normal distribution

(C) Exponential distribution

(D) Geometric distribution

28. The probability of exactly '$k$' events in time '$t$' in a Poisson process is given by :

(A) Binomial formula

(B) Poisson probability function

(C) Normal approximation

(D) Hypergeometric formula

29. In a Poisson process, probability of more than one event in a very small interval is :

(A) Very large

(B) Equal to 1

(C) Negligible

(D) Equal to $\lambda$

30. One property of a Poisson process is :

(A) Dependence of increments

(B) Independent increments

(C) Decreasing increments

(D) Periodic increments

31. The parameter $\lambda$ in a Poisson process represents :

(A) Mean rate of occurrence

(B) Probability of success

(C) Variance of process only

(D) Time interval

32. The number of events in a Poisson process follows :

(A) Binomial distribution

(B) Normal distribution

(C) Geometric distribution

(D) Poisson distribution

33. A Poisson process is used to model :

(A) Deterministic arrivals

(B) Random events occurring over time

(C) Periodic events

(D) Seasonal events only

34. If the mean offspring $m > 1$, the process is called :

(A) Subcritical

(B) Critical

(C) Supercritical

(D) Stationary

35. If the mean number of offspring $m < 1$, the population will :

(A) Grow indefinitely

(B) Fluctuate randomly

(C) Eventually become extinct

(D) Remain constant

36. The expected number of offspring per individual in a branching process is called :

(A) Reproduction mean

(B) Growth index

(C) Branching factor

(D) Survival constant

37. In a branching process, each individual produces offspring according to :

(A) Deterministic rule

(B) Fixed number

(C) Geometric rule only

(D) Probability distribution

38. The classical branching model was introduced by :

(A) Kolmogorov

(B) Markov

(C) Galton and Watson

(D) Laplace

39. A branching process describes :

(A) Population growth over generations

(B) Stock market fluctuations

(C) Weather prediction

(D) Deterministic growth

40. In Gambler's ruin, if $p = q = 1/2$, the probability of ruin depends on :

(A) Initial capital only

(B) Target capital only

(C) Initial and target capital

(D) Number of games

41. A random walk with equal probabilities of moving left and right is called :

(A) Biased random walk

(B) Asymmetric walk

(C) Symmetric random walk

(D) Deterministic walk

42. If the probability of winning a game is $p$, then probability of losing is :

(A) $p^2$

(B) $1 - p$

(C) $p(1 - p)$

(D) $1 + p$

43. In the Gambler's Ruin problem, the game stops when :

(A) Gambler reaches a fixed profit

(B) Gambler reaches zero or target capital

(C) Gambler plays infinite games

(D) Gambler doubles the stake.

44. In a simple symmetric random walk, the probability of moving one step to the right is :

(A) 0

(B) 0.5

(C) 1

(D) 0.25

45. A random walk is a stochastic process in which :

(A) Successive positions depend on random steps

(B) Steps are deterministic

(C) Values remain constant

(D) Steps are periodic

46. In a transient Markov chain :

(A) Some states may never be revisited

(B) All states are recurrent

(C) All states are absorbing

(D) All states are periodic

47. If two states communicate with each other, they are :

(A) Independent

(B) Equivalent

(C) Periodic

(D) Absorbing

48. A state j is accessible from state $i$ if :

(A) $P_{ij} = 0$

(B) $P_{ii} = 1$

(C) $P_{ji} = 0$

(D) $p_{ij}^{(n)} > 0$ for some $n$

49. For a Markov chain, $P^0$ equals :

(A) Zero matrix

(B) Identity matrix

(C) Transition matrix

(D) Diagonal matrix

50. The long-run probability of being in state $j$ is called :

(A) Initial probability

(B) Posterior probability

(C) Conditional probability

(D) Limiting probability

51. A Markov chain with finite states and at least one absorbing state is called :

(A) Ergodic chain

(B) Absorbing chain

(C) Reducible chain

(D) Periodic chain

52. The rows of a transition matrix must sum to :

(A) 0

(B) 1

(C) 2

(D) *n*

53. If $P = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, the chain is :

(A) Aperiodic

(B) Periodic

(C) Absorbing

(D) Irreducible aperiodic

54. If $P = \begin{bmatrix} 0.5 & 0.5 \\ 0.2 & 0.8 \end{bmatrix}$, the probability of moving from state 1 to state 2 is :

