



Date :- 25/04/2025

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Statistics (Sem. III & VI)

Ref. :- Decision of the Academic Council at its meeting held on 22/04/2025.

The Syllabi of B. Sc. in Statistics (Third and Fourth Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2024 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2025-26.

Copy of the Syllabi Shall be downloaded from the College Website
(www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

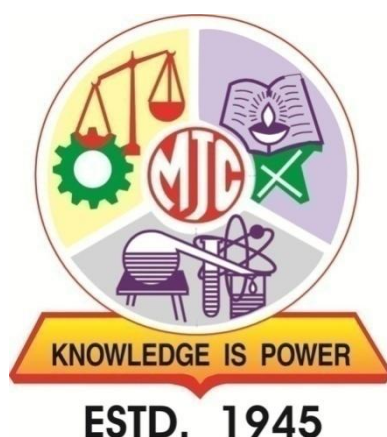
To :

- 1) The Head of the Dept., M. J. College, Jalgaon.
- 2) The office of the COE, M. J. College, Jalgaon.
- 3) The office of the Registrar, M. J. College, Jalgaon.

Knowledge is Power

Khandesh College Education Society's
Moolji Jaitha College, Jalgaon
An "Autonomous College"

Affiliated to
Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon-425001



STRUCTURE AND SYLLABUS

B.Sc. Honours/Honours with Research (S.Y. B.Sc. Statistics)

**Under Choice Based Credit System (CBCS)
and
as per NEP-2020 Guidelines**

[w.e.f. Academic Year: 2025-26]

Preface

Welcome to the Bachelor of Science in Statistics program! This syllabus serves as your guide to understand the curriculum and objectives of the program. The field of statistics plays a crucial role in today's data-driven world, and this program is designed to equip you with the necessary knowledge and skills to navigate the ever-expanding realm of statistical analysis. The BSc in Statistics program offers a comprehensive and rigorous study of statistical theory, methodology, and applications. It aims to develop your critical thinking abilities, analytical skills, and problem-solving capabilities, all of which are essential for making informed decisions based on data. Whether you aspire to work in industry, academia, research, or any other sector where data analysis is vital, this program will provide you with a solid foundation in statistical principles and techniques.

The syllabus is structured to cover a wide range of statistical topics, including probability theory, mathematical statistics, statistical modeling, experimental design, regression analysis, multivariate analysis, time series analysis, and more. Throughout the program, you will also have opportunities to enhance your computational skills through the use of statistical software packages widely used in the field. As you progress through this program, you will not only develop a strong statistical foundation but also cultivate essential skills in data collection, data cleaning, data visualization, and effective communication of statistical findings. These skills are highly valued in today's job market, where organizations across industries are seeking professionals who can harness the power of data to drive evidence-based decision-making.

Hence, Board of Studies in Statistics in its meeting held on 22 March, 2025 resolved to accept therevised syllabus for S. Y. B. Sc. (Statistics) based on Choice Based Credit System (CBCS) of UGC, NEP-2020 and the Government of Maharashtra guidelines.

Program Outcomes (PO) for B.Sc. Program:

Program outcomes associated with a B.Sc. degree are as follows:

PO No.	PO
1	Graduates should have a comprehensive knowledge and understanding of the fundamental principles, theories, and concepts in their chosen field of study.
2	Graduates should possess the necessary technical skills and competencies related to their discipline, including laboratory techniques and data analysis.
3	Graduates should be able to identify, analyze, and solve complex problems using logical and critical thinking skills. They should be able to apply scientific methods and principles to investigate and find solutions.
4	Graduates should be proficient in effectively communicating scientific information, both orally and in writing.
5	Graduates should have a basic foundation in research methods and be capable of designing and conducting scientific investigations.
6	Graduates should be able to work effectively as part of a team, demonstrating the ability to collaborate with others, respect diverse perspectives, and contribute to group projects.
7	Graduates should recognize the importance of ongoing learning and professional development. They should be equipped with the skills and motivation to engage in continuous learning, adapt to new technologies and advancements in their field, and stay updated with current research.

