Course Structure for S.Y.B.Sc. (Computer Science) Statistics
As per NEP 2.0 (2024 Pattern)

Sem.	Course Type	Course Code	Course Name	Theory / Practical	Credits
III	Minor	COS-206-MN(A)	Foundations of Probability	Theory	02
	Minor	COS-207-MN(A)	Minor Statistics Practical (CS) -I	Practical	02
IV	Minor	COS-256-MN(A)	Continuous Probability Distributions and Testing of Hypothesis	Theory	02
	Minor	COS-257-MN(A)	Minor Statistics Practical (CS) -II	Practical	02

CBCS Syllabus as per NEP 2.0 for S.Y.B.Sc. (Computer Science) (2024 Pattern)

Name of the Programme : B.Sc. (Computer Science)

Programme Code : USCOS

Class : S.Y.B.Sc. (Computer Science)

Semester : III

Course Type : Minor (Theory)

Course Code : COS-206-MN(A)

Course Title : Foundations of Probability

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1) To understand the concept of sample spaces, events, probability, conditional probability including Bayes' theorem and independence of events.
2) To understand the characteristics and types of Experiment.
3) To understand the concept of principle of counting.
4) To understand the importance of Probability model.
5) To understand concept of Probability distribution.
6) To computation of probabilities to solve real-world problems.
7) To develop problem-solving skills related to discrete probability distributions.

Course Outcome:

By the end of the course, students will be able to:

CO1. distinguish between random and non-random experiments.

CO2. find the probabilities of various events.

CO3. obtain probability distribution of univariate discrete and continuous random variables.

CO4. apply Binomial distribution in real life situations.

CO5. apply Poisson distribution in real life situations.

CO6. probability Distributions give up the possible outcome of any random event.

CO7. studying probability will help children to develop critical thinking skills and to interpret the probability that surround us daily.

TOPICS/CONTENTS:

UNIT 1: Sample Space and Events (6L)

1.1 Concepts of experiments, deterministic and nondeterministic experiments.

1.2 Definitions: sample space, types of sample space, event, types of events: Elementary event, Complementary event, Sure event, Impossible event.

1.3 Concept of occurrence of an event, Equally-likely events

1.4 Algebra of events (Union, Intersection, Complementation).

1.5 Definitions of Mutually exclusive events, Exhaustive events.

1.6 Algebra of events and its representation of events in set theory notation: Occurrence of the following events:

- at least one of the given events
- none of the given events
- all of the given events
- mutually exclusive events
- mutually exhaustive events
- Exactly one event out of the given events.

1.7 Numerical problems related to real life situations.

UNIT 2: Probability (10L)

2.1 Concept of Multiplication principle and Permutation and Combination

2.2 Classical Probability: Classical definition of probability, examples, Probability model, probability of an event, examples. Axiomatic definition of probability.

2.3 Important results and their proofs:

i. $0 \leq P(A) \leq 1$,

ii. $P(A) + P(A^c) = 1$

iii. $P(\Phi) = 0$

iv. If $A \subset B$, $P(A) \leq P(B)$

v. $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (Addition theorem of probability) and its generalization (Statement only).

2.4 Numerical problems related to real life situations.

2.5 Conditional Probability

i. Concepts and definitions of Conditional Probability.

ii. Definition of conditional probability of an event.

iii. Multiplication theorem for two events. Examples.

iv. Partition of sample space.

v. Idea of Posterior probability, Statement and proof of Bayes' theorem, examples on Bayes' theorem.

2.6 Independence of Events

i. Concept of Independence of two events.

ii. Proof of the result that if A and B are independent then
a) A and B^c, b) A^c and B c) A^c and B^c are independent.

iii. Pairwise and Mutual Independence for three events.

iv. Numerical problems related to real life situations.

UNIT 3: Discrete Random Variable and Probability Distributions (4L)

3.1 Definition of random variable (r.v.), discrete and continuous random variable.

3.2 Definition of probability mass function (p.m.f.) of discrete r.v. and probability density function of continuous r.v.

