Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science and Commerce, Baramati

(Empowered Autonomous)

Four Year B.Sc. Degree Program in Statistics

(Faculty of Science & Technology)

CBCS Syllabus

S.Y.B.Sc. (Statistics) Semester – III

For Department of Statistics

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Choice Based Credit System Syllabus

As Per NEP 2.0 (2024 Pattern)

To be implemented from Academic Year 2025 – 2026

Title of the Programme: S.Y.B.Sc. (Statistics)

Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science and Commerce Baramati, Dist-Pune, MS, India.

(Empowered Autonomous)

Board of Studies in Statistics

(Academic Year 2025-26 to 2027-28)

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18.	**Dr. Koshti Rohan**	Subject Expert from Outside the Parent University
19.	**Prof. Gardi Chandrakant Gopal**	Subject Expert from Outside the Parent University
20.	**Mr. Kadam Saurabh**	Representative from industry/corporate sector/allied areas
21.	**Dr. Limbore Jaya Laxman**	Member of the College Alumni
22.	**Miss. Shirke Satakshi Shrikant**	UG Student
23.	**Miss. Pathak Siddhi Rajendra**	PG Student

Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science & Commerce, Baramati.

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati is an empowered autonomous & dynamic institute and has successfully implemented the National Education Policy 2.0 2024 pattern since the academic year 2024-25. We are updating our academic policies as per local needs keeping in view the global perspectives. Accordingly, we have updated our program outcomes as per the graduate attributes defined in New Education Policy. In general, program outcomes are categorized into two categories as disciplinary & interdisciplinary outcomes and generic outcomes.

Program Outcomes for B.Sc.

1. **Comprehensive Knowledge and Understanding**: Graduates will possess a profound understanding of their field of study, including foundational theories, principles, methodologies, and key concepts, within a broader multidisciplinary context.
2. **Practical, Professional, and Procedural Knowledge**: Graduates will acquire practical skills and expertise essential for professional tasks within their field. This includes knowledge of industry standards, best practices, regulations, and ethical considerations, with the ability to apply this knowledge effectively in real-world scenarios.
3. **Entrepreneurial Mindset and Knowledge**: Graduates will cultivate an entrepreneurial mindset, identifying opportunities, fostering innovation, and understanding business principles, market dynamics, and risk management strategies.
4. **Specialized Skills and Competencies**: Graduates will demonstrate proficiency in technical skills, analytical abilities, problem-solving, effective communication, and leadership, relevant to their field of study. They will also adapt and innovate in response to changing circumstances.
5. **Capacity for Application, Problem-Solving, and Analytical Reasoning**: Graduates will possess the capacity to apply learned concepts in practical settings, solve complex problems, and analyze data effectively. This requires critical thinking, creativity, adaptability, and a readiness to learn and take calculated risks.

6. **Communication Skills and Collaboration**: Graduates will effectively communicate complex information, both orally and in writing, using appropriate media and language. They will also collaborate effectively in diverse teams, demonstrating leadership qualities and facilitating cooperative efforts toward common goals.
7. **Research-related Skills**: Graduates will demonstrate observational and inquiry skills, formulate research questions, and utilize appropriate methodologies for data collection and analysis. They will also adhere to research ethics and effectively report research findings.
8. **Learning How to Learn Skills**: Graduates will acquire new knowledge and skills through self-directed learning, adapt to changing demands, and set and achieve goals independently.
9. **Digital and Technological Skills**: Graduates will demonstrate proficiency in using ICT, accessing information sources, and analyzing data using appropriate software.
10. **Multicultural Competence, Inclusive Spirit, and Empathy**: Graduates will engage effectively in multicultural settings, respecting diverse perspectives, leading diverse teams, and demonstrating empathy and understanding of others' perspectives and emotions.
11. **Value Inculcation and Environmental Awareness**: Graduates will embrace ethical and moral values, practice responsible citizenship, recognize and address ethical issues, and take appropriate actions to promote sustainability and environmental conservation.
12. **Autonomy, Responsibility, and Accountability**: Graduates will apply knowledge and skills independently, manage projects effectively, and demonstrate responsibility and accountability in work and learning contexts.
13. **Community Engagement and Service**: Graduates will actively participate in community-engaged services and activities, promoting societal well-being.

Programme Specific Outcomes (PSOs)

PSO1. Proficiency in basic statistical calculations: Students should develop the ability to perform basic statistical calculations, such as measures of central tendency, measures of dispersion, and probabilities. They should be able to use appropriate formulas and procedures to calculate these measures accurately.

PSO2. Competence in data collection and organization: Students should gain practical skills in collecting and organizing data for statistical analysis. They should be able to identify different types of data (categorical, numerical) and employ appropriate methods for data collection.

PSO3. Understanding of graphical representation of data: Students should be able to create and interpret basic graphical representations of data, such as histograms, bar charts, scatter plots, and box plots. They should understand the purpose of these visualizations and how they can aid in data analysis and interpretation.

PSO4. Effective communication of statistical results: Students should practice effectively communicating statistical results. They should be able to present findings in a clear and concise manner, both orally and in written form, using appropriate statistical terminology.

PSO5. Competence in statistical software and programming: Students should gain proficiency in using statistical software packages (e.g., R, Python, SPSS) and programming languages commonly used in statistical analysis. They should be able to efficiently manipulate, analyse, and visualize data using these tools.

PSO6. Development of critical thinking and problem-solving skills: Students should develop the ability to think critically and solve statistical problems using appropriate techniques. They should be able to identify the correct statistical method for a given problem and apply it effectively.

PSO7. Application of statistical software for data analysis: Students should gain hands-on experience with statistical software packages, such as R or Excel, to perform basic data analysis tasks. They should be able to input data, perform calculations, generate graphical representations, and interpret the results.

Credit Distribution Structure for Three/Four Year Honours/Honours with Research Degree Programme With Multiple Entry and Exit options as per National Education Policy (2024 Pattern as per NEP-2020)

Level/ Difficulty	Sem	Subject DSC-1				Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)				2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T) (Generic)	2(T)	2(T)	--	22
	II	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T	22
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor **Continue option**: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.														
Level/ Difficulty	**Sem**	**Credits Related to Major**				**Minor**	--	**GE/OE**	**SEC**	**IKS**	**AEC**	**VEC**	**CC**	**Total**
		Major Core	**Major Elective**	**VSC**	**FP/OJT/CEP/RP**									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	2(T)	--	2(T)	22
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	22
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	--	22
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 3Years		**44**	**8**	**8**	**10**	**18**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**132**
Exit option: Award of **UG Degree in Major** with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	--	22
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	--	22
Total 4Years		**64**	**16**	**8**	**22**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours with Research Degree** in Major and Minor with 176 credits														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	--	22
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 4Years		**72**	**16**	**8**	**14**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours Degree** in Major and Minor with 176 credits														

T = Theory **P =** Practical **DSC =** Discipline Specific Course **OE =** Open Elective **SEC =** Skill Enhancement Course
IKS = Indian Knowledge System **AEC =** Ability Enhancement Course **VEC =** Value Education Course **CC =** Co-curricular Course
VSC= Vocational Skill Course **OJT**= On Job Training **CEP**= Community Engagement Project **FP**= Field Project **RP**= Research Project

Course Structure for F.Y.B.Sc. (2024 Pattern as per NEP- 2.0)

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
I	DSC-I (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-II (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-III (General)	STA-101-GEN	Descriptive Statistics	T	02
		STA-102-GEN	Statistics Practical-I	P	02
	Open Elective (OE)	STA-103-OE	Commercial Statistics	T	02
	Skill Enhancement Course (SEC)	STA-104-SEC	Statistical Computing using MS-Excel	P	02
	Ability Enhancement Course (AEC)	ENG-104-AEC		T	02
	Value Education Course (VEC)	ENV-105-VEC		T	02
	Generic Indian Knowledge System (GIKS)	GEN-106-IKS		T	02
				Total Credits Semester- I	**22**
II	DSC-I (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-II (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-III (General)	STA-151-GEN	Discrete Probability and Probability Distributions – I	T	02
		STA-152-GEN	Statistics Practical-II	P	02
	Open Elective (OE)	STA-153-OE	Introduction to MS-Excel and Statistical Computing	P	02
	Skill Enhancement Course (SEC)	STA-154-SEC	Application of Statistics Using Advanced Excel	P	02
	Ability Enhancement Course (AEC)	ENG-154-AEC		T	02
	Value Education Course (VEC)	COS-155-VEC		T	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/NCC-156-CC	To be selected from the CC Basket	T	02
				Total Credits Semester- II	**22**
				Cumulative Credits Semester I + Semester II	**44**

Course Structure for S.Y.B.Sc. (2024 Pattern as per NEP- 2.0)