Programme Specific Outcome (PSO) for B.Sc. Statistics Honours/Honours with Research:

After completion of this program, students are expected to learn/understand the:

PSO No.	PSO
1	Serve as a statistician with sound theoretical, practical and computational skills.
2	Work as researcher for formulation and solution of mathematical, scientific, societal and industrial problems.
3	Understand the role of statistics in science, society and for National Development.
4	Apply some discrete and continuous distributions which are highly useful in modelling real life.
5	Investigate the relationship between a variable of interest (the response) and a set of related predictor variables and formulate and fit the appropriate regression model to the given dataset.
6	Serve as Administrators/Investigators in the private as well as government sectors and worked as Analyst in Manufacturing (SQC Unit), Pharmaceutical industries.

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree- Honours Or Bachelor's Degree- Honours with Research	160	176	8	4

Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit

F.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1)	Subject-II (M-2)	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT, RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
I (4.5)	I	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	OE-1(2T)	---	AEC-1(2T) (Eng) VEC-1(2T) (ES) IKS(2T)	CC-1(2T)	22	UG Certificate
	II	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	OE-2(2T) OE-3(2P)	---	AEC-2(2T) (Eng) VEC-2(2T) (CI)	CC-2(2T)	22	
	Cum. Cr.	8	8	8	6	---	10	4	44	
Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										

S.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major*		Subject-II (M-2) Minor #	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
2 (5.0)	III	DSC-5(2T) DSC-6(2T) DSC-7(2P)	---	MIN-1(2T) MIN-2(2T) MIN-3(2P)	---	OE-4(2T)	SEC-1(2T)	AEC-3(2T) (MIL)	CC-3(2T) CEP(2)	22	UG Diploma
	IV	DSC-8(2T) DSC-9(2T) DSC-10(2P)	---	MIN-4(2T) MIN-5(2P)	---	OE-5(2T)	SEC-2(2T) SEC-2(2P)	AEC-4(2T) (MIL)	CC-4(2T) ⊕FP(2)	22	
	Cum . Cr.	12	---	10	---	4	6	4	8	44	
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major & Minor.											

* Student must choose one subject as a Major subject out of M-1, M-2 and M-3 that he/she has chosen at First year

#Student must choose one subject as a Minor subject out of M-1, M-2 and M-3 that he/she has chosen at First year (Minor must be other than Major)

⊕ OJT/Internship/CEP should be completed in the summer vacation after 4th semester

T.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major		Subject-II (M-2) Minor	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
3 (5.5)	V	DSC-11(2T) DSC-12(2T) DSC-13(2T) DSC-14(2P) DSC-15(2P)	DSE-1A/B (2T) DSE-2A/B (2P)	---	---	---	VSC-1(2T) VSC-2(2P)	---	OJT/Int (4)	22	UG Degree
	VI	DSC-16(2T) DSC-17(2T) DSC-18(2T) DSC-19(2T) DSC-20(2T) IKS DSC-21(2P) DSC-22(2P)	DSE-3A/B (2T) DSE-4A/B (2P)	---	---	---	VSC-3(2T) VSC-4(2P)	---	---	22	
	Cum . Cr.	24	8	---	---	---	8	---	4	44	
		Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor									

Fourth Year B.Sc. (Honours)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-25(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	---	22	UG Honours Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-29(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	OJT/Int (4)	22	
	Cum. Cr.	28	8	4	---	---	---	4	44	
Four Year UG Honors Degree in Major and Minor with 176 credits										

Fourth Year B.Sc. (Honours with Research)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	RP(4)	22	UG Honours with Research Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	RP(8)	22	
	Cum. Cr.	20	8	4	---	---	---	12	44	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