3.3 Cumulative distribution function (c.d.f.) of discrete and continuous r.v. and their properties. (Characteristic properties only)

3.4 Definition of expectation and variance of discrete and continuous r.v., theorem on expectation and variance (statement only).

3.5 Determination of median and mode using p.m.f. only.

3.6 Numerical problems related to real life situations.

UNIT 4: Standard Discrete Distributions (Finite Sample Space) (10L)

4.1 Uniform Distribution: definition, mean, variance.

4.2 Bernoulli Distribution: definition, mean, variance.

4.3 Binomial Distribution: definition, mean, variance, additive property, relation between Bernoulli and Binomial Distribution.

4.4 Hypergeometric Distribution: definition, mean, variance.

4.5 Numerical problems related to real life situations.

4.6 Numerical problems related to real life situations.

References:

1. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
2. Gupta and Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
3. Sharma K. V. S. (2001) Statistics made it simple: Do it yourself on PC. Prentce Hall of India, New Delhi.
4. Gupta and Kapoor : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.

Programme Outcomes and Course Outcomes Mapping:

CO-PO Mapping Table

Course Outcomes	Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	2	1	1	1	1	1	1	1	1
CO2	2	2	1	3	2	1	1	1	1	1	1	1	1
CO3	2	2	1	3	2	1	1	1	1	1	1	1	1
CO4	2	2	1	3	2	1	1	1	1	1	1	1	1
CO5	1	2	1	3	2	1	1	1	1	1	1	1	1
CO6	1	2	1	3	2	1	1	1	1	1	1	1	1
CO7	1	2	2	2	3	1	1	1	1	1	1	1	1

Justification:

PO1. Comprehensive Knowledge and Understanding:

CO1: Strongly Related (Weightage: 3)
CO2: Moderately Related (Weightage:2)
CO3: Moderately Related (Weightage: 2)
CO4: Moderately Related (Weightage: 2)
CO5: Partially Related (Weightage: 1)
CO6: Partially Related (Weightage: 1)
CO7: Partially Related (Weightage: 1)

Justification: PO1 emphasizes the acquisition of broad knowledge and understanding. CO1 directly contributes to this by differentiating between random and non-random experiments, forming a fundamental aspect of probability theory. CO2 to CO4 also enhance understanding by applying probability concepts in various scenarios. However, CO5 to CO7 are only partially related as they focus more on the application and interpretation of probability rather than deepening knowledge and understanding.

PO2. Practical, Professional, and Procedural Knowledge:

CO1: Moderately Related (Weightage: 2)
CO2: Moderately Related (Weightage: 2)
CO3: Moderately Related (Weightage: 2)
CO4: Moderately Related (Weightage: 2)
CO5: Moderately Related (Weightage: 2)
CO6: Moderately Related (Weightage: 2)
CO7: Moderately Related (Weightage: 2)

Justification: PO2 involves the application of knowledge in practical and professional contexts. All the objectives (CO1 to CO7) contribute to this by requiring the understanding and application of probability concepts in real-life scenarios and problem-solving situations.

PO3. Entrepreneurial Mindset and Knowledge:

CO1: Partially Related (Weightage: 1)
CO2: Partially Related (Weightage: 1)
CO3: Partially Related (Weightage: 1)
CO4: Partially Related (Weightage: 1)
CO5: Partially Related (Weightage: 1)
CO6: Partially Related (Weightage: 1)
CO7: Moderately Related (Weightage: 2)

Justification: Entrepreneurial mind set involves recognizing opportunities and taking calculated risks. While CO7 mentions the importance of probability in developing critical thinking skills, the rest of the objectives do not directly address entrepreneurial mind set or knowledge.