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
III	Major Mandatory	STA-201-MRM	Discrete Probability and Probability Distributions - II	Theory	02
	Major Mandatory	STA-202-MRM	Continuous Probability Distributions – I	Theory	02
	Major Mandatory	STA-203-MRM	Major Statistics Practical – I	Practical	02
	Vocational Skill Course (VSC)	STA-204-VSC	Practicals on Predictive Techniques	Practical	02
	Field Project (FP)	STA-205-FP	Field Project	Practical	02
	Minor	STA-206-MN	Probability Distributions and its Applications	Theory	02
	Minor	STA-207-MN	Minor Statistics Practical – I	Practical	02
	Open Elective (OE)	STA-208-OE	Applied Statistical Techniques	Theory	02
	Subject Specific Indian Knowledge System (IKS)	STA-209-IKS	Evolution of Science and Statistics in India	Theory	02
	Ability Enhancement Course (AEC)	MAR-210-AEC / HIN-210-AEC / SAN-210-AEC		Theory (Any One)	02
	Co-curricular Course (CC)	YOG/PES/CUL/ NSS/NCC-211-CC	To be continued from the Semester - II		02
				Total Credits Semester-III	**22**
IV	Major Mandatory	STA-251-MRM	Statistical Techniques	Theory	02
	Major Mandatory	STA-252-MRM	Continuous Probability Distributions – II	Theory	02
	Major Mandatory	STA-253-MRM	Major Statistics Practical – II	Practical	02
	Vocational Skill Course (VSC)	STA-254-VSC	Statistical Process Control	Theory	02
	Community Engagement Project (CEP)	STA-255-CEP	Community Engagement Project	Practical	02
	Minor	STA-256-MN	Predictive Techniques	Theory	02
	Minor	STA-257-MN	Practicals on Predictive Techniques	Practical	02
	Open Elective (OE)	STA-258-OE	Practical Based on Applied Statistical Techniques	Practical	02
	Skill Enhancement Course (SEC)	STA-259-SEC	Introduction to Tableau and Power BI	Practical	02
	Ability Enhancement Course (AEC)	MAR-260-AEC / HIN-260-AEC / SAN-260-AEC		Theory (Any One)	02
	Co-curricular Course (CC)	YOG/PES/CUL/ NSS/NCC-261-CC	To be continued from the Semester - III		02
				Total Credits Semester-IV	**22**
				Total Credits Semester III + IV	**44**

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

Name of the Programme : B.Sc. Statistics

Programme Code : USST

Class : S.Y.B.Sc.

Semester : III

Course Type : Major Mandatory (Theory)

Course Code : STA-201-MRM

Course Title : Discrete Probability and Probability Distributions - II

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. Understand Bivariate Discrete Probability Distributions – Explain the concept of joint, marginal, and conditional probability distributions and their applications.
2. Analyze Poisson distribution – Study the properties, applications, and real-world relevance of the Poisson distribution in modeling count data.
3. Explore Geometric Distribution – Understand the formulation, moments, and practical applications of the geometric distribution in probability modeling.
4. Apply the negative binomial distribution in real-life scenarios, such as modeling the number of failures before a fixed number of successes.
5. Explore the negative binomial distribution as a generalization of the geometric distribution and study its properties.
6. Apply Probability Models to Real-World Problems – Utilize different discrete probability distributions to solve practical problems in fields like risk analysis, reliability, and queuing theory.
7. Study the properties and applications of the Poisson distribution, including its relation to the binomial distribution. Course Outcomes:

Course Outcomes:

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

CO1. understand Bivariate Discrete Distributions – Explain the concept of joint, marginal, and conditional probability distributions for bivariate discrete random variables.

CO2. calculate expected values, variances, and covariances for bivariate discrete distributions.

CO3. assess the independence of two discrete random variables.

CO4. assess the interrelationship between two discrete random variables.

CO5. apply Poisson distribution to real-world scenarios and compute probabilities for different events.

CO6. apply Geometric distribution to real-world scenarios and compute probabilities for different events.

CO7. interpret the Memoryless Property – Explain and apply the memoryless property of the geometric distribution in probability modeling.

CO8. establish Relationships Between the geometric and negative binomial distributions.

CO9. Apply Negative Binomial distribution to real-world scenarios and compute probabilities for different events.

Topics and Learning Points

Unit – 1: Bivariate Discrete Probability Distribution: (8 L)

1.1 Definition of a bivariate discrete random variable (X,Y) on finite sample space, Joint p.m.f., and c.d.f., Properties of c.d.f. (without proof).

1.2 Computation of probabilities of events in the bivariate probability distribution, the concept of a marginal and conditional probability distribution, independence of two discrete r.v.s. Examples.

1.3 Mathematical Expectation: Definition of expectation of a function of r.v. in bivariate distribution, Theorems on expectations: (i) $E(X+Y) = E(X) + E(Y)$ (ii) $E(XY) = E(X)\cdot E(Y)$ when X and Y are independent, expectation and variance of a linear combination of two discrete r.v.s., the definition of conditional mean, conditional variance, covariance and correlation coefficient, $Cov(aX+bY, cX+dY)$, the distinction between uncorrelated and independent variables, joint m.g.f, proof of the m.g.f. of the sum of two independent r.v.as the product of their m.g.f. examples.

Unit – 2: Poisson Distribution (8 L)

2.1. Definition of Poisson with parameter λ.

2.2. Moment Generating Function (MGF), Cumulant Generating Function (CGF), mean, variance, skewness, kurtosis

2.3. Recurrence relation for successive Probabilities, Additive property of Poisson(λ).

2.4. Poisson distribution as a limiting case of Binomial distribution, examples.

2.5. Conditional distribution of X given (X+Y) for Poisson distributions.

2.6. Real life situations and applications.

Unit – 3: Geometric Distribution **(6 L)**

3.1 Geometric Distribution: Definition of Geometric with parameter p in both cases with support {0,1,2,….} and with support{1,2, …..}.

3.2 Mean, Variance, distribution function

3.3 Lack of memory property

3.4 Real life situations and applications.

Unit – 4: Negative Binomial Distribution **(8 L)**

4.1 Probability mass function (p.m.f.)

$$P(X = x) = \binom{x+k-1}{x} p^k q^x \quad ; x = 0, 1, 2, \ldots$$

$$; 0 < p < 1; q = 1 - p; k > 0$$

$$= 0 \quad ; \quad otherwise.$$

Notation: $X \sim NB(k, p)$.

4.2 Nature of probability curve, negative binomial distribution as a waiting time distribution,

4.3 Moment Generating Function (MGF), Cumulant Generating Function (CGF), mean, variance, skewness, kurtosis (recurrence relation between moments is not expected), additive property of NB(k, p).

4.4 Relation between Geometric Distribution and Negative Binomial Distribution. Poisson approximation to Negative Binomial Distribution.

4.5 Real life situations and applications.

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2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye: Probability & Statistics for Engineers & Scientists.
3. Bhat B. R., Srivenkatramana T and Madhava Rao K. S. (1997): Statistics: a Beginner's Text, Vol. II, New Age International (P) Ltd.
4. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
5. Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics Ed.4.

6. Gupta and Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
7. Meyer P.L.(1970): Introductory Probability and Statistical Applications, Edition Wesley.
8. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia)
9. Gupta and Kapoor : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
10. B. L. Agarwal : Programmed Statistics, New Age International Publishers, New Delhi.
11. Biston Moore D. S., Notz W. I., Flinger M. A., (2013), The Basic Practice of Statistics, Sixth Edition, Freeman and Company New York
12. Hoel P. G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.
13. M. B. Kulkarni and S. B. Ghatpande : Discrete Probability and Probability Distributions, SIPF Academy, Nashik.

Programme Outcomes and Course Outcomes Mapping:

CO-PO Mapping Table

Course Outcomes (COs)	Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**
CO1	3	2	2	3	3	2	2	2	1	1	1	1	1
CO2	3	3	2	3	3	2	2	2	1	1	1	1	1
CO3	3	3	2	3	3	2	2	2	1	1	1	1	1
CO4	3	3	2	3	3	2	2	2	1	1	1	1	1
CO5	3	3	3	3	3	2	3	2	2	1	1	2	1
CO6	3	3	3	3	3	2	3	2	2	1	1	2	1
CO7	3	3	3	3	3	2	3	2	2	1	1	2	1
CO8	3	3	3	3	3	2	3	2	2	1	1	2	1
CO9	3	3	3	3	3	2	3	2	2	1	1	2	1

1=Partially Related, 2=Moderately Related, 3=Strongly Related

PO1: Comprehensive Knowledge and Understanding

CO1 to CO9 (Weightage: 3 - Strongly Related)

Justification: The course covers essential probability concepts, including bivariate distributions, Poisson, geometric, and negative binomial distributions, ensuring students develop a strong statistical foundation.

PO2: Practical, Professional, and Procedural Knowledge

CO5 to CO9 (Weightage: 3 - Strongly Related)

CO1 to CO4 (Weightage: 2 - Moderately Related)

Justification: The study of probability distributions prepares students for professional applications in various fields, including finance, risk assessment, and reliability engineering.