Sem- Semester, **DSC-** Department Specific Course, **DSE-** Department Specific Elective, **OE/GE-** Open/Generic elective, **VSC-** Vocational Skill Course, **SEC-** Skill Enhancement Course, **VSEC-** Vacation and Skill Enhancement Course, **AEC-** Ability Enhancement Course, **IKS-** Indian Knowledge System, **VEC-** Value Education Course, **T-** Theory, **P-** Practical, **CC-** Co-curricular **RM-** Research Methodology, **OJT-** On Job Training, **FP-** Field Project, **Int-** Internship, **RP-** Research Project, **CEP-** Community Extension Programme, **ENG-** English, **CI-** Constitution of India, **MIL-** Modern Indian Language

- Number in bracket indicate credit
- The courses which do not have practical 'P' will be treated as theory 'T'
- If student select subject other than faculty in the subjects M-1, M-2 and M-3, then that subject will be treated as Minor subject, and cannot be selected as Major at second year.

Details of S.Y. B.Sc. (Statistics)

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks			
					T	P	Total	Internal		External	
								T	P	T	P
Semester III, Level – 5.0											
DSC-5	DSC	STA-DSC-231	Probability and Probability Distributions-I	2	2	---	2	20	---	30	---
DSC-6	DSC	STA-DSC-232	Statistical Techniques-I	2	2	---	2	20	---	30	---
DSC-7	DSC	STA-DSC-233	Statistics Practical-III	2	---	4	4	---	20	---	30
SEC-1	SEC	STA-SEC-231	Introduction to R	2	2	---	2	20	---	30	---
CEP	CEP	STA-CEP-231	Community Engagement Program	2	---	4	4	50	---	---	---
MIN-1	MIN	STA-MIN-231	Probability and Probability Distributions	2	2	---	2	20	---	30	---
MIN-2	MIN	STA-MIN-232	Statistical Methods-I	2	2	---	2	20	---	30	---
MIN-3	MIN	STA-MIN-233	Practical on STA-MIN-231 & 232	2	---	4	4	---	20	---	30
OE-4	OE	STA-OE-231	Applied Statistics-I	2	2	---	2	20	---	30	---
Semester IV, Level – 5.0											
DSC-8	DSC	STA-DSC-241	Probability and Probability Distributions-II	2	2	---	2	20	---	30	---
DSC-9	DSC	STA-DSC-242	Statistical Techniques-II	2	2	---	2	20	---	30	---
DSC-10	DSC	STA-DSC-243	Statistics Practical-IV	2	---	4	4	---	20	---	30
SEC-2	SEC	STA-SEC-241	Data Analysis Using SPSS	2	2	---	2	20	---	30	---
SEC-3	SEC	STA-SEC-242	Practical on SPSS	2	---	4	4	---	20	---	30
FP	FP	STA-FP-241	Field Project	2	---	4	4	50	---	---	---
MIN-4	MIN	STA-MIN-241	Statistical Methods-II	2	2	---	2	20	---	30	---
MIN-5	MIN	STA-MIN-242	Practical on STA-MIN-241	2	---	4	4	---	20	---	30
OE-5	OE	STA-OE-241	Applied Statistics-II	2	2	---	2	20	---	30	---

Examination Pattern

Theory Question Paper Pattern:

- 30 (External) +20 (Internal) for 2 credits
 - External examination will be of 1½ hours duration
 - There shall be 3 questions: Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. The tentative pattern of question papers shall be as follows;
 - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
 - Q 2 and Q3 Attempt any 3 out of 4 sub-question; each 4 marks.

Rules of Continuous Internal Evaluation:

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous & Comprehensive Evaluation (CCE): CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the subject teacher should choose any three assessment methods from the following list, with each method carrying 10/5 marks:

- i. Individual Assignments
- ii. Seminars/Classroom Presentations/Quizzes
- iii. Group Discussions/Class Discussion/Group Assignments
- iv. Case studies/Case lets
- v. Participatory & Industry-Integrated Learning/Field visits
- vi. Practical activities/Problem Solving Exercises
- vii. Participation in Seminars/Academic Events/Symposia, etc.
- viii. Mini Projects/Capstone Projects
- ix. Book review/Article review/Article preparation
- x. Any other academic activity
- xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT): IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher is at liberty to decide which units are to be assessed using CCEs and which unit is to be assessed on the basis of IAT. The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations. The subject teachers are required to communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Practical Examination Credit 2: Pattern (30+20)