PO4. Specialized Skills and Competencies:

CO1: Strongly Related (Weightage: 3)
CO2: Strongly Related (Weightage: 3)
CO3: Strongly Related (Weightage: 3)
CO4: Strongly Related (Weightage: 3)
CO5: Strongly Related (Weightage: 3)
CO6: Strongly Related (Weightage: 3)
CO7: Moderately Related (Weightage: 2)

Justification: PO4 focuses on acquiring specialized skills and competencies. All the objectives (CO1 to CO7) are strongly related as they directly contribute to developing these skills through understanding and applying probability concepts.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning:

CO1: Moderately Related (Weightage: 2)
CO2: Moderately Related (Weightage: 2)
CO3: Moderately Related (Weightage: 2)
CO4: Moderately Related (Weightage: 2)
CO5: Moderately Related (Weightage: 2)
CO6: Moderately Related (Weightage: 2)
CO7: Strongly Related (Weightage: 3)

Justification: PO5 emphasizes the ability to apply knowledge in problem-solving and analytical reasoning. CO7 directly addresses this by highlighting the role of probability in developing critical thinking skills. The other objectives (CO1 to CO6) also contribute to problem-solving and analytical reasoning, albeit to a lesser extent.

PO6. Communication Skills and Collaboration:

All COs: Partially Related (Weightage: 1)

Justification: None of the objectives directly relate to communication skills or collaboration. These aspects are not explicitly addressed within the context of probability theory.

PO7. Research-related Skills:

All COs: Partially Related (Weightage: 1)

Justification: While understanding probability concepts can contribute to research skills, none of the objectives explicitly address research methodologies or techniques.

PO8. Learning How to Learn Skills:

All COs: Partially Related (Weightage: 1)

Justification: While the objectives focus on understanding probability concepts, they do not directly address learning how to learn skills.

PO9. Digital and Technological Skills:

All COs: Partially Related (Weightage: 1)

Justification: Understanding probability concepts may involve the use of digital tools like statistical software, but these objectives do not specifically focus on developing digital or technological skills.

PO10. Multicultural Competence, Inclusive Spirit, and Empathy:

All COs: Partially Related (Weightage: 1)

Justification: Probability concepts are not directly related to multicultural competence, inclusive spirit, or empathy. These aspects are not addressed within the context of probability theory.

PO11. Value Inculcation and Environmental Awareness:

All COs: Partially Related (Weightage: 1)

Justification: Probability concepts are not directly related to value inculcation or environmental awareness.

PO12. Autonomy, Responsibility, and Accountability:

All COs: Partially Related (Weightage: 1)

Justification: While these objectives involve understanding probability concepts, they do not directly address autonomy, responsibility, or accountability.

PO13. Community Engagement and Service:

All COs: Partially Related (Weightage: 1)

Justification: Probability concepts are not directly related to community engagement or service. These aspects are not addressed within the context of probability theory.

CBCS Syllabus as per NEP 2.0 for S.Y.B.Sc. (Computer Science) (2024 Pattern)

Name of the Programme : B.Sc. (Computer Science)

Programme Code : USCOS

Class : S.Y.B.Sc. (Computer Science)

Semester : III

Course Type : Minor (Practical)

Course Code : COS-207-MN(A)

Course Title : Minor Statistics Practical (CS) - I

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

1) To understand the importance of sampling in statistics.
2) To understand the importance of data visualization.
3) To understand concept of central tendency.
4) To understand the various measures of central tendency in data analysis.
5) To understand the various measures of dispersion in data analysis.
6) To understand the concept of Experiment.
7) To understand the probability distributions and their real life scenario.

Course Outcome:

By the end of the course, students should be able to:

CO1. interpret the data by using various data visualization tools.

CO2. use various statistical techniques for data analysis.

CO3. understand sampling techniques in real life.

CO4. apply Binomial distribution in real life situations.

CO5. apply Poisson distribution in real life situations.

CO6. understand the probability distributions give up the possible outcome of any random event.

CO7. develop critical thinking skills and to interpret the probability that surround us daily.