PO3: Entrepreneurial Mindset and Knowledge

CO5 to CO9 (Weightage: 3 - Strongly Related)

CO1 to CO4 (Weightage: 2 - Moderately Related)

Justification: Understanding probability models is crucial for data-driven decision-making, enabling students to identify trends, assess risks, and develop innovative business solutions.

PO4: Specialized Skills and Competencies

CO1 to CO9 (Weightage: 3 - Strongly Related)

Justification: The course enhances students' ability to analyze and interpret probability models, equipping them with specialized skills for problem-solving and statistical analysis.

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

CO1 to CO9 (Weightage: 3 - Strongly Related)

Justification: The application of probability distributions to real-world problems strengthens students' analytical thinking, problem-solving skills, and ability to model complex scenarios.

PO6: Communication Skills and Collaboration

CO1 to CO4 (Weightage: 2 - Moderately Related), CO5 to CO9 (Weightage: 1 - Weakly Related)

Justification: Students develop the ability to communicate statistical concepts, explain probability models, and collaborate in problem-solving exercises.

PO7: Research-related Skills

CO5 to CO9 (Weightage: 3 - Strongly Related), CO1 to CO4 (Weightage: 2 - Moderately Related)

Justification: The course introduces probability models used in research applications such as epidemiology, reliability studies, and artificial intelligence.

PO8: Learning How to Learn Skills

CO1 to CO9 (Weightage: 2 - Moderately Related)

Justification: Students develop self-learning skills through statistical problem-solving, application of probability concepts, and critical thinking.

PO9: Digital and Technological Skills

CO5 to CO9 (Weightage: 2 - Moderately Related), CO1 to CO4 (Weightage: 1 - Weakly Related)

Justification: Computational tools can be used to solve probability problems, enhancing students' digital and technological proficiency.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO5 to CO9 (Weightage: 1 - Weakly Related)

Justification: Statistical models help in decision-making across diverse fields, fostering an inclusive and data-driven approach to problem-solving.

PO11: Value Inculcation and Environmental Awareness

CO1 to CO4 (Weightage: 1 - Weakly Related), CO5 to CO9 (Weightage: 1 - Weakly Related)

Justification: Ethical application of probability models promotes responsible decision-making in various domains, including environmental studies and public policy.

PO12: Autonomy, Responsibility, and Accountability

CO5 to CO9 (Weightage: 2 - Moderately Related), CO1 to CO4 (Weightage: 1 - Weakly Related)

Justification: Students develop independent analytical skills and responsibility in applying statistical methods ethically.

PO13: Community Engagement and Service

CO5 to CO9 (Weightage: 1 - Weakly Related)

Justification: Understanding probability distributions aids in addressing community-based challenges such as risk assessment, health studies, and disaster management.

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

Name of the Programme : B.Sc. Statistics

Programme Code : USST

Class : S.Y.B.Sc.

Semester : III

Course Type : Major Mandatory (Theory)

Course Code : STA-202-MRM

Course Title : Continuous Probability Distributions – I

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. The main objective of this course is to understand concept of continuous distributions with real life situations.
2. To identify the appropriate probability model that can be used.
3. To find various measures of r.v. and probabilities using its probability distributions.
4. To know the relations among the different distributions.
5. To understand the concept of transformation of univariate continuous random variables.
6. To understand the concept of transformation of bivariate continuous random variables.
7. To apply transformations to bivariate random variables and analyze their probability distributions using M.G.F. and related properties.

Course Outcomes:

Students should be able to:

CO1. define and understand the concept of continuous random variables.

CO2. understand continuous distributions with real life situations.

CO3. understand the statement and significance of the central limit theorem for continuous random variables.

CO4. learn uniform and Normal distributions.

CO5. learn Bivariate distributions.

CO6. learn the relations among the different distributions

CO7. learn the concept of transformation of continuous random variables which help to study derived distributions.

Topics and Learning Points

UNIT 1: Continuous Univariate Distributions (8L)

1.1 Definition of function, Continuous function, Monotonic function, One to one function, Onto function, Inverse function.

1.2 Continuous sample space: Definition, illustrations.
Continuous random variable: Definition, probability density function (p.d.f.), cumulative distribution function (c.d.f.), properties of c.d.f. (without proof), probabilities of events related to random variable.

1.3 Expectation of continuous r.v., expectation of function of r.v. E[g(X)], mean, variance, geometric mean, harmonic mean, raw and central moments, skewness, kurtosis.

1.4 Moment generating function (M.G.F.): Definition and properties, cumulant generating function (C. G. F.): definition**,** properties.

1.5 Mode, median, quartiles.

1.6 Probability distribution of function of r. v. : Y = g(X) using

i) Jacobian of transformation for g(.) monotonic function and one-to-one, on to functions,

ii) Distribution function for $Y = X^2$, Y = |X| etc.,

iii) M.G.F. of g(X).

UNIT 2: Continuous Bivariate Distributions: (10L)

2.1 Continuous bivariate random vector or variable (X, Y): Joint p. d. f. , joint c. d. f , properties (without proof), probabilities of events related to r.v. (events in terms of regions bounded by regular curves, circles, straight lines). Marginal and conditional distributions

2.2 Expectation of r.v., expectation of function of r.v. E[g(X, Y)], joint moments, Cov (X,Y), Corr (X, Y), conditional mean, conditional variance, E[E(X|Y = y)] = E(X), regression as a conditional expectation.

2.3 Independence of r. v. (X, Y) and its extension to k dimensional r. v. Theorems on expectation: i) E(X + Y) = E(X) + E(Y), (ii) E(XY) = E(X) E(Y), if X and Y are independent, generalization to k variables. E(aX + bY + c), Var (aX + bY + c).

2.4 M.G.F. : $M_{X,Y}(t_1, t_2)$, properties, M.G.F. of marginal distribution of r. v.s., properties,

i) $M_{X,Y}(t_1, t_2) = M_X(t_1,0)\, M_Y(0,t_2)$, if X and Y are independent r. v.s.

ii) $M_{X+Y}(t) = M_{X,Y}(t, t)$.

iii) $M_{X+Y}(t) = M_X(t)\, M_Y(t)$ if X and Y are independent r.v.s.

2.5 Probability distribution of transformation of bivariate r. v. $U = \phi_1(X, Y)$, $V = \phi_2(X, Y)$

UNIT 3: Uniform or Rectangular Distribution **(4L)**

3.1 Probability density function (p.d.f.) $f(x) = \begin{cases} \frac{1}{b-a} & ; a \le x \le b \\ 0 & ; \text{Otherwise} \end{cases}$

Notation : X ~ U[a, b], sketch of p. d. f., c. d. f., mean, variance, symmetry.

3.2 Distribution of i) $\frac{X-a}{b-a}$ ii) $\frac{b-X}{b-a}$ iii) Y=F(X), where F(X) is the c.d.f. of continuous r.v. X.

3.3 Application of the result to model sampling. (Distributions of X + Y, X – Y, XY and X/Y are not expected.)

UNIT 4: Normal Distribution **(8L)**

4.1 Probability density function (p. d. f.)

$$f(x) = \begin{cases} \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{1}{-2\sigma^2}(x-\mu)^2} & ; -\infty < x < \infty; -\infty < \mu < \infty; \sigma > 0 \\ 0 & ; \quad otherwise \end{cases}$$

p. d. f. curve, identification of scale and location parameters, nature of probability curve, mean, variance, M.G.F., C.G.F., central moments, cumulants, β_1, β_2, γ_1, γ_2, median, mode, quartiles, mean deviation, additive property, computations of normal probabilities using normal probability integral tables.

4.2 Probability distribution of : i) $\frac{X-\mu}{\sigma}$ standard normal variable (S.N.V.), ii) aX + b, iii) aX + bY + c, iv) X^2, where X and Y are independent normal variates.

4.3 Probability distribution of $\overline{X}$, the mean of n i.i.d. $N(\mu, \sigma^2)$ r.v.s.

4.4 Statement and proof of central limit theorem (CLT) for i.i.d. r.v.s with finite positive

variance. (Proof should be using M.G.F.) Its illustration for Poisson and Binomial distributions.

References:

1. Mukhopadhya Parimal (1999), Applied Statistics, New Central Book Agency, Pvt. Ltd. Kolkata
2. Hogg, R. V. and Craig, A. T. , Mckean J. W. (2012), Introduction to Mathematical Statistics (Tenth Impression), Pearson Prentice Hall.
3. Gupta S. C. &Kapoor V.K.: (2002), Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
4. Gupta S. C. &Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.
5. Walpole R.E. & Mayer R.H.: Probability & Statistics. (Chapter 4, 5, 6, 8, 10) MacMillan Publishing Co. Inc, New York
6. Goon, A.M., Gupta M.K. and Dasgupta B: (1986), Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.
7. Meyer, P. L., Introductory Probability and Statistical Applications, Oxford and IBH Publishing Co. New Delhi.
8. Mood, A. M., Graybill F. A. and Bose, F. A. (1974), Introduction to Theory of Statistics (Third Edition, Chapters II, IV, V, VI), McGraw - Hill Series G A 276
9. Ross, S. (2003), A first course in probability (Sixth Edition), Pearson Education publishers, Delhi, India.