External Practical Examination (30 marks):

- Practical examination shall be conducted by the respective department at the end of the semester.
- Practical examination will be of 3 hours duration and shall be conducted as per schedule.
- Practical examination shall be conducted for 2 consecutive days for 2 hr/ day where incubation condition is required.
- There shall be 05 marks for journal and viva-voce. Certified journal is compulsory to appear for practical examination.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by department as per schedule given.
- For internal practical examination student must produce the laboratory journal of practicals completed along with the completion certificate signed by the concerned teacher and the Head of the department.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities assigned by the faculty during regular practicals. For details refer internal theory examination guidelines.
- Finally 40 (10+30) marks performance of student will be converted into 20 marks.

SEMESTER-III

S.Y. B.Sc. Statistics (Major)
Semester-III
STA-DSC-231: Probability and Probability Distributions-I

Total Hours: 30

Credits: 2

Course Objectives	- To explain with illustration about the concept of sample space and events - To state axioms of probability and basic results of probability - To introduce concept of conditional probability and Bayes' theorem	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the concepts of Sample space and events - Understand the concept of Probability - Compute probability and apply Bayes' theorem in real life situations problems - Understand the concepts of random variable, discrete random variable, Probability distribution	
Unit	Contents	Hours
Unit I	Sample Space and Events - Meaning of experiment, random experiment, deterministic and non-deterministic models. - Definitions of the following terms: Outcome, sample space (finite and infinite), discrete sample space, Event, Elementary event, Compound event, Complementary event, Favorable event, Equally-likely events, Sure event, Impossible event. - Concept of occurrence of an event - Union and intersection of two or more events - Exhaustive events, Mutually exclusive events - Representation of sample space and events by Venn diagram - Occurrence of (i) at least one of the given events (ii) all of the given events (iii) none of the given events. - Examples and problem	5
Unit II	Probability (For finite sample space only) - Theory of Permutation and Combinations - Equiprobable sample space, probability of an event, certain event, impossible event, classical definition of probability and its limitations, relative frequency approach. - Non-equiprobable sample space, probability with reference to a finite sample space: probability assignment approach, probability of an event. - Axioms of probability - Probability of union of two events, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ and its generalization to three events (with proof). - Following results with proof $P(A') = 1 - P(A)$ - If $A \subseteq B$, then $P(A) \leq P(B)$ $P(\bigcup_{i=1}^n A_i) \leq \sum_{i=1}^n P(A_i)$, $n \geq 2$ - Examples and problems.	10

Unit III	Conditional Probability and Independence ▪ Independence of events, pair wise and mutual independence for three events. ▪ Conditional probability of an event ▪ Multiplication theorem of probability (with proof) ▪ Partition of sample space. ▪ Theorem of total probability with proof. ▪ Bayes' theorem (with proof) ▪ Examples and problems.	7
Unit IV	Univariate Probability Distributions ▪ Concepts and definition of discrete random variable. ▪ Probability mass function of a discrete random variable. ▪ Distribution functions of a discrete random variable. ▪ Statement of properties of a distribution function. ▪ Concept of symmetric random variable. ▪ Median and mode of a discrete random variable. ▪ Definition of Expectation of discrete random variable. ▪ Function of random variable. ▪ Examples and problems.	8
Study Resources	▪ Agarwal, B. L. (2017). Programmed Statistics, Third Edition, New Age International Publishers, New Delhi. ▪ Gupta, S. C. and Kapoor, V. K. (2019). Fundamentals of Mathematical Statistics, Eleventh Edition, Sultan Chand and Sons Publishers, New Delhi. ▪ Hogg, R. V. and Craig R. G. (1995). Introduction to Mathematical Statistics, Ed. 7. MacMillan Publishing Co., New York. ▪ Miller, Irwin and Miller, Marylees (2014). John E. Freund's Mathematical Statistics with Applications, (8th Edn.), Pearson Education, Asia. ▪ Mood, A.M. Graybill, F.A. and Boes, D.C. (2007). Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd. ▪ Ross S. (2019). A First Course in Probability, Ninth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc. ▪ Hogg, R.V., Tanis, E.A. and Rao J.M. (2011). Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi. ▪ Myer, P.L. (1970). Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi.	