Topics and Learning Points

Sr. No.	Title of the Experiment
1	Introduction to Tableau
2	Data Cleaning and Preprocessing Techniques
3	Data Visualization using Tableau
4	Measures of Central Tendency – I
5	Measures of Central Tendency – II
6	Measures of Dispersion – I
7	Measures of Dispersion – II
8	Sampling Techniques
9	Probability and Conditional Probability
10	Univariate Discrete Probability Distributions
11	Application of Bayes' Theorem and Independence of Events
12	Application of Binomial and Hypergeometric Distribution Using R Software
13	Fitting of binomial distribution and Model sampling from binomial distribution Using R Software
14	Case Study (2 Practical)

Note:

1. Every practical is equivalent to four hours per batch per week
2. Practical batch should be of 15 students
3. For project, a group of maximum 15 students be made
4. Different data sets from newspapers, internet and magazines may be collected and students will be asked to use Statistical techniques/tools which they have learnt.
5. Students must complete all the practicals to the satisfaction of the teacher concerned.
6. Students must produce at the time of practical examination, the laboratory journal along with the completion certificate signed by the Head of the Department.

Programme Outcomes and Course Outcomes Mapping:

Course Outcomes	Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3							1					
CO2		3					1						
CO3									2				
CO4													
CO5													
CO6					3								
CO7						2				2			

CO-PO Mapping Table

PO1. Comprehensive Knowledge and Understanding:

CO1. Distinguish between random and non-random experiments. (Weightage: 3 - Strongly Related)

Justification: Graduates need a profound understanding of their field, including foundational theories and principles such as distinguishing between random and non-random experiments, which is essential knowledge within the broader context of probability theory and statistics.

PO2. Practical, Professional, and Procedural Knowledge:

CO2. Find the probabilities of various events. (Weightage: 3 - Strongly Related)

Justification: Acquiring practical skills and expertise for professional tasks involves the ability to find probabilities of various events, which is fundamental in applying probability theory to real-world scenarios.

PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning:

CO6. Probability distributions give up the possible outcome of any random event. **(Weightage: 3 - Strongly Related)**

Justification: Graduates possessing the capacity for application, problem-solving, and analytical reasoning should understand probability distributions, as they are essential for analysing and interpreting data effectively in practical settings.

PO6. Communication Skills and Collaboration:

CO7. Studying probability will help children to develop critical thinking skills and to interpret the probability that surround us daily. (Weightage: 2 - Moderately Related)

Justification: While this CO focuses on the benefits of studying probability for

children's critical thinking skills, it indirectly relates to communication skills as understanding probability concepts and their interpretation requires effective communication and explanation, especially when teaching or explaining these concepts to others.

PO7. Research-related Skills:

CO2. Find the probabilities of various events. (Weightage: 1 - Partially Related)

Justification: Research-related skills involve utilizing appropriate methodologies for data collection and analysis, which may require understanding probability concepts and finding probabilities of various events as part of the research process.

PO8. Learning How to Learn Skills:

CO1. Distinguish between random and non-random experiments. (Weightage: 1 - Partially Related)

Justification: Learning how to learn involves understanding the fundamentals of various subjects, including probability theory. Distinguishing between random and non-random experiments is a foundational concept within probability theory that contributes to learning how to learn effectively.

PO9. Digital and Technological Skills:

CO3. Obtain probability distribution of univariate discrete and continuous random variables. (Weightage: 2 - Moderately Related)

Justification: Proficiency in digital and technological skills often involves data analysis using appropriate software, which may include statistical software for obtaining probability distributions of random variables, aligning with the broader objective of utilizing technology for data analysis and interpretation.

PO10. Multicultural Competence, Inclusive Spirit, and Empathy:

CO7. Studying probability will help children to develop critical thinking skills and to interpret the probability that surrounds us daily. (Weightage: 2 - Moderately Related)

Justification: Developing an inclusive spirit and empathy involves understanding diverse perspectives and fostering critical thinking skills. Studying probability, as indicated in CO7, contributes to critical thinking development, indirectly aligning with the objective of fostering an inclusive spirit and empathy in multicultural settings.