Hindi Vidya Prachar Samiti's

Ramniranjan Jhunjhunwala College

of Arts, Science & Commerce

(Empowered Autonomous College)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabus of Statistics Major for the T.Y.B.Sc. Semester- VI (under NEP)

Program: B.Sc. STATISTICS

Program Code: RJSUSTA

(REVISED in 2025-2026 in alignment with the NEP2020 facilitating the inter-and multidisciplinary learning and multiple entry and exit of the students)

(CBCS 2025-2026)

T.Y.B.Sc. Semester VI Statistics DSC Syllabus

Preamble

The National Education Policy 2020 aims at imparting skill-based learning and caters to the multiple entry and exit facility for the students thus empowering them to acquire knowledge at their pace. In the three-year UG program, the student has two exit options. Students also have the option of choosing the Honors program of four years study in a given discipline and later converting it to a five-year integrated PG degree program. As an undergraduate student, he/she learns the core subject (Major), subject complementing the core subject (Minor), a course from another discipline (OEC or GEC), Vocational and Skill Enhancement course from the Major (VSEC). The remaining verticals under NEP 2020 are IKS (Indian Knowledge System), AEC (Ability Enhancement Course), VEC (Value Enhancement Course) and with progressive three years of UG, student also completes at different levels OJT (On Job Training), FP (Field Projects), CEP (Community Engagement Program), RP (Research Project) which helps him/her in understanding their roots, application of the knowledge for the benefit of self and the society. Vertical CC (Co-curricular activities and activities related to yoga and human well-being) helps in preparing youth with good character and interpersonal relationships.

Credit Structure for B Sc Semester V as per NEP 2020 Implemented from the academic year 2025-2026
Course Code: RJDSCSTA

Semester VI
Level 5.5 Major Statistics

Courses	Credits	Total Credits	Course Code
Discipline Specific Core -I Distribution Theory and Stochastic Processes	4	12	RJDSCSTA361
Discipline Specific Core -II Testing of Hypothesis	4		RJDSCSTA362
Discipline Specific Core -III Practical on DSC-I and DSC-II	4		Practicals related to DSC I and II RJDSCSTAP361
Discipline Specific Elective-I Elements of Actuarial Science	4	4	RJDSESTA361
Discipline Specific Elective-II Introduction to Six Sigma			RJDSESTA362
Vocational Skill Course (VSC) Foundations of Python Programming	2	2	RJVSCSTAP361
On Job Training (OJT)	4	4	RJOJTSTA361
Total Credits	22	22	

*As per University Grid

DISTRIBUTION OF TOPICS AND CREDITS

T.Y.B.Sc. STATISTICS SEMESTER VI

Vertical	Course Code	Nomenclature	Topics	Credits
DSC (12 credits)	RJDSCSTA361	Distribution Theory and Stochastic Processes	Unit- I Bivariate Normal Distribution Unit- II Generating Functions Unit- III Stochastic Processes Unit- IV Queueing Theory	04
	RJDSCSTA362	Testing of Hypothesis	Unit- I Most Powerful Tests Unit- II Uniformly Most Powerful & Likelihood Ratio Tests Unit- III Sequential Probability Ratio Test Unit- IV Non-Parametric Tests	04
	RJDSCSTAP361	Practical	Statistics Practical	04

SEMESTER	:	VI (CORE SUBJECT)
TITLE OF THE SUBJECT/COURSE	:	**Distribution Theory and Stochastic Processes**
COURSE CODE	:	**RJDSCSTA361**
CREDITS	:	04
DURATION	:	60 HOURS

LEARNING OBJECTIVES

1. Understand, interpret, and apply the properties of the bivariate normal distribution, including joint, marginal, and conditional distributions, as well as the concept of correlation and its impact on the shape and orientation of the distribution.
2. Define, derive, and apply the Probability Generating Function (PGF) for discrete random variables, and use it to compute probabilities, moments, and understand distributions in a compact and analytical form.
3. Application of stochastic processes such as Queuing process, Poisson processes etc. in solving real life problems.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	apply the bivariate normal model to data analysis and real-life scenarios involving two interdependent variables.	1, 3, 7	BT Level I , II and III remember, understand and apply
CO2	derive PGFs for standard discrete distributions (e.g., Binomial, Poisson) and calculate mean, variance, and higher moments of a distribution.	2, 3, 4	BT Level III and IV applying and analyzing
CO3	develop stochastics and queueing models.	3, 4	BT Level II and III understand and apply
CO4	apply stochastic models to real-life systems such as communication networks, customer service, and manufacturing.	1, 3, 4	BT level IV apply

SEMESTER VI (THEORY)		**L**	**Cr**
Paper-I: Distribution Theory and Stochastic Processes	**Paper Code: RJDSCSTA361**	60	4
UNIT I		15	
BIVARIATE NORMAL DISTRIBUTION			
1	Definition of joint probability distribution (X, Y). Joint Moment Generating function, moments μ_{rs} where r=0, 1, 2 and s=0, 1, 2. Marginal & Conditional distributions. Derivation for marginal probability density function of X and Y. Derivation of conditional distribution of X given Y and Y given X. Their Means & Variances using MGF Correlation coefficient between the random variables. Necessary and sufficient conditions for the independence of X and Y. Distribution of aX + bY, where 'a' and 'b' are constants.		
2	Distribution of sample correlation coefficient when $\rho = 0$. Testing the significance of a correlation coefficient. Fisher's z – transformation. Tests for i) H_0: $\rho = \rho_0$ ii) H_1: $\rho_1 = \rho_2$. Confidence interval for ρ.		
UNIT II		15	
GENERATING FUNCTIONS			
1	Definitions of generating function and probability generating function. Expression for mean and variance in terms of generating functions. Definition of a convolution of two or more sequences. Generating function of a convolution. Generating functions of the standard discrete distributions. Effect of change of origin and scale on P.G.F.		
2	Relation between: i) Bernoulli and Binomial distributions ii) Geometric and Negative Binomial distributions in terms of convolutions.		

	UNIT III	15	
	STOCHASTIC PROCESSES		
1	Definition of stochastic process. Definition of State space. Postulates and difference differential equations for : (i) Pure birth process (ii) Poisson process with initially 'a' members, for a =0 and a >0 (iii) Yule Furry process (iv)Pure death process (v) Death process with μ_n=μ (vi) Death process with μ_n= nμ (vii) Birth and death process (viii) Linear growth model. Derivation of Pn (t), mean and variance wherever applicable.		
	UNIT IV	15	
	QUEUEING THEORY		
1	Basic elements of the Queuing model. Roles of the Poisson and Exponential distributions. Derivation of steady state probabilities for birth and death process. Steady state probabilities and various average characteristics for the following models: (i) (M/M/1) : (GD/ ∞ /∞) (ii) (M/M/1) : (GD/ N /∞) (iii) (M/M/c) : (GD/∞/∞) (iv) (M/M/c) : (GD/ N /∞) (v) (M/M/∞) : (GD/ ∞ /∞)		

References

1. Kantiswarup, P.K. Gupta, Manmohan: Operations Research, Twelfth edition, Sultan Chand & sons.
2. Sharma S. D. : Operations Research, Eighth edition, Kedarnath Ramnath & Co.
3. Taha Hamdy A. : Operations Research : Eighth edition, Prentice Hall of India Pvt. Ltd.
4. Gupta S C & Kapoor V K: Fundamentals of Mathematical statistics, Eleventh edition, Sultan Chand & Sons.

SEMESTER	:	VI (CORE SUBJECT)
TITLE OF THE SUBJECT/COURSE	:	**Testing of Hypothesis**
COURSE CODE	:	**RJDSCSTA362**
CREDITS	:	04
DURATION	:	60 HOURS

LEARNING OBJECTIVES
1. Understanding of statistical concepts and techniques.
2. Identify, formulate, and analyze statistical problems using appropriate hypothesis testing methods.
3. Apply statistical tests to draw inferences and develop solutions based on data analysis.
4. Differentiate between parametric and non parametric tests and use them effectively.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	understand the basic concepts and components of hypothesis testing. Knowledge of simple, composite, null, and alternative hypotheses; Type I & II errors; level of significance; power of a test.	1, 6	BT Level I ,and II Remember and understand
CO2	apply the Neyman-Pearson framework for hypothesis testing. Understand most powerful tests, UMP tests, power functions, and randomized tests.	1, 3, 6, 7	BT Level I ,and II Remember and understand
CO3	analyze and construct Likelihood Ratio Tests (LRT) for known / unknown mean / variance in normal distributions.	1, 3, 6, 7	BT Level I ,and II Remember and understand
CO4	understand and implement Sequential Probability Ratio Tests. Design and comparison with fixed sample tests; applying SPRT to different distributions.	1, 3, 6, 7	BT Level I ,and II Remember and understand
CO5	differentiate between parametric and non-parametric tests and apply suitable tests for given data types. Use various N.P. tests and understand their assumptions.	1, 3, 6, 7	BT Level I ,and II Remember and understand

SEMESTER VI (THEORY)		**L**	**Cr**
Paper-II: Testing of Hypothesis	**Paper Code: RJDSCSTA362**	60	4
UNIT I		15	
MOST POWERFUL TESTS			
1	Problem of testing hypothesis.		
2	Definitions and illustrations of i) Simple hypothesis ii) Composite hypothesis iii) Null Hypothesis iv) Alternative Hypothesis v)Test of hypothesis vi) Critical region vii) Type I and Type II errors viii) Level of significance ix) p-value x) size of the test xi) Power of the test xii) Power function of a test xiii) Power curve.		
3	Definition of the most powerful test of size α for a simple hypothesis against a simple alternative hypothesis. Neyman-Pearson fundamental lemma. Randomized test.		
UNIT II		15	
UNIFORMLY MOST POWERFUL & LIKELIHOOD RATIO TESTS			
1	Definition, Existence and Construction of uniformly most powerful (UMP) test.		
2	Likelihood ratio principle. Definition of test statistic and its asymptotic distribution (statement only). Construction of LRT for the mean of normal distribution for i) known $\sigma 2$ ii) unknown $\sigma 2$ (two sided alternatives). LRT for variance of normal distribution for i) known μ ii) unknown μ (two-sided alternatives hypothesis).		

UNIT III		15	
SEQUENTIAL PROBABILITY RATIO TESTS			
1	Sequential test procedure for testing a simple null hypothesis against a simple alternative hypothesis. Its comparison with fixed sample size (Neyman-Pearson) test procedure.		
2	Definition of Wald's SPRT of strength (α, β). Graphical / Tabular procedure for carrying out the tests. Problems based on Bernoulli, Binomial, Poisson, Normal and Exponential distributions.		
UNIT IV		15	
NON-PARAMETRIC TESTS			
1	Measurements of Scales: Nominal, Ordinal, Interval and Ratio. Quantiles. Need for non parametric tests.		
2	Distinction between a parametric and a non parametric test.		
3	Concept of a distribution free statistic. Single sample and two sample Nonparametric tests. (i) Sign test (ii) Wilcoxon's signed rank test (iii)Median test (iv) Mann–Whitney test (v) Run test (vi) Fisher exact test (vii) Kruskal - Wallis test (viii) Friedman test. Large sample approximation in various non parametric tests.		
4	Assumptions, justification of the test procedure for small & large samples.		

References:

1. Lehmann, E. L: Testing of Statistical Hypothesis, Wiley & Sons.
2. Daniel W.W.:Applied NonParametric Statistics, First edition Boston-Houghton Mifflin Company.
3. Gupta S C & Kapoor V K: Fundamentals of Mathematical statistics, Eleventh edition, Sultan Chand & Sons.
4. V.K Rohatgi: An Introduction to Probability and Mathematical Statistics.

SEMESTER	:	VI (CORE PRACTICAL COMPONENT)
TITLE OF THE SUBJECT/COURSE	:	**Statistics Practical**
COURSE CODE	:	**RJDSCSTAP361**
CREDITS	:	04
DURATION	:	120 HOURS

LEARNING OBJECTIVES	
1	Solve the problems based on Probability Generating Function and understand its domain of applicability.
2	Understand application of Stochastic and Queuing Processes to solve real life problems.
3	Understand the problem and apply foundational concepts of statistical inference and hypothesis testing to solve the real life problems.
4	Analyze real-world problems using suitable statistical test strategies including MP, UMP, and non-parametric methods.
5	Interpret and validate results of statistical tests to draw logical and meaningful conclusions.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	develop a stochastic model to solve problems related to birth and death processes.	3, 4	BT Level II and III understand and apply
CO2	develop models for queuing processes to solve real life problems related to queueing.	3, 4, 7	BT Level I, II and III remember, understand and apply
CO3	implement the Most Powerful (MP) and Uniformly Most Powerful (UMP) tests using appropriate statistical procedures.	3, 4, 6, 7	BT Level II and III understand and apply
CO4	apply the Likelihood Ratio Test (LRT) in various hypothesis testing contexts.	3, 4, 6, 7	BT Level II and III understand and apply
CO5	apply the Sequential Probability Ratio Test (SPRT) for decision-making in sequential analysis.	3, 4, 6, 7	BT Level II and III understand and apply
CO6	use non-parametric tests for situations where parametric assumptions do not hold.	3, 4, 6, 7	BT Level II and III understand and apply

Semester VI	
Statistics Practical	Paper Code: **RJDSCSTAP361**
Practicals based on DSC I (60 hours)	
1. Bivariate Normal Distribution	
2. Tests for correlation and Interval estimation	
3. Generating Function	
4. Stochastic Process	
5. Queuing Theory -1	
6. Queuing Theory -2	
Practicals based on DSC II (60 hours)	
1. Testing of Hypothesis - 1	
2. Testing of Hypothesis - 2	
3. Likelihood Ratio Tests	
4. Sequential Probability Ratio Tests	
5. Non Parametric Tests -1	
6. Non Parametric Tests - 2	

T.Y.B.Sc. Semester VI Statistics DSC Syllabus

Scheme of Examinations

1. Evaluation will be for 100 marks based on both internal and external assessment for DSC I and DSC II.
2. Internal examination of 40 Marks for DSC I and DSC II based on MCQ/ True or false/ Short answers / Assignments / Projects / Seminar.
3. External examination (Semester End Examination) for DSC I and DSC II of 60 marks based on all units.
4. Minimum marks for passing the examination for DSC I and DSC II is 40 %.
5. Students must appear for at least one Internal to be eligible for the Semester End Examination.
6. Students must appear for the Semester End Examination to be able to complete total credits for a given Semester.
7. One combined Practical Examination DSC III (based on DSC I and DSC II) at the end of Semester consisting of 100 marks with minimum 40 marks for passing.
8. A candidate will be allowed to appear for the practical examinations if he/she submits a certified Journal of T.Y.B.Sc. Statistics or a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of T.Y.B.Sc. Statistics as per the minimum requirements.
9. In case of loss of journal, a candidate must produce a certificate from the Head of the Department /Institute that the practicals for the academic year were completed by the student. However, such a candidate will be allowed to appear for the practical examination, but the marks allotted for the journal (if any) will not be granted.
10. HOD's decision, in consultation with the Principal, shall remain final and abiding to all.

Evaluation and Assessment
(Based on the centralised guidelines given by EC under NEP 2020)

For DSC I and DSC II

Internal examination : 40 Marks

Internal examination consists of 2 types of assessments as follows:

Internal Assessment	Max Marks	Duration	Evaluation Particulars
1	20 /25	30 Minutes	MCQ / True or False / Short Answers
2	20/15	Based on set of rules	Projects / Assignments / Seminar

External examination : 60 Marks

Duration: 2 hours.

Theory question paper pattern at the end of the semester for each course is as follows:

Question no.	Max Marks	Question based on
1	15 (with internal option)	Unit I
2	15 (with internal option)	Unit II
3	15 (with internal option)	Unit III
4	15 (with internal option)	Unit IV
Total	60	

Key to set effective Question paper:

Question	Knowledge	Understanding	Application and Analysis	Total marks- Per unit

Unit 1	06	05	04	15
Unit 2	06	05	04	15
Unit 3	06	04	05	15
Unit 4	06	04	05	15
-TOTAL- Per objective	24	18	18	**60**
% WEIGHTAGE	40%	30%	30%	**100%**

For DSC III

Practical examination : **100 marks**

Question no.	Max Marks	Question based on
1	40 (with internal option)	DSC I
2	40 (with internal option)	DSC II
Journal	10	-
Viva	10	-
Total	100	

T.Y.B.Sc. Semester VI Statistics DSC Syllabus

Mapping of the course to Local/ Regional/National/International relevance

Class	Course Name	Course Code	Local relevance	Regional relevance	National relevance	International relevance
TYBSc Statistics DSC-I	Distribution Theory and Stochastic Processes	RJDSCSTA361	Useful in developing models to solve queuing problems at local level like queues at ration counters, hospitals etc.	Theory holds significant regional relevance in the Mumbai Metropolitan Region (MMR) and across Maharashtra, due to the area's rapidly growing urban infrastructure, transportation systems, IT hubs, telecommunication sectors, and service industries.	Theory is critically relevant at the national level in India, given their wide application across sectors that are central to the country's economic growth, digital transformation, and public service optimization.	Theory has profound global importance, as they form the mathematical foundation for analyzing and solving problems involving randomness, uncertainty, and waiting lines across diverse domains in science, technology, business, and public policy.
TYBSc Statistics DSC-II	Testing of Hypothesis	RJDSCSTA362	1. Useful in educational research and local industry 2. Local health centres and NGOs can apply statistical testing in evaluating community programs.	1. helps in regional development projects 2. Analysing regional economic trends	1 Aligns with national initiatives like digital India, Atmanirbhar Bharat etc 2. Crucial for national level studies in public health, economy and education.	1 Plays major role in global research methodology 2. Foundational knowledge used in international standardized testing and cross country surveys.
T Y B Sc	Practical	RJDSCSTAP361	Developing models and solving	Developing models and solving	Developing models and solving	Developing models and solving

Statistics DSC			problems at the local level.	problems at the regional level	problems at the national level	problems at the global level

Mapping of the course to Employability/ Entrepreneurship/Skill development

The courses in Statistics have been designed to impart one or more skills to make students employable.

Class	Course Name	Course Code	Topic focussing on Employability/ Entrepreneurship/ skill development	Employability/Entrepreneurship/Skill development	Specific activity
TYBSC SEM VI	Distribution Theory and Stochastic Processes	RJDSCSTA361	Unit-I Bivariate Normal Distribution Unit- II Generating Functions Unit- III Stochastic Processes Unit- IV Queueing Theory	1 Data analysis 2 Quality control 3 Business analysis 4 Data Scientist 5 Healthcare sector 6 IT	
	Testing of Hypothesis	RJDSCSTA362	Unit-II UMP test & LRT Unit-III SPRT Unit- IV Non-Parametric Tests	1 Data analysis 2 Quality control 3 Market research 4 Consulting services 5 Data scientist	

Integration of Cross cutting Issues

Class	Course Code	Cross Cutting Issues
T Y B Sc Statistics Major	RJDSCSTA361 RJDSCSTA362 RJDSCSTAP361	Equity and inclusion, Human values UNSDG 4, 5, 8, 9