S.Y. B.Sc. Statistics (Major)
Semester-III
STA-DSC-232: Statistical Techniques-I

Total Hours: 30

Credits: 2

Course Objectives	- To introduce multiple linear regression model. - To introduce introductory part of time series. - To present introductory part of statistical decision theory.	
Course Outcomes	After successful completion of this course, students are expected to: - Understand multiple linear regression models and its utility in real life situations. - Understand and identify the components of time series. - Apply time series models in real life situations. - Apply decision theory in real life situations.	
Unit	Contents	Hours
Unit I	Multiple Linear Regression Model - Definition of multiple correlation coefficient $R_{Y.X_1X_2}$. Derivation of the expression for the multiple correlation coefficient. Properties of multiple correlation coefficient i) $0 \leq R_{Y.X_1X_2} \leq 1$, ii) $R_{Y.X_1X_2} \geq \min(r_{YX_1}, r_{YX_2})$ - Interpretation of coefficient of multiple determination $R_{Y.X_1X_2}^2$ as i) proportion of variation explained by the linear regression ii) $R_{Y.X_1X_2}^2 = 1$, iii) $R_{Y.X_1X_2}^2 = 0$. - Definition of partial correlation coefficient $r_{YX_1.X_2}$ and $r_{YX_2.X_1}$. - Notion of multiple linear regression, Yule's notation (trivariate case). - Fitting of regression plane of Y on X_1 and X_2, $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \varepsilon$, by the method of least squares; obtaining normal equations, solutions of normal equations. - Residuals: Definition, order, derivation of variance, properties. - Definition and interpretation of partial regression coefficients $b_{YX_1.X_2}$ and $b_{YX_2.X_1}$. - Properties of partial correlation coefficient: i) $-1 \leq r_{YX_1.X_2} \leq 1$ and $-1 \leq r_{YX_2.X_1} \leq 1$, ii) $b_{YX_1.X_2} b_{YX_2.X_1} = r_{YX_1.X_2}^2$ - Examples and problems.	8
Unit II	Time Series I - Introduction: meaning and usefulness. - Components: Secular trend, seasonal variations. Cyclical variations, Irregular Variations - Additive and multiplicative models. - Examples and problems	7
Unit III	Time Series II - Measurement of trend, Moving average method, Least square method. - Measurement of seasonal variations, method of simple average, ratio to trend method, ratio to moving average method.	7

	▪ Examples and problems.	
Unit IV	Statistical Decision Theory ▪ Meaning of statistical decision theory, acts, states of nature, outcomes, pay-off and opportunity loss (or regret). ▪ Decision making environment: Decision making under certainty, decision making under uncertainty and decision making under risk. ▪ Decision under uncertainty: Decision rules (i) Maximax (optimistic) criterion, (ii) Minimax regret criterion and Hurwicz criterion (criterion of realism) (iii) Laplace criterion. ▪ Decision under risk: Decision rules (i) Expected value criterion and (ii) Expected opportunity loss criterion. ▪ Examples and problems.	8
Study Resources	▪ Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Mathematical Statistics. S. Chand and Sons, New Delhi. ▪ Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Applied Statistics. S. Chand and Sons, New Delhi. ▪ Kanti Swarup, Gupta P. K. and Man Mohan.(2004). Operations Research, S. Chand & Sons ▪ Snedecor G.W and Cochran W.G. (1991). Statistical Methods. Wiley ▪ Roxy Peck and Jay L. Devore. (2012). Statistics: The Exploration and Analysis of Data. Cengage Learning.	