Programme Outcomes and Course Outcomes Mapping:

CO-PO Mapping Table:

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

1=Partially Related, 2=Moderately Related, 3=Strongly Related

PO1: Comprehensive Knowledge and Understanding

All COs: Strongly Related (Weightage: 3)

Justification: The objectives directly contribute to the understanding of continuous random variables and their distributions, which are fundamental concepts in statistics. Therefore, they strongly align with the goal of comprehensive knowledge and understanding.

PO2: Practical, Professional, and Procedural Knowledge

All COs: Strongly Related (Weightage: 3)

Justification: The course emphasizes practical applications of probability distributions, such as uniform and normal distributions, which are essential for data analysis and decision-making in professional settings.

PO3: Entrepreneurial Mindset and Knowledge

All COs: Moderately Related (Weightage: 2)

Justification: Understanding probability distributions aids in risk analysis, financial modeling, and decision-making, which are essential skills for entrepreneurial and business analytics applications.

PO4: Specialized Skills and Competencies

CO2 – CO7: Strongly Related (Weightage: 3), CO1: Moderately Related (Weightage: 2)

Justification: The course introduces specialized concepts such as moment-generating functions (MGF), transformation of variables, and the Central Limit Theorem (CLT), which are crucial for statistical modeling and advanced studies.

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

All COs: Strongly Related (Weightage: 3)

Justification: Students develop problem-solving skills by applying probability distributions to real-world scenarios, computing probabilities, and deriving properties using mathematical tools**.**

PO6: Communication Skills and Collaboration

All COs: Moderately Related (Weightage: 2)

Justification: The course requires students to articulate statistical findings, interpret probability distributions, and work collaboratively on probability-related problems.

PO7: Research-related Skills

CO3 – CO7(Strongly Related Weightage: 3),

CO1 – CO2 (Moderately Related Weightage: 2)

Justification: The study of probability distributions, their transformations, and relationships enhances students' ability to conduct statistical research and analyze data.

PO8: Learning How to Learn Skills

CO3 – CO7(Strongly Related Weightage: 3)

CO1 – CO2(Moderately Related Weightage: 2)

Justification: Concepts like transformations, bivariate distributions, and the Central Limit Theorem require continuous learning and critical thinking, which help students develop independent learning skills.

PO9: Digital and Technological Skills

All COs: Moderately Related (Weightage: 2)

Justification: Probability distributions are widely used in statistical software and programming languages (e.g., R, Python), helping students develop computational skills for data analysis.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

All COs: Partially Related (Weightage: 1)

Justification: Students engage with probability models that apply across disciplines and cultures, fostering an inclusive and analytical approach to problem-solving.

PO11: Value Inculcation and Environmental Awareness

All COs: Partially Related (Weightage: 1)

Justification: Ethical considerations in probability modeling and data analysis help students develop responsible and conscientious analytical skills.

PO12: Autonomy, Responsibility, and Accountability

All COs: Moderately Related (Weightage: 2)

Justification: Independent problem-solving, critical thinking, and logical reasoning in probability theory enhance students' ability to take responsibility for statistical analysis.

PO13: Community Engagement and Service

All COs: Partially Related (Weightage: 1)

Justification: Probability models are applied in public health, environmental statistics, and social sciences, enabling students to contribute to community-oriented data analysis.

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

Name of the Programme : B.Sc. Statistics

Programme Code : USST

Class : S.Y.B.Sc.

Semester : III

Course Type : Major Mandatory (Practical)

Course Code : STA-203-MRM

Course Title : Major Statistics Practical – I

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

The practical course aims to:

1. Provide hands-on experience in fitting discrete and continuous probability distributions using statistical software.
2. Enable students to analyze and interpret real-world data using Poisson, Negative Binomial, and Normal distributions.
3. Develop proficiency in using MS-Excel and R Software for statistical modeling and simulation.
4. Enhance the ability to select appropriate probability distributions based on data characteristics.
5. Strengthen problem-solving skills through practical applications of probability distributions in real-world scenarios.
6. Equip students with the ability to visualize probability distributions and interpret their implications.
7. Introduce computational techniques for generating random samples from various probability distributions.

Course Outcomes:

Students should be able to

CO1. apply Poisson distribution to model count data and assess its goodness of fit.

CO2. estimate parameters and interpret the suitability of the Negative Binomial distribution.

CO3. implement statistical functions in R to analyze discrete and continuous probability

distributions.

CO4. apply Normal Distribution in Real-World Scenarios using MS-Excel and R.

CO5. generate Random Samples from Various Distributions using MS-Excel and R.

CO6. apply Box-Muller and inverse transformation techniques for random variates generation.

CO7. compute probabilities of Poisson, Geometric, Negative Binomial, Uniform, and Normal distributions.

Practical Index

Sr. No.	Title of the experiment
1.	Fitting of Poisson Distribution **(Using MS-Excel)**
2.	Fitting of Negative Binomial Distribution **(Using MS-Excel)**
3.	Fitting of Poisson and Negative Binomial Distribution (**Using R Software)**
4.	Fitting of Normal Distributions **(Using MS-Excel and R Software)**
5.	Normality Testing of Sample Data: Shapiro Wilk test and Q-Q Plot (**Using R Software)**
6.	Applications of Poisson and Geometric Distributions **(Using MS-Excel and R Software)**
7.	Applications of Negative Binomial Distributions **(Using MS-Excel and R Software)**
8.	Applications of Normal Distributions **(Using MS-Excel and R Software)**
9.	Model Sampling from **(Using MS-Excel)** i) Poisson distribution ii) Normal distribution using distribution function iii) Normal distribution using Box-Muller transformation
10.	Model Sampling from Poisson, Geometric, Negative Binomial, Uniform and Normal Distributions (**Using R Software)**
11.	Case Study

Programme Outcomes and Course Outcomes Mapping:

CO-PO Mapping Table

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

1=Partially Related, 2=Moderately Related, 3=Strongly Related

PO1: Comprehensive Knowledge and Understanding

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course builds a solid foundation in probability distributions by covering Poisson, Negative Binomial, and Normal distributions. Students gain an in-depth understanding of statistical modeling, parameter estimation, and real-world applications.

PO2: Practical, Professional, and Procedural Knowledge

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The practical application of statistical distributions in MS-Excel and R equips students with essential computational and data analysis skills, which are valuable in professional fields like data science, finance, and risk assessment.

PO3: Entrepreneurial Mindset and Knowledge

CO3 to CO7 (Weightage: 2 - Moderately Related)

Justification: The ability to analyze and model probability distributions enables students to identify trends, make data-driven decisions, and develop innovative solutions for business, finance, and industrial applications.

PO4: Specialized Skills and Competencies

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course provides hands-on experience with statistical modeling and simulation, enhancing students' problem-solving skills and technical competencies in data analytics.

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

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course emphasizes solving real-world problems using probability distributions, enabling students to apply theoretical concepts to practical scenarios and enhance their analytical reasoning.

PO6: Communication Skills and Collaboration

CO1 to CO7 (Weightage: 2 - Moderately Related)

Justification: Through practical exercises and case studies, students learn to interpret statistical results, present findings clearly, and collaborate effectively in teams for data analysis.

PO7: Research-related Skills

CO3 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course develops students' ability to conduct statistical research, use computational tools for data analysis, and validate statistical models using real-world datasets.

PO8: Learning How to Learn Skills

CO3 to CO7 (Weightage: 3 - Strongly Related)

Justification: Students develop self-learning capabilities by exploring statistical techniques in R and MS-Excel, enabling them to adapt to new tools and methodologies in their future careers.

PO9: Digital and Technological Skills

CO3 to CO7 (Weightage: 3 - Strongly Related)

Justification: The integration of R and MS-Excel in the curriculum enhances students' computational proficiency and data handling skills, which are essential in modern data science applications.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO1 to CO7 (Weightage: 1 - Slightly Related)

Justification: Understanding probability distributions helps in analyzing diverse datasets across different domains, fostering an appreciation for multicultural perspectives in statistical applications.

PO11: Value Inculcation and Environmental Awareness

CO1 to CO7 (Weightage: 1 - Slightly Related)

Justification: Statistical models are applied in environmental studies, healthcare, and social sciences to analyze trends and assess risks, promoting responsible decision-making.

PO12: Autonomy, Responsibility, and Accountability

CO3 to CO7 (Weightage: 2 - Moderately Related)

Justification: The practical nature of the course encourages students to work independently, analyze data responsibly, and apply ethical considerations in statistical modeling.

PO13: Community Engagement and Service

CO1 to CO7 (Weightage: 2 - Moderately Related)

Justification: The application of probability distributions in public health, economics, and engineering enables students to contribute to community-based projects and real-world problem-solving.

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

Name of the Programme : B.Sc. Statistics
Programme Code : USST
Class : S.Y.B.Sc.
Semester : III
Course Type : Vocational Skill Course (Practical)
Course Code : STA-204-VSC
Course Title : Practicals on Predictive Techniques
No. of Credits : 02
No. of Teaching Hours : 60

Course Objectives:

1. Introduce fundamental concepts of simple and multiple regression analysis for predictive modelling.
2. Provide hands-on experience in fitting regression models and curves using MS-Excel and R Software.
3. Enable students to understand the relationship between variables through correlation and regression techniques.
4. Develop the ability to compute and interpret multiple and partial correlation coefficients.
5. Familiarize students with the concepts of time series analysis, including trend estimation and seasonal variations.
6. Teach students how to apply least squares regression, moving averages, and exponential smoothing techniques for forecasting.
7. Train students in Auto-Regressive (AR) models and their application in time series forecasting.

Course Outcomes:

Student will be able to

CO1. use MS-Excel and R to fit a regression line and analyze relationships between two variables.
CO2. apply polynomial and other curve-fitting techniques for non-linear relationships.
CO3. explain the fundamental concepts of multiple regression models.
CO4. use software tools to fit multiple regression planes and calculate multiple/partial

correlation coefficients.

CO5. understand different components of time series data and their significance in forecasting.

CO6. estimate AR(1) and AR(2) models using MS-Excel.

CO7. compute seasonal indices using the Ratio-to-Trend method to identify seasonal patterns in data.

Practical Title

Sr. No.	Title of the experiment
1.	Preliminaries of Regression (Equivalent to 2 Practicals)
2.	Fitting of Regression Line **(Using MS-Excel and R Software)**
3.	Fitting of Regression Curve **(Using MS-Excel and R Software)**
4.	Preliminaries of Multiple Regression (Equivalent to 2 Practicals)
5.	Fitting of Multiple Regression Plane and Computation of Multiple and Partial Correlation Coefficients **(Using MS-Excel and R Software)**
6.	Preliminaries of Time Series (Equivalent to 3 Practicals)
7.	Estimation and Forecasting by Curve Fitting Using Least Square Principle. **(Using MS-Excel)**
8.	Estimation and Forecasting of Trend by Fitting of AR (1) and AR (2) Models **(Using MS-Excel)**
9.	Estimation and Forecasting of Trend by Exponential Smoothing **(Using MS-Excel)**
10.	Estimation and Forecasting of Trend by Moving Averages **(Using MS-Excel)**
11.	Estimation of Seasonal Indices By Ratio to Trend **(Using MS-Excel)**

Preliminary

Unit – 1: Regression (Bivariate case) **(8 L)**

1.1. Review of Bivariate Data and Correlation

1.2. Fitting of line $Y = \beta_0 + \beta_1 X_1$

1.3. Fitting of second degree curve $Y = \beta_0 + \beta_1 X + \beta_1 X^2$

1.4. Fitting of exponential curves of the type $Y = \beta_0 \beta_1^X$ and $Y = \beta_0 X^{\beta_1}$.

UNIT – 2: Multiple Linear Regression (Trivariate case) **(8 L)**

1.1 Definition of multiple correlation coefficient $R_{i.jk}$ $i, j, k = 1,2,3.$

1.2 Properties of multiple correlation coefficient

1.3 Interpretation of coefficient of multiple determination $R^2_{i.jk}$

1.4 Definition of the partial correlation coefficient

1.5 Fitting of regression plane of Y on X_1 and X_2, $(Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2)$

1.6 Residuals: Definition, order, derivation of variance, properties.

1.7 Properties of the partial regression coefficient

UNIT – 3: Time Series **(12 L)**

3.1 Meaning and utility of time series, components of time series: trend, seasonal variations, cyclical variations, irregular (error) fluctuations.

3.2 Exploratory data analysis: Time series plot

3.3 Methods of trend estimation and smoothing:

(i) Moving average

(ii) Curve fitting by least square principle

(iii) Exponential smoothing.

3.4 Measurement of seasonal variations

(i) Simple average method

(ii) Ratio to moving average method

3.5 Ratio to trend where trend is calculated by method of least squares.

3.6 Fitting of autoregressive model $AR\ (p)$, where $p\ =\ 1,2$.

Programme Outcomes and Course Outcomes Mapping:

CO-PO Mapping Table

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

1=Partially Related, 2=Moderately Related, 3=Strongly Related

PO1: Comprehensive Knowledge and Understanding

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course provides an in-depth understanding of regression analysis, correlation, and time series forecasting, ensuring students build a strong foundation in predictive modelling.

PO2: Practical, Professional, and Procedural Knowledge

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The practical application of regression and time series forecasting using MS-Excel and R software prepares students for data analysis roles in various industries, such as finance, economics, and research.

PO3: Entrepreneurial Mindset and Knowledge

CO1 to CO7 (Weightage: 2 - Moderately Related)

Justification: The ability to predict trends and model relationships between variables supports data-driven decision-making, enabling students to develop innovative business solutions and entrepreneurial strategies.

PO4: Specialized Skills and Competencies

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course enhances students' ability to perform regression analysis, fit predictive models, and forecast trends, equipping them with specialized analytical and computational skills.

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

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course emphasizes practical problem-solving using regression and time series models, helping students apply statistical methods to real-world scenarios.

PO6: Communication Skills and Collaboration

CO1 to CO7 (Weightage: 2 - Moderately Related)

Justification: The interpretation of regression and time series results requires effective communication, enabling students to present findings clearly and work collaboratively on data-driven projects.

PO7: Research-related Skills

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course fosters research skills by training students in statistical modeling, data exploration, and the application of predictive techniques to real-world datasets.

PO8: Learning How to Learn Skills

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: Students develop self-learning capabilities by working with regression and forecasting techniques in MS-Excel and R, preparing them for continuous learning in data science.

PO9: Digital and Technological Skills

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course integrates computational tools like MS-Excel and R for regression analysis and time series forecasting, enhancing students' proficiency in modern data analytics.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO1 to CO7 (Weightage: 2 - Moderately Related)

Justification: Understanding time series and regression techniques enables students to analyze diverse datasets, fostering an appreciation for global economic and social trends.

PO11: Value Inculcation and Environmental Awareness

CO1 to CO7 (Weightage: 1 - Slightly Related)

Justification: Predictive techniques are widely used in environmental studies, climate analysis, and sustainability research, helping students appreciate their role in responsible decision-making.

PO12: Autonomy, Responsibility, and Accountability

CO1 to CO7 (Weightage: 2 - Moderately Related)

Justification: The practical nature of the course encourages students to work independently, analyze data responsibly, and interpret statistical models with accountability.

PO13: Community Engagement and Service

CO1 to CO7 (Weightage: 2 - Moderately Related)

Justification: Regression and time series forecasting techniques can be applied in public health, economics, and social sciences to address community-based issues and contribute to data-driven policy-making.

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

Name of the Programme : B.Sc. Statistics
Programme Code : USST
Class : S.Y.B.Sc.
Semester : III
Course Type : Minor (Theory)
Course Code : STA-206-MN
Course Title : Probability Distributions and its Applications
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives:

1. To understand Bivariate Distributions along with their properties and applications.
2. To Explore Discrete Probability Distributions their properties, and real-life applications.
3. To Analyze Continuous Distributions and statistical measures such as expectation, variance, skewness, and kurtosis.
4. To Examine Standard Continuous Distributions and real-world relevance.
5. To Develop Problem-Solving Skills.
6. To Demonstrate how probability distributions are used in applied fields like machine learning through case studies and examples.

Course Outcomes:

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

CO1. Explain Bivariate Probability Concepts and analyze the independence of random variables.

CO2. Analyze Expectation and Dependence in Bivariate Distributions

CO3. Understand the additive properties and recurrence relations of Poisson and Negative Binomial distributions.

CO4. Explore Relationships Between Discrete Distributions.

CO5. Understand the most common continuous probability distributions and their real-life applications.

CO6. Understand and apply the Central Limit Theorem (CLT) in probability and

statistics.

CO7. Develop problem-solving skills using discrete and continuous probability distributions.

Topics and Learning Points

Unit – 1: Bivariate Discrete Probability Distribution (6 L)

1.1 Definition of a bivariate discrete random variable (X, Y) on finite sample space, Joint p.m.f., and c.d.f., Properties of c.d.f. (without proof).

1.2 Computation of probabilities of events in the bivariate probability distribution

1.3 Marginal and conditional probability distribution, independence of two discrete r.v.s. Examples.

1.4 Mathematical Expectation: Definition of expectation of function of r.v. in bivariate distribution, Theorems on expectations: (i) E(X+Y) = E(X) + E(Y) (ii) E(XY) = E(X)·E(Y) when X and Y are independent, expectation and variance of linear combination of two discrete r.v.s.

1.5 Conditional mean, conditional variance, covariance and correlation coefficient, distinction between uncorrelated and independent variables

Unit – 2: Discrete Probability distribution (Countably Infinite Sample Space) (8 L)

2.1 Poisson Distribution:

Review of random variable based on countably infinite sample space. Definition of Poisson with parameter λ. Mean, variance**,** mode, m.g.f., c.g.f. skewness, kurtosis, Recurrence relation for successive Probabilities, Additive property of Poisson distribution. Poisson distribution as a limiting case of Binomial distribution, examples. Conditional distribution of X given (X+Y) for Poisson distributions. Real life situations.

2.2 Geometric Distribution:

Definition of Geometric with parameter p in both cases with support {0, 1, 2,….} and with support{1, 2, …..}.Mean, Variance, distribution function, Lack of memory property, examples. Real life situations.

2.3 Negative Binomial Distribution

Probability mass function (p.m.f.).Nature of probability curve, negative binomial distribution as a waiting time distribution, Moment Generating Function (MGF), Cumulant Generating Function (CGF), mean, variance, skewness, kurtosis (recurrence relation between moments is not expected), additive property of NB (k, p). Relation

between Geometric Distribution and Negative Binomial Distribution. Poisson approximation to Negative Binomial Distribution. Real life situations.

UNIT – 3: Continuous Univariate Distributions (8 L)

3.1 Definition of function, Continuous function, Monotonic function, One to one function, Onto function, Inverse function.

3.2 Continuous sample space: Definition, illustrations. Continuous random variable: Definition, probability density function (p.d.f.), cumulative distribution function (c.d.f.), properties of c.d.f. (without proof), probabilities of events related to random variable.

3.3 Expectation of continuous r.v., expectation of function of r.v. E[g(X)], mean, variance, geometric mean, harmonic mean, raw and central moments, skewness, kurtosis.

3.4 Mode, median, quartiles.

3.5 Numerical problems related to real life situations.

UNIT – 4: Standard Continuous Probability Distributions (8 L)

4.1 Uniform or Rectangular Distribution

Probability density function (p.d.f.) $f(x) = \begin{cases} \frac{1}{b-a} & ; a \le x \le b \\ 0 & ; \text{Otherwise} \end{cases}$

Notation : X ~ U[a, b], sketch of p. d. f., c. d. f., mean, variance, , nature of probability curve.

4.2 Exponential Distribution:

Statement of Probability density function (p.d.f.) of the form,

$f(x) = \begin{cases} \frac{1}{\theta} e^{\frac{-x}{\theta}} & ; x \ge 0, \theta > 0 \\ 0 & ; \text{Otherwise} \end{cases}$

Mean, Variance, Nature of Probability Curve, Lack of Memory Property.

4.3 Normal Distribution:

Probability density function (p. d. f.)

$$f(x) = \begin{cases} \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{1}{-2\sigma^2}(x-\mu)^2} & ; -\infty < x < \infty; -\infty < \mu < \infty; \sigma > 0 \\ 0 & ; \quad otherwise \end{cases}$$

p. d. f. curve, identification of scale and location parameters, nature of probability curve, mean, variance, standard normal distribution, symmetry, distribution of aX+b, aX+bY+c where X and Y are independent normal variables, computations of probabilities using normal probability table, normal approximation to binomial and Poisson distribution , central limit theorem (statement only), normal probability plot.

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Programme Outcomes and Course Outcomes Mapping:

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

1=Partially Related, 2=Moderately Related, 3=Strongly Related

PO1: Comprehensive Knowledge and Understanding

CO1 to CO7 (Strongly Related – 3)

Justification: The course provides an in-depth understanding of probability distributions, covering discrete and continuous distributions along with their properties. It enables students

to develop a strong conceptual foundation in probability theory, statistical inference, and their real-life applications.

PO2: Practical, Professional, and Procedural Knowledge

CO1 to CO7 (Moderately to Strongly Related – 2,3)

Justification: Students gain hands-on experience with probability distributions and statistical measures such as expectation, variance, skewness, and kurtosis. They also develop analytical skills to apply these distributions to various real-world scenarios in fields like risk analysis, economics, and engineering.

PO3: Entrepreneurial Mindset and Knowledge

CO1 to CO7 (Partially Related – 1)

Justification: Although the course primarily focuses on theoretical aspects, the problem-solving skills acquired can help students develop innovative solutions in domains like actuarial science, data analysis, and machine learning, fostering an entrepreneurial mindset.

PO4: Specialized Skills and Competencies

CO1 to CO7 (Moderately to Strongly Related – 2,3)

Justification: The course equips students with essential statistical tools and techniques, such as understanding the properties of standard probability distributions and applying them to decision-making scenarios in business, healthcare, and finance.

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

CO1 to CO7 (Strongly Related – 3)

Justification: Students learn to apply probability distributions in real-world contexts, solve complex probability problems, and analyze patterns in data, making informed statistical inferences.

PO6: Communication Skills and Collaboration

CO1 to CO7 (Moderately Related – 2)

Justification: Students develop the ability to effectively communicate statistical findings, interpret probability distributions, and present analytical results through structured explanations and graphical representations.

PO7: Research-related Skills

CO1 to CO7 (Moderately Related – 2)

Justification: The course fosters research-oriented learning by enabling students to explore statistical relationships, study data patterns, and use probability theory in experimental design and advanced research.

PO8: Learning How to Learn Skills

CO1 to CO7 (Strongly Related – 3)

Justification: Students engage in self-learning by exploring the applications of probability theory in various domains, enhancing their ability to adapt and apply statistical knowledge to new situations.

PO9: Digital and Technological Skills

CO1 to CO7 (Moderately Related – 2)

Justification: Students develop computational skills by using statistical software to visualize probability distributions, perform simulations, and analyze datasets effectively.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO1 to CO7 (Partially Related – 1)

Justification: Understanding probability distributions helps in decision-making across diverse domains, including social sciences and public policy, where statistical insights influence societal outcomes.

PO11: Value Inculcation and Environmental Awareness

CO1 to CO7 (Partially Related – 1)

Justification: The application of probability in environmental studies, sustainability research, and risk management contributes to awareness and informed decision-making in these areas.

PO12: Autonomy, Responsibility, and Accountability

CO1 to CO7 (Moderately Related – 2)

Justification: Students develop the ability to independently analyze probability models, evaluate data distributions, and apply theoretical knowledge responsibly in professional and academic settings.

PO13: Community Engagement and Service

CO1 to CO7 (Partially Related – 1)

Justification: The knowledge gained through this course can be applied in community-driven projects, such as analyzing public health statistics, predicting economic trends, and contributing to social research.

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

Name of the Programme : B.Sc. Statistics

Programme Code : USST

Class : S.Y.B.Sc.

Semester : III

Course Type : Minor (Practical)

Course Code : STA-207-MN

Course Title : Minor Statistics Practical – I

No. of Credits : 02

No. of Teaching Hours : 60

Course Objectives:

The practical course aims to:

1. Provide hands-on experience in fitting discrete and continuous probability distributions using statistical software.
2. Enable students to analyze and interpret real-world data using Poisson, Negative Binomial, and Normal distributions.
3. Develop proficiency in using MS-Excel and R Software for statistical modeling and simulation.
4. Enhance the ability to select appropriate probability distributions based on data characteristics.
5. Strengthen problem-solving skills through practical applications of probability distributions in real-world scenarios.
6. Equip students with the ability to visualize probability distributions and interpret their implications.
7. Introduce computational techniques for generating random samples from various probability distributions.

Course Outcomes:

Students should be able to

CO1. apply Poisson distribution to model count data and assess its goodness of fit.

CO2. estimate parameters and interpret the suitability of the Negative Binomial distribution.

CO3. implement statistical functions in R to analyze discrete and continuous probability distributions.

CO4. apply Normal Distribution in Real-World Scenarios using MS-Excel and R.

CO5. generate Random Samples from Various Distributions using MS-Excel and R.

CO6. apply Box-Muller and inverse transformation techniques for random variates generation.

CO7. compute probabilities of Poisson, Geometric, Negative Binomial, Uniform, and Normal distributions.

Practical Index

Sr. No.	Title of the experiment
1.	Fitting of Poisson Distribution **(Using MS-Excel)**
2.	Fitting of Negative Binomial Distribution **(Using MS-Excel)**
3.	Fitting of Poisson and Negative Binomial Distribution (**Using R Software)**
4.	Fitting of Normal Distributions **(Using MS-Excel and R Software)**
5.	Normality Testing of Sample Data: Shapiro Wilk test and Q-Q Plot (**Using R Software)**
6.	Applications of Poisson and Geometric Distributions **(Using MS-Excel and R Software)**
7.	Applications of Negative Binomial Distributions **(Using MS-Excel and R Software)**
8.	Applications of Normal Distributions **(Using MS-Excel and R Software)**
9.	Model Sampling from **(Using MS-Excel)** i) Poisson distribution ii) Normal distribution using distribution function iii) Normal distribution using Box-Muller transformation
10.	Model Sampling from Poisson, Geometric, Negative Binomial, Uniform and Normal Distributions (**Using R Software)**
11.	Case Study

Programme Outcomes and Course Outcomes Mapping:

CO-PO Mapping Table

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

1=Partially Related, 2=Moderately Related, 3=Strongly Related

PO1: Comprehensive Knowledge and Understanding

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course provides a strong theoretical foundation in probability distributions, enabling students to fit and interpret distributions like Poisson, Negative Binomial, and Normal using MS-Excel and R.

PO2: Practical, Professional, and Procedural Knowledge

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: Students gain hands-on experience in fitting and analyzing probability distributions using MS-Excel and R software, improving their professional competency in statistical analysis.

PO3: Problem-Solving and Analytical Skills

CO1 to CO5 (Weightage: 2 - Moderately Related)

Justification: The application of probability distributions in real-world scenarios (Poisson, Geometric, Negative Binomial, and Multinomial) enhances students' analytical and problem-solving abilities.

PO4: Specialized Technical Skills

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course equips students with specialized technical skills such as fitting distributions, model sampling, and assessing goodness-of-fit using computational tools like MS-Excel and R.

PO5: Research and Inquiry-Based Learning

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The ability to evaluate goodness-of-fit, perform model sampling, and apply probability distributions supports students' research-oriented learning and inquiry-based problem-solving.

PO6: Communication and Interpretation of Data

CO1 to CO3 (Weightage: 2 - Moderately Related),

CO4 to CO7 (Weightage: 1 - Partially Related)

Justification: Students learn to interpret statistical results and communicate findings effectively, particularly when fitting distributions and assessing their goodness-of-fit.

PO7: Digital and Computational Proficiency

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The use of statistical software (MS-Excel, R) for distribution fitting, model sampling, and data visualization ensures students develop computational proficiency.

PO8: Lifelong Learning and Adaptability

CO1 to CO7 (Weightage: 2 - Moderately Related)

Justification: Exposure to evolving statistical techniques and software tools encourages continuous learning and adaptability in data analysis.

PO9: Digital and Technological Skills

CO1 to CO7 (Weightage: 3 - Strongly Related)

Justification: The course emphasizes the use of MS-Excel and R for data analysis, ensuring students develop essential digital skills required for modern statistical applications.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO1 to CO7 (Partially Related – 1)

Justification: The course indirectly contributes to this PO by enabling students to analyze datasets from diverse domains, fostering an appreciation for statistical applications in different social contexts.

PO11: Value Inculcation and Environmental Awareness

CO1 to CO7 (Partially Related – 1)

Justification: While not a primary focus, probability distributions and statistical modeling are useful in environmental and public health studies, allowing students to contribute to sustainability and social impact projects.

PO12: Autonomy, Responsibility, and Accountability

CO1 to CO7 (Partially Related – 1)

Justification: Students develop independent problem-solving skills in probability modeling and statistical software applications, fostering responsibility in data analysis and decision-making.

PO13: Community Engagement and Service

CO1 to CO7 (Partially Related – 1)

Justification: Statistical techniques, such as probability modeling and sampling, can be applied in public health, education, and community-based research, although direct application in community service is limited.

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

Name of the Programme : B.Sc. Statistics
Programme Code : USST
Class : S.Y.B.Sc.
Semester : III
Course Type : Open Elective (Theory)
Course Code : STA-208-OE
Course Title : Applied Statistical Techniques
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives:

1. To provide students with a solid foundation in real functions, derivatives, and their applications, particularly in the context of economics and commerce
2. To understand the fundamental principles of attributes in statistics, including classification and independence of attributes.
3. To analyze relationships between different attributes using measures such as Yule's coefficient of association and coefficient of colligation.
4. To understand different population growth models and their economic implications.
5. To analyze life tables to study mortality rates, survival rates, and life expectancy in a population.
6. To analyze mortality patterns using life table analysis.
7. To analyze the mathematical models for optimization problems in business, economics, and operations research.

Course Outcomes:

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

CO1. Understand the fundamental concepts of attributes and their classification.
CO2. Identify different types of class frequencies, including positive, negative, and ultimate class frequency.
CO3. Learn methods for obtaining vital statistics and calculating vital event rates.
CO4. Compute and interpret different mortality rates, including crude death rate and age-specific death rates.

CO5. Understand and calculate various fertility rates, including crude birth rate and total fertility rate.

CO6. Construct and interpret life tables, understanding key life table functions and their applications in actuarial science and public health.

CO7. Develop proficiency in the construction of life tables.

CO8. Understand the concept of Linear Programming Problems (LPP) and their significance in optimization.

CO9. Develop problem-solving skills through examples and case studies related to LPP.

Topics and Learning Points

UNIT 1: Theory of Attributes (10L)

1.1 Introduction, Classification, Notation of manifold classification, dichotomy, class-frequency order of class, positive class-frequency, negative class-frequency ,quantra class frequencies , ultimate class frequency .

1.2 Relationship among different class frequencies (Up to two attributes), dot operator to find the relation between frequencies, fundamental set of class frequencies.

1.3 Consistency of data for two attributes.

1.4 Concept of independence and fundamental of two attributes.

1.5 Yule's coefficient of association (Q), $-1 \leq Q \leq 1$, interpretation.

1.6 Examples and problems

UNIT 2: Demography (10L)

2.1 Introduction, vital events, vital statistics, methods of obtaining vital statistics rate if vital events, sex ratios, dependency ratio.

2.2 Death/Mortality rates: Crude death rate, specific (age, sex, etc.) death rate, Standardized death rate (direct and indirect), infant mortality rate.

2.3 Fertility/Birth rate: Crude birth rate, genera fertility rate, specific (age, sex, etc.) fertility rates, total fertility rate.

2.4 Growth/reproduction rates: Gross reproduction rate, net reproduction rate.

2.5 Interpretations of different rates, uses and applications.

2.6 Trends in vital rates due to the latest census.

UNIT 3: Life Table (5L)

3.1 Introduction, Construction of life table, functions (l_x, d_x, p_x, q_x, L_x, T_x, e_x)

and their interpretation, expectation of life.

3.2 Example and problems**.**

UNIT 4: Linear Programming Problems (LPP) (5L)

4.1 Statement of the linear Programming Problem (LPP), (minimization and maximization) Formulation of problem as LPP.

4.2 Definition of (i) A slack variable and (ii) Surplus Variable.

4.3 LPP in Canonical form and LPP in Standard form.

4.4 Definition of (i) a solution (ii) basic and non-basic variables (iii) a feasible solution (iv) a basic feasible solution, (v) a degenerate and non–degenerate solution and (vi) an optimal solution.

4.5 Examples and problems.

References:

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Programme Outcomes and Course Outcomes Mapping

CO-PO Mapping Table

Course Outcomes (COs)	Programme Outcomes (POs)												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**
CO1	3	2	1	2	3	2	2	2	2	1	1	2	1
CO2	3	2	1	3	3	2	2	3	2	1	1	2	1
CO3	3	2	1	3	3	2	2	2	2	1	1	2	1
CO4	3	2	1	3	3	2	2	2	2	1	1	2	1
CO5	3	2	1	3	3	2	2	2	2	1	1	2	1
CO6	3	2	1	3	3	2	2	3	2	1	1	2	1
CO7	3	3	1	3	3	3	2	3	2	1	1	2	1
CO8	3	3	1	3	3	3	2	3	2	1	1	2	1
CO9	3	3	1	3	3	3	2	3	2	1	1	2	1

1=Partially Related, 2=Moderately Related, 3=Strongly Related

PO1: Comprehensive Knowledge and Understanding

CO1 to CO9 (Strongly Related – 3)

Justification: This course provides a strong theoretical foundation in quantitative techniques, covering topics such as attributes, demographic statistics, life tables, and linear programming, which are crucial in statistical analysis**.**

PO2: Practical, Professional, and Procedural Knowledge

CO7 to CO9 (Strongly Related – 3), CO1 to CO6 (Moderately Related – 2)

Justification: The course equips students with practical skills in solving real-world statistical problems, including optimization techniques and demographic analysis, essential for professional applications.

PO3: Critical Thinking and Analytical Reasoning

CO1 to CO9 (Weakly Related – 1)

Justification: Students develop analytical skills by working with statistical models, solving optimization problems, and interpreting statistical data in various contexts.

PO4: Research and Inquiry-Based Learning

CO2 to CO9 (Strongly Related – 3), CO1 (Moderately Related – 2)

Justification: The course encourages research-based learning by enabling students to explore advanced statistical techniques and apply them in fields such as economics, business, and public health.

PO5: Communication Skills

CO1 to CO6 (Strongly Related – 3)

Justification: Students enhance their ability to communicate quantitative information effectively through statistical reporting, interpretation of data, and discussion of research findings.

PO6: Ethical Awareness and Professional Integrity

CO1 to CO9 (Moderately Related – 2)

Justification: Understanding statistical concepts like demographic measures and life tables helps students analyze social and economic data responsibly, ensuring ethical decision-making.

PO7: Individual and Teamwork

CO1 to CO9 (Moderately Related – 2)

Justification: The course promotes both independent problem-solving and teamwork in statistical analysis, fostering collaboration through case studies and projects.

PO8: Societal and Cultural Awareness

CO2, CO6 to CO9 (Strongly Related – 3), CO1, CO3 to CO5 (Moderately Related – 2)

Justification: The application of demographic techniques and life tables enables students to analyze societal trends, mortality patterns, and economic growth, contributing to informed policy decisions.

PO9: Multidisciplinary Knowledge

CO1 to CO9 (Moderately Related – 2)

Justification: The integration of statistics with economics, operations research, and demographic studies provides students with a broad, multidisciplinary perspective on quantitative analysis.

PO10: Lifelong Learning

CO1 to CO9 (Weakly Related – 1)

Justification: The fundamental principles of quantitative techniques encourage continuous learning and adaptability in various professional and research fields.

PO11: Application of Knowledge for Sustainable Development

CO1 to CO9 (Weakly Related – 1)

Justification: Quantitative methods are essential for making data-driven decisions that impact sustainability initiatives in areas such as healthcare, population studies, and resource management.

PO12: Research, Innovation, and Entrepreneurship

CO1 to CO9 (Moderately Related – 2)

Justification: By applying statistical models and optimization techniques, students can contribute to innovation and entrepreneurship, particularly in analytics-driven industries.

PO13: Employability and Entrepreneurship

CO1 to CO9 (Weakly Related – 1)

Justification: The knowledge of quantitative techniques enhances career opportunities in analytics, operations research, finance, and public policy, preparing students for diverse professional roles.

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

Name of the Programme : B.Sc. Statistics
Programme Code : USST
Class : S.Y.B.Sc.
Semester : III
Course Type : Subject Specific Indian Knowledge System (Theory)
Course Code : STA-209-IKS
Course Title : Evolution of Science and Statistics in India
No. of Credits : 02
No. of Teaching Hours : 30

Course Objectives:

1. Creating awareness amongst the youths about the true history and rich culture of the country;
2. To learn about India's contributions from traditional to modern to the world of science and technology.
3. To learn about the torch bearers, ancient and modern, of Indian Knowledge System.
4. To understand the scientific value of the traditional knowledge of India.
5. To trace the evolution of Statistics as a subject in India.
6. To learn about renowned Indian Statisticians and their works.
7. To understand the working of various Statistical organizations in India.

Course Outcomes:

At the end of this course, students will be able to

CO1. know the knowledge system was developed during the Vedic period, the Saraswatī-Sindhu Civilization, the Middle ages and practiced knowingly or unknowingly till date.

CO2. understand that, in Bhārata, a special attention was given to the reasons of ideas occurrence, and connection with the concept of material world, and religious, social, and cultural beliefs.

CO3. give awareness amongst the youths about the true history and rich culture of the country.

CO4. competent enough to choose the IKS as career at the professional and business levels.

CO5. identify the erstwhile lesser known applications of Statistics since ancient times in India.

CO6. recognize the significance of contributions of Indian Statisticians.

CO7. Identify the role of Statistical organizations towards the progress and development of India.

Topics and Learning Points

UNIT 1: Bhāratīya Civilization and Development of Bhartiya Knowledge System (5L)

Genesis of the land, Antiquity of civilization, On the Trail of the Lost River, Discovery of the Saraswatī River, the Saraswatī-Sindhu Civilization, Traditional Knowledge System, The Vedas, Main Schools of Philosophy, Ancient Education System,the Takṣaśilā University, the Nālandā University, Alumni, Knowledge Export from Bhārata.

UNIT 2: Arts, Literature, and Scholars in Ancient Bharat (5L)

Art, Music, and Dance, Naṭarāja– A Master piece of Bhāratīya Art, Literature, Life and works of Agastya, Lopāmudrā, Ghoṣā, Vālmīki, Patañjali, Vedavyāsa, Yājňavalkya, Gārgī, Maitreyī, Bodhāyana, Caraka, Suśruta, Jīvaka, Nāgārjuna, Kaṇāda, Kauṭīlya, Pāṇini, Thiruvalluvar, Āryabhaṭa, Varāhamihira, ĀdiŚaṅkarācārya Bhāskarācārya, Mādhavācārya.

UNIT 3: Nobel Laureates of Indian Origin/Relevance (3L)

Rabindranath Tagore, Sir C. V. Raman, Amrtya Sen, Subrahmanyan Chandrasekhar, Har Govind Khorana,

UNIT 4: Inspiring Life of Indian Scientists and their Contributions (4L)

Sushruta, Bhaskara II (Bhaskaracharya), Aryabhatta, Jagadish Chandra Bose, Acharya Prafulla Chandra Ray, Birbal Sahni, P. C. Mahalanobis, Meghnad Saha, Satyendra Nath Bose, Salim Ali, Panchanan Maheshwari, Homi Jehangir Bhabha, Vikram Ambalal Sarabhai, Varghese Kurien, etc.

UNIT 5: Historical Perspective of Statistics in India (4L)

Statistics in ancient times, Probability in ancient India, Antiquity of the Mean, Statistics and Mathematics in ancient Indian poetry, Inferential Statistics

and Statistical Economics before andduring 4CE (Vishalaksha's contributions to inference and Kautilya's Arthashastra), Statistical System during British India, Statistical System in Independent India, Research Teaching and Training in Statistics,

UNIT 6: Statistical Heritage of India (4L)

Contributions of Calyampudi Radhakrishna Rao, Raghu Raj Bahadur, Pandurang Vasudeo Sukhatme, Debabrata Basu, Vasant Shankar *Huzurbazar.*, Keshav Raghavan Nair, Vidyadhar Godambe,

UNIT 7 : Official Statistics in India (5L)

Historical perspective of Official Statistics in India, Overview of present Indian Statistical System: Statistical organizations and their functions.

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Programme Outcomes and Course Outcomes Mapping:

CO-PO Mapping Table

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

1=Partially Related, 2=Moderately Related, 3=Strongly Related

PO1: Comprehensive Knowledge and Understanding

CO1 to CO7 (Strongly Related – 3)

Justification: The course provides an in-depth understanding of India's scientific and statistical heritage, from ancient to modern times, enriching students' knowledge of the subject.

PO2: Practical, Professional, and Procedural Knowledge

CO4 to CO7 (Strongly Related – 3)

CO1 to CO3 (Moderately Related – 2)

Justification: The course equips students with knowledge of statistical applications, Indian statisticians' contributions, and statistical organizations' functions, preparing them for careers in academia, research, and policy-making.

PO3: Entrepreneurial Mindset and Knowledge

CO3, CO4 (Strongly Related – 3)

CO2, CO5, CO6, CO7 (Moderately Related – 2)

Justification: The study of India's traditional knowledge systems, statistical contributions, and the evolution of science fosters an entrepreneurial mindset by encouraging students to explore opportunities in historical research, analytics, and consulting.

PO4: Specialized Skills and Competencies

CO1 to CO7 (Strongly Related – 3)

Justification: The course provides specialized insights into historical and contemporary developments in statistics and science, strengthening students' research and analytical competencies.

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

CO3 to CO7 (Strongly Related – 3)

CO1, CO2 (Moderately Related – 2)

Justification: The study of statistical evolution in India and its application in governance and research enhances students' problem-solving and analytical skills.

PO6: Communication Skills and Collaboration

CO1 to CO7 (Moderately Related – 2)

Justification: While the course focuses on historical and theoretical aspects, students must effectively communicate statistical ideas and collaborate in research discussions.

PO7: Research-related Skills

CO1 to CO7 (Strongly Related – 3)

Justification: Understanding the contributions of Indian scholars and statisticians fosters research-oriented thinking and the ability to analyze historical and modern data.

PO8: Learning How to Learn Skills

CO1, CO3 to CO7 (Moderately Related – 2)

CO2 (Strongly Related – 3)

Justification: By tracing the evolution of science and statistics in India, students develop independent learning skills and critical thinking.

PO9: Digital and Technological Skills

CO3 to CO7 (Strongly Related – 3)

CO1, CO2 (Moderately Related – 2)

Justification: The course indirectly contributes to digital skills by encouraging research on statistical organizations, computational statistics, and modern technological advancements.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO1 to CO3 (Strongly Related – 3)

CO4 to CO7 (Moderately Related – 2)

Justification: The course enhances appreciation for India's rich scientific traditions, fostering inclusivity and respect for diverse cultural contributions to knowledge.

PO11: Value Inculcation and Environmental Awareness

CO1 to CO3 (Strongly Related – 3)

CO4 to CO7 (Moderately Related – 2)

Justification: By learning about India's knowledge system and its ethical and philosophical foundations, students develop a deeper understanding of values, sustainability, and responsible research.

PO12: Autonomy, Responsibility, and Accountability

CO1 to CO7 (Moderately Related – 2)

Justification: The course fosters independent learning and accountability in understanding statistical contributions and their impact on society.

PO13: Community Engagement and Service

CO3 to CO7 (Strongly Related – 3)

CO1, CO2 (Moderately Related – 2)

Justification: The study of India's statistical heritage and its role in governance and development encourages students to engage with community-driven research and public service initiatives.