(A) 1

(B) 0.2

(C) 0.8

(D) 0.5

55. The limiting probability distribution exists for :

(A) Irreducible and aperiodic chains

(B) Reducible chains only

(C) Periodic chains only

(D) Deterministic chains

56. A state with period 1 is called :

(A) Aperiodic

(B) Periodic

(C) Transient

(D) Recurrent

57. The period of a state is defined as :

(A) Maximum return time

(B) Minimum return probability

(C) G. C. D. of return step lengths

(D) Average transition time

58. If every state communicates with every other state, the chain is :

(A) Absorbing

(B) Irreducible

(C) Periodic

(D) Reducible

59. A recurrent state is one where :

(A) Return probability equals 1

(B) Return probability equals 0

(C) Transition probability is zero

(D) State cannot be revisited

60. A state is transient if :

(A) Probability of returning to it is less than 1

(B) Probability of returning is 1

(C) It cannot be left

(D) It is absorbing

61. A state $i$ is called absorbing if :

(A) $p_{ii} = 1$

(B) $p_{ii} = 0$

(C) $p_{ij} = 1$

(D) $p_{ij} = 0$

62. If the chain reaches a limiting distribution independent of initial state, it is called :

(A) Absorbing chain

(B) Regular chain

(C) Deterministic chain

(D) Degenerate chain

63. Kolmogorov's backward equations relate probabilities with :

(A) Final state

(B) Intermediate states

(C) Initial state probabilities

(D) Deterministic values

64. The Chapman-Kolmogorov equation is :

(A) $p_{ij}^{(n+m)} = \sum_k p_{ik}^{(n)} p_{kj}^{(m)}$

(B) $p_{ij} = p_{ji}$

(C) $p_{ij}^{(n)} = 1$

(D) $p_{ij}^{(n)} = p_{ij}$

65. If P is the transition matrix, then the 2-step transition matrix equals :

(A) $P^3$

(B) $P^2$

(C) 2P

(D) P + P

66. The $n$-step transition probability matrix is obtained by :

(A) $P^n$

(B) $nP$

(C) $P + n$

(D) $P^{-1}$

67. The probability of transition from state $i$ to $j$ in $n$ steps is denoted by :

(A) $p_{ij}^{(n)}$

(B) $p_{ji}$

(C) $p_i$

(D) $p_j$

68. If P = [$p_{ij}$] is a transition matrix, then :

(A) $p_{ij} \geq 0$ and $\sum_i p_{ij} = 1$

(B) $p_{ij} \geq 0$ and $\sum_j p_{ij} = 1$

(C) $p_{ij} = 1$

(D) $\sum_i p_{ij} = 0$

69. A matrix containing probabilities of moving from one state to another in one step is called :

(A) Identity matrix

(B) Stochastic matrix

(C) Transition probability matrix

(D) Diagonal matrix

70. The Markov property is expressed as :

(A) $P\left(X_{n+1} \mid X_n, X_{n-1}, \ldots\right) = P\left(X_{n+1} \mid X_n\right)$

(B) $P\left(X_{n+1} \mid X_0\right) = P\left(X_{n+1}\right)$

(C) $P\left(X_n \mid X_{n-1}\right) = 0$

(D) $P\left(X_n\right) = 1$

71. In a simple symmetric random walk, starting from 0, after 4 steps the maximum possible position is :

(A) 2

(B) 3

(C) 4

(D) 5

72. If a process has countable state space, it is called :

(A) Discrete state process

(B) Continuous state process

(C) Deterministic process

(D) Gaussian process

73. A stochastic process takes values in the set {1, 2, 3, ... } and is defined for all real t ≥73. This is :

(A) Discrete-time, discrete-state

(B) Continuous-time, continuous-state

(C) Continuous-time, discrete-state

(D) Discrete-time, continuous-state

74. In a Markov chain, transition probabilities satisfy :

(A) Regression equation

(B) Deterministic law

(C) Memoryless property

(D) Linear trend

75. The covariance function of a stationary process depends on :

(A) Absolute time

(B) Time difference (lag)

(C) Mean value

(D) Variance only

76. A Gaussian process is one where :

(A) All finite-dimensional distributions are normal

(B) Mean is zero

(C) Variance is one

(D) Variables are discrete

77. For $\lambda = 3$ per hour, what is the probability of at least 1 event in 1 hour ?

(A) $e^{-3}$

(B) $1 - e^{-3}$

(C) $1 - e^{-1}$

(D) $e^{-1}$

78. If $X_t = X_0 + \sum Y_i$ where $Y_i$ are independent random variables, the process is :

(A) Poisson process

(B) Gaussian process

(C) Random walk

(D) Deterministic sequence

79. The Wiener process has increments that follow :

(A) Poisson distribution

(B) Normal distribution

(C) Exponential distribution.

(D) Binomial distribution

80. Which of the following processes has independent increments ?

(A) Poisson process

(B) AR process

(C) Deterministic trend

(D) Periodic process

81. The expected value of a Poisson process with rate $\lambda$ at time t is :

(A) $\lambda t$

(B) $\lambda + t$

(C) $\lambda / t$

(D) $\lambda^2 t$

82. If events occur according to a Poisson process with rate λ = 3 per hour, what is the probability of exactly 2 events in 1 hour ?

(A) $\frac{9e^{-3}}{2}$

(B) $\frac{6e^{-3}}{2}$

(C) $\frac{3e^{-2}}{2}$

(D) $\frac{9e^{-2}}{2}$

83. The state space of a Poisson process is :

(A) Real numbers

(B) Continuous interval

(C) Non-negative integers

(D) Negative integers

84. In a simple random walk, each step is determined by :

(A) Deterministic rule

(B) Independent identically distributed random variables

(C) Constant value

(D) Linear equation

85. The Wiener process is also called :

(A) Random walk

(B) Brownian motion

(C) Markov chain

(D) Poisson process

86. A random walk is an example of :

(A) Deterministic process

(B) Continuous deterministic model

(C) Discrete-time stochastic process

(D) Linear regression model

87. A continuous-time stochastic process is indexed by :

(A) Integers only

(B) Real numbers representing time

(C) Finite numbers only

(D) Negative integers

88. If $\{X(t)\}$ is a stochastic process with discrete time and continuous state space, it is called :

(A) Continuous state discrete time process

(B) Continuous time process

(C) Deterministic model

(D) Finite state process

89. A process where increments follow Poisson distribution is known as :

(A) Markov chain

(B) Wiener process

(C) Random walk

(D) Poisson process

90. A stochastic process $\{X(t)\}$ is said to be strictly stationary if :

(A) Mean is constant

(B) Variance is constant

(C) Joint distributions remain unchanged under time shift

(D) Covariance is zero

91. In stochastic processes, the probability law governing the process is determined by :

(A) Mean only

(B) Finite dimensional distributions

(C) Variance only

(D) Median

92. A sequence of independent random variables is an example of :

(A) Stochastic process

(B) Deterministic sequence

(C) Markov chain

(D) Random variable pair

93. A process in which future states depend only on the present state is known as :

(A) Stationary process

(B) Independent process

(C) Poisson process

(D) Markov process

94. The stochastic process whose statistical properties do not change over time is called :

(A) Random walk

(B) Markov process

(C) Stationary process

(D) Poisson process

95. A process where the state space is a real interval is called :

(A) Discrete state process

(B) Continuous state process

(C) Finite state process

(D) Deterministic sequence

96. A stochastic process indexed by integers is an example of :

(A) Discrete-time process

(B) Continuous-time process

(C) Deterministic process

(D) Stationary process

97. A stochastic process with discrete time and discrete state space is called :

(A) Continuous process

(B) Gaussian process

(C) Diffusion process

(D) Markov chain

98. In a stochastic process, the index set usually represents :

(A) Probability distribution

(B) Sample outcome

(C) Time or space parameter

(D) Population size

99. The set of values that a stochastic process can take is called the :

(A) Parameter space

(B) State space

(C) Sample size

(D) Index set

100. A stochastic process is defined as :

(A) A collection of random variables indexed by time or space

(B) A deterministic function of time

(C) A fixed probability distribution

(D) A sample survey method

*(Only for Rough Work)*

4. Four alternative answers are mentioned for each question as—A, B, C & D in the booklet. The candidate has to choose the correct answer and mark the same in the OMR Answer-Sheet as per the direction :

**Example :**

**Question :**

Q. 1 Ⓐ ● Ⓒ Ⓓ
Q. 2 Ⓐ Ⓑ ● Ⓓ
Q. 3 Ⓐ ● Ⓒ Ⓓ

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.
6. All answers are to be given on OMR Answer Sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.
7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.
8. After the completion of the examination candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.
9. There will be no negative marking.
10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.
11. To bring and use of log-book, calculator, pager and cellular phone in examination hall is prohibited.
12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

**Impt. :** On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is any discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर—A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से सही उत्तर छाँटना है। उत्तर को OMR आन्सर-शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

**उदाहरण :**

**प्रश्न :**

प्रश्न 1 Ⓐ ● Ⓒ Ⓓ
प्रश्न 2 Ⓐ Ⓑ ● Ⓓ
प्रश्न 3 Ⓐ ● Ⓒ Ⓓ

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उन्हें निरस्त कर दिया जाएगा।

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।
6. सभी उत्तर केवल ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।
7. ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।
8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।
9. निगेटिव मार्किंग नहीं है।
10. कोई भी रफ कार्य, प्रश्न-पुस्तिका के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।
11. परीक्षा-कक्ष में लॉग-बुक, कैलकुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।
12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

**महत्वपूर्ण :** प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्न-पुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्न-पुस्तिका प्राप्त कर लें।