S.Y. B.Sc. Statistics (Major)
Semester-III
STA-DSC-233: Statistics Practical-III

Total Hours: 60

Credits: 2

General Instructions	- All practical must be carried out by using computers based on R/MS-Excel/MINITAB software. - Student must complete all the practical to the satisfaction of concerned teacher. - Students must be encouraged to collect live data from real life situations for practical.	
Course Objectives	- To become familiar with R/MS-Excel/MINITAB for statistical analysis. - To introduce applications and model sampling of learned distributions. - To develop skills of statistical computations.	
Course Outcomes	After successful completion of this course, students are expected to: - Solve problems on probability - To fit regression equation, to compute and interpret multiple and partial correlation coefficient. - To construct and interpret measurement of trend. - To construct and interpret measurement of indices.	
Sr. No.	Contents	Hours
1	Problems based on probability I	4
2	Problems based on probability II	4
3	Problems based on univariate probability distribution	4
4	Statistical decision theory	4
5	Multiple Linear Regression	4
6	Multiple and Partial correlation coefficient	4
7	Measurement of Trend I	4
8	Measurement of Trend II	4
9	Measurement of Seasonal Indices I	4
10	Measurement of Seasonal Indices II	4
11	Introduction to R Software I	4
12	Introduction to R Software II	4
13	Data objects and built in functions used in R	4
14	Real Life Data Analysis-I	4
15	Real Life Data Analysis-II	4
Study Resources	- Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Mathematical Statistics. S. Chand and Sons, New Delhi. - Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Applied Statistics. S. Chand and Sons, New Delhi. - Purohit S.G., Gore S.D. and Deshmukh S.R. (2008). Statistics Using R. Narosa Pub. - Peter Dalgaard. (2002). Statistics and computing: Introductory Statistics with R. Springer	

	▪ Gardener, M. (2012). Beginning R: The Statistical Programming Language. Wiley & Sons ▪ Acharya, S. (2018). Data Analytics using R. McGraw Hill Education.	
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***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Statistics (Major)
Semester-III
STA-SEC-231: Introduction to R

Total Hours: 30

Credits: 2

Course Objectives	▪ To introduce R software. ▪ To focus on developing programming skills using R. ▪ To familiarize with R graphics.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand how to download and install R software. ▪ Know various R packages with their utility. ▪ Understand data structures in R. ▪ Use R software for statistical computations	
Unit	Contents	Hours
Unit I	Overview of R ▪ Downloading and installation of R ▪ Features of R, to start R and exit from R, Introduction to R screen. ▪ Meaning of package, base (standard package) package, to install a package, to load a package, to delete a package, learning about a package, getting help. ▪ Meaning of workspace, saving a workspace, loading a workspace, deleting a workspace. ▪ Data Types (Modes) in R: numeric, character, logical. ▪ Meaning of object, function. Types of function: built-in function and user defined function, Naming an object. ▪ Data objects, Types of data object: scalar, vector, factor, data frame, list, array, matrix ▪ Functions for working with objects: mode (), length(), cbind(), rbind(), names(), ls(), rm() ▪ Types of operators: arithmetic operators, relational operators, logical operators. ▪ Expression: arithmetic expression, relational expression, logical expression. ▪ Precedence rule of arithmetic operators and logical operators.	8
Unit II	Working with data objects and using functions ▪ Vectors: creating a vector, modifying a vector, deleting a vector. ▪ Working with vectors: the functions to be discussed-c(), rep(), rev(), sort(), diff(), max(),min(), colon operator(:), seq(), scan(), cut(), cat(), table(), which(), unique(), . ▪ Mathematical functions: abs(), sqrt(), log(), log10(), exp(), sin(), cos(), tan(), atan(),round(). ▪ Meaning of data frame, creation of data frame, modifying a data frame, deleting dataframe, extracting elements from a data frame, use of \$ sign. Functions to be discussed: subset(), transform(), attach(), detach(), with(), data.entry(), edit(), is.data.frame(),as.data.frame().	8

Unit III	Graphics ▪ Low level and high level functions. ▪ Functions to be discussed: plot(), lines(), points(), smooth. spline(), curve(), barplot(), pie(), hist(), mtext(), legend().	6
Unit IV	Statistical applications ▪ Diagrams and Graphs: Bar Chart (Subdivided, multiple), Pie diagram, Stem and Leaf diagram ▪ Histogram (equal as well as unequal class intervals), Ogive curve, Frequency polygon superimposed. ▪ Measures of Central Tendency: Mean, Mode, Median, G.M., H.M., Partition values: Quartiles, Deciles, Percentiles. ▪ Measures of Dispersion, Range, M. D. about Mean, Mode, Median, S.D., Variance and C.V.	8
Study Resources	▪ Purohit S.G., Gore S.D. and Deshmukh S.R.(2008): Statistics Using R., Narosa Pub. ▪ Peter Dalgaard. (2002). Statistics and computing: Introductory Statistics with R, Springer. ▪ MainDonald, J. and Braum, J. (2007). Data Analysis and Graphics Using R: An example-based approach (2nd Ed. Cambridge Series in Statistical and Probabilistic Mathematics) ▪ Hey-Jahans, C. (2012). An R Companion to Linear Statistical Models. CRC Press. ▪ Gardener, M. (2012). Beginning R: The Statistical Programming Language Wiley & Sons. ▪ Acharya, S. (2018). Data Analytics using R. McGraw Hill Education. ▪ Wickham, H. and Grolemond, G. (2017). R for Data Science. O'Reilly Media. ▪ Lander, J.P. (2017). R for Everyone: Advanced Analytics and Graphics. Addison-Wesley Professional. ▪ Kabacoff, R.I. (2015). R in Action: Data Analysis and Graphics with R. (2nd Ed. Manning Publications)	

S.Y. B.Sc. Statistics (Major)
Semester-III
STA-CEP-231: Community Engagement Program

Total Hours: 60

Credits: 2

Course Objectives	▪ To develop an appreciation of rural culture, lifestyle and wisdom amongst students. ▪ To learn about the status of various agricultural and development programmes. ▪ To apply classroom knowledge of courses to field realities and thereby improve the quality of learning.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Gain an understanding of rural life, Indian culture and ethos and social realities. ▪ Develop a sense of empathy and bonds of mutuality with the local community. ▪ Appreciate significant contributions of local communities to Indian society and economy. ▪ Identify opportunities for contributing to community’s socio-economic improvements.	
	Contents	
Unit I	Appreciation of Rural Society ▪ Rural lifestyle, rural society, caste and gender relations. ▪ Rural values with respect to community, nature and resources, elaboration of “soul of India lies in villages” (Gandhi), rural infrastructure.	6
Unit II	Understanding rural and local economy and livelihood ▪ Agriculture, farming, land ownership, water management, animal husbandry. ▪ Non-farm livelihoods and artisans, rural entrepreneurs, rural markets, migrant labor.	8
Unit III	Rural and local Institutions ▪ Traditional rural and community organizations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees). ▪ Nagarpalikas and municipalities, local civil society, local administration.	8
Unit IV	Rural and National Development Programmes ▪ History of rural development and current national programmes in India: Sarva Shiksha Abhiyan, Beti Bachoo, Beti Padhao, Ayushman Bharat, Swachh Bharat, PM Awaas Yojana, Skill India, Gram Panchayat Decentralized Planning, National Rural livelihood Mission (NRLM). ▪ Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA), SHRAM, Jal Jeevan Mission, Scheme of Fund for Regeneration of Traditional Industries (SFURTI), Atma Nirbhar Bharat, etc.	8
Some Recommended field based practical activities	▪ Interaction with Self Help Groups (SHGs) women members, and study their functions and challenges; planning for their skill-building and livelihood activities ▪ Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures ▪ Visit Mahatma Gandhi National, Rural Employment Guarantee Act 2005 (MGNREGS) project sites, interact with beneficiaries and interview functionaries at the work site ▪ Conduct Mission Antyodaya survey to support under Gram Panchayat	

	Development Plan (GPDP)	
	Teaching Methods: One credit theory and one credit field work. Reading and classroom discussions, Community dialogues, Oral History, Social and institutