



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- V (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)

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: RJDSESTA****Semester V****Level 5.5 Major Statistics**

Courses	Credits	Total Credits	Course Code
Discipline Specific Core -I Probability and Distribution Theory	4	12	RJDSCSTA351
Discipline Specific Core -II Theory of Estimation	4		RJDSCSTA352
Discipline Specific Core -III Practical on DSC-I and DSC-II	4		Practicals related to Theory I and II RJDSCSTAP351
Discipline Specific Elective- I Biostatistics	4	4	RJDSESTA351
Discipline Specific Elective- II Mathematical Economics			RJDSESTA352
Vocational Skill Course (VSC) Regression Analysis Using R software	2	2	RJVSCSTA351
Vocational Skill Course (VSC) Practical	2	2	RJVSCSTAP351
Field Project (FP)	2	2	RJFPSTA351
Total Credits	22	22	

***As per University Grid**

DISTRIBUTION OF TOPICS AND CREDITS**T.Y.B.Sc. STATISTICS SEMESTER V**

Vertical	Course Code	Nomenclature	Topics	Credits
DSE (4 credits)	RJDSESTA351	Biostatistics	Unit-I Epidemic Models Unit- II Bioassays Unit- III Clinical Trials Unit- IV Clinical Trials and Bioequivalence	04
	OR			
	RJDSESTA352	Mathematical Economics	Unit-I Introduction to Mathematical Economics Unit-II Marginal Concepts Unit-III Optimization and Production Function Unit- IV Input Output Analysis and Market Equilibrium	04

SEMESTER	:	V (ELECTIVE SUBJECT)
TITLE OF THE SUBJECT/COURSE	:	Biostatistics
COURSE CODE	:	RJDSESTA351
CREDITS	:	04
DURATION	:	60 HOURS

LEARNING OBJECTIVES
1. Understand the dynamics of communicable diseases, different stages of epidemic and apply models to describe and analyze the spread of epidemics.
2. Explain the principles and scope of bioassays, and conduct statistical analysis for both direct and indirect bioassays, including estimation of relative potency.
3. Understand the need, benefits and risks associated with clinical trials, various concepts related to clinical trials and analyze clinical trial designs.
4. Understand Time-to -event data, censoring and Interpret survival data.
5. Understand the statistical foundation of bioequivalence studies and check whether formulation is bioequivalent.
6. Apply statistical techniques such as ANOVA, probit and logit analysis, Kaplan Meire analysis and confidence interval estimation in the context of real-world biostatistical problems.

T.Y.B.Sc. Semester V Statistics DSE Syllabus

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	define and differentiate key epidemiological terms and stages in disease spread.	1, 2	BT Level II and III understand, apply.
CO2	construct and analyse basic epidemic models and interpret their implications.	2, 3, 4	BT Level I, II and III remember, understand, apply.
CO3	apply Reed-Frost and Greenwood chain binomial models to simulate disease outbreaks and estimate parameters using MLE and its standard deviation.	2, 3, 4	BT Level II and III understand, apply.
CO4	analyze, interpret results and compare old and new drugs in terms of relative potency from bioassays using Fieller's theorem and probit/logit methods.	2, 3, 4, 7	BT Level II, III and IV understand, apply, and analyse.
CO5	demonstrate knowledge of clinical trial phases, various terminology, designs, and ethical considerations including ICH guidelines and blinding techniques.	2, 3	BT Level I, and II remember and understand.
CO6	use statistical methods to assess outcomes in clinical trials, and analyze survival data using appropriate techniques.	2, 3, 4, 7	BT Level II, III and IV understand, apply, and analyse.
CO7	understand survival analysis, Kaplan Meire analysis, Design and evaluate bioequivalence studies using statistical tools such as ANOVA, logarithmic transformations, and 90% confidence intervals to check bioequivalence.	2, 3, 4, 7	BT Level II, III and IV understand, apply, and analyse.

SEMESTER V (THEORY)		L	Cr
DSE I: Biostatistics	Paper Code: RJDSESTA351	60	4
UNIT I		15	

<i>EPIDEMIC MODELS</i>			
1	The features of Epidemic spread. Stages of Epidemic, Latent Period, Infectious Period, Incubation Period and Serial Interval. Definitions of various terms involved. Simple mathematical models for epidemics: Deterministic model without removals, Carrier model. Problems based on both models.		
2	Chain binomial models. Reed - Frost model and Greenwood model. Distribution of individual chains and total number of cases. Maximum likelihood estimator of 'p' and its asymptotic variance for households of sizes up to 3. Problems based on both models.		
<i>UNIT II</i>		15	
<i>BIOASSAYS</i>			
1	Meaning and scope of bioassays. Relative potency. Direct assays assuming normality of i) doses and ii) logarithm of doses. Point estimate and Interval estimate of relative potency. Fieller's theorem. Problems based on theory.		
2	Indirect assays for qualitative data. Linearizing transformations. Quantal Response assays. Median effective dose ED50 and Median lethal dose LD50. Probit and Logit analysis by calculation and by graphical method. Estimate of relative potency. Problems based on theory.		
<i>UNIT III</i>		15	
<i>CLINICAL TRIALS</i>			
1	Introduction to clinical trials: Need, benefits and risks associated with clinical trials. Terminology used in clinical trials: In vivo, In vitro, Maximum tolerance dose, Pharmacokinetics and Pharmacodynamics.		
2	Overview of all phases, Introduction to ICH E9 guidelines, Protocol, Case record/Report form, Blinding (Single/Double) Randomized controlled		

	(Placebo/Active controlled), Study Designs (Parallel, Cross Over). Problems based on theory.		
3	Types of Trials: Inferiority, Superiority and Equivalence, Multicentre Trial. Inclusion/Exclusion Criteria.		
UNIT IV		15	
CLINICAL TRIALS AND BIOEQUIVALENCE			
1	Statistical tools : Analysis of parallel Design using Analysis of Variance. Concept of odds ratio and relative risk. Survival analysis: Time - to - event data, Censoring, Median survival time, Kaplan-Meire approach for survival analysis.		
2	Bioequivalence: Definitions of Generic Drug product. Bioavailability, Bioequivalence, Pharmacokinetic (P_K) parameters : C_{max}, AUC_t, $AUC(0-\infty)$, T_{max}, K_{el}, T_{half}. Estimation of PK parameters using 'time vs. concentration' profiles. Problems based on theory.		
3	Designs in Bioequivalence: Analysis of Parallel design using logarithmic transformation (Summary statistics, ANOVA and 90% confidence interval). Confidence Interval approach to establish bioequivalence (80/125 rule). Problems based on theory.		

References:

1. Finney D. J. : Statistical Methods in Biological Assays, First edition, Charles Griffin and Co. London
2. Sanford Bolton and Charles Bon: Pharmaceutical Statistics, Fourth edition, Marcel Dekker Inc.
3. Zar Jerrold H.: Biostatistical Analysis, Fourth edition, Pearson's education.
4. Friedman L. M., Furburg C., Demets D. L.: Fundamentals of Clinical Trials, Third edition, Springer Verlag.
5. Fleiss J. L. The Design and Analysis of Clinical Experiments, Second edition, Wiley and Sons.

6. Shein-Chung-Chow: Design and Analysis of Bioavailability & Bioequivalence studies, Third Edition, Chapman & Hall/CRC Biostatistics series.

SEMESTER	:	V (ELECTIVE SUBJECT)
TITLE OF THE SUBJECT/COURSE	:	Mathematical Economics
COURSE CODE	:	RJDSESTA352
CREDITS	:	04
DURATION	:	60 HOURS

LEARNING OBJECTIVES
1. Understand the Fundamentals of Mathematical Economics and represent basic economic models.
2. Analyze Economic Relationships Using Mathematical Functions and illustrate and interpret real-world economic behavior.
3. Apply Marginal Concepts in Economic Analysis. Also explore the relationships between marginal and average measures in both cost and revenue contexts.
4. Evaluate Elasticity and analyze how elasticity affects pricing decisions and market responses.
5. Use Mathematical Techniques for Optimization
6. Examine Production Functions and Returns to Scale.
7. Apply Input-Output Analysis in Economic Systems.
8. Analyze Market Equilibrium Under Different Market Structures.

T.Y.B.Sc. Semester V Statistics DSE Syllabus

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	describe the significance of mathematical tools in formulating and solving economic problems.	1, 3, 4, 7	BT Level II and III understand, apply
CO2	construct and interpret economic functions to model consumer and producer behavior.	3, 4, 7	BT Level II, III and IV understand, apply and analyse
CO3	analyze marginal values and their interrelationships in economic decision-making.	3, 4, 7	BT Level III and IV apply and analyse.
CO4	evaluate different types of elasticity and their impact on market outcomes.	3, 4, 7	BT Level II and III understand, apply
CO5	apply mathematical optimization techniques to solve economic problems related to utility, cost, and profit.	1, 3, 4, 7	BT Level II, III and IV understand, apply and analyse.
CO6	analyze production processes using the Cobb-Douglas production function and assess returns to scale.	3, 4, 7	BT Level II and III understand, apply and analyse
CO7	utilize input-output analysis to understand the structure of interdependent economic sectors.	3, 4, 7	BT level II and III Understand and apply
CO8	determine market equilibrium and assess the effect of market structures on price and output decisions.	3, 4, 7	BT level II, III and IV understand, apply and analyse

SEMESTER V (THEORY)		L	Cr
DSE II: Mathematical Economics	Paper Code: RJDSESTA352	60	4
UNIT I		15	
INTRODUCTION TO MATHEMATICAL ECONOMICS			
1	Mathematical Economics: Meaning and Importance-Mathematical Representation of Economic Models.		
2	Economic functions: Demand function, Supply function, Utility function, Consumption function, Production function, Cost function,		

	Revenue function, Profit function, Saving function, Investment function.		
UNIT II		15	
MARGINAL CONCEPTS			
1	Marginal utility, Marginal propensity to Consume, Marginal propensity to Save, Marginal product, Marginal Cost, Marginal Revenue, Marginal Rate of Substitution, Marginal Rate of Technical Substitution. Relationship between Average Revenue and Marginal Revenue Relationship between Average Cost and Marginal Cost.		
2	Elasticity: Price elasticity, Income elasticity, Cross elasticity.		
UNIT III		15	
OPTIMISATION AND PRODUCTION FUNCTION			
1	Utility Maximisation, Cost Minimisation, Profit Maximisation.		
2	Production function- homogeneous and non-homogeneous. Degree of homogeneity and returns to scale.		
3	Cobb-Douglas production function. Properties of Cobb-Douglas production function. Production possibility curve.		
UNIT IV			
INPUT OUTPUT ANALYSIS AND MARKET EQUILIBRIUM		15	
1	Input-output analysis. Matrix of technical coefficients–The Leontief matrix–computation of total demand for a two/ three sector economy. Its assumptions and limitations.		

2	Market Equilibrium. Equilibrium in the Perfect Competitive Market. Equilibrium in Monopoly. Discriminating Monopoly. Price discrimination and price elasticity of Demand.		
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References:

1. Allen R.G.D. : Mathematical Analysis for Economics.
2. Dowling E.T, Introduction to Mathematical Economics, 2nd Edition, Schaum's Outline Series, McGraw-Hill, New York, 2003(ETD).
3. Henderson, J. M. and R.E. Quandt (1980), Microeconomic Theory: A Mathematical Approach, McGraw Hill, New Delhi.
4. James Bradfield , Jeffrey Baldani, An Introduction to Mathematical Economics, Cengage Learning India Pvt Ltd (2008).

Scheme of Examinations

1. Evaluation will be for 100 marks based on both internal and external assessment.
2. Internal examination of 40 Marks based on MCQ/ True or false/ Short answers / Assignments / Projects / Seminar.
3. External examination (Semester End Examination) of 60 marks based on all units.
4. Minimum marks for passing the examination 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. 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)

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%

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

Class	Course Name	Course Code	Local relevance	Regional relevance	National relevance	International relevance
T Y B Sc Statistics DSE-I	Biostatistics	RJDSESTA351	Domain knowledge of biostatistics which helps healthcare professionals to analyse disease trends within communities.	It supports state and regional health agencies in planning vaccination programs and managing epidemics.	It aids in nationwide clinical trials, policy making and healthcare resources allocation.	It contributes to global disease surveillance, pandemic response and regulatory approval of new drugs.
T Y B Sc Statistics DSC-II	Mathematical Economics	RJDSESTA352	It helps businesses and policymakers optimize resource allocation and pricing strategies in local markets.	It supports regional economic planning, infrastructure development, and industry growth analysis.	It aids in formulating economic policies, taxation strategies and market regulations for national stability.	It contributes to global trade analysis, economic forecasting and international market equilibrium studies.

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 V	Biostatistics	RJDSESTA351	Unit- I Epidemic Models Unit- III Clinical Trials Unit- IV Clinical Trials and Bioequivalence	1. Biostatistician: Designing and analysing medical studies, clinical trials and epidemiological research. 2. Pharmaceutical analyst: Assessing drug safety, efficacy and bioequivalence before market approval. 3. Clinical research associate: managing clinical trials for new drug and medical treatments.	
	Mathematical Economics	RJDSESTA352	Unit-II Marginal Concepts Unit-III Optimization and Production Function Unit- IV I/O Analysis and Market Equilibrium	1. Data analyst: analyzing economic trends, market behaviour, demand supply pattern 2. Policy analyst: assisting in formulating economic policies and regulations. 3. Market research analyst: studying consumer behaviour and predicting market trends.	

T.Y.B.Sc. Semester V Statistics DSE Syllabus

Integration of Cross cutting Issues

Class	Course Code	Cross Cutting Issues
T Y B Sc Statistics Major	RJDSESTA351 RJDSESTA352	Equity and inclusion, Environment and sustainability, , professional ethics, UNSDG 4, 5, 8, 9, 12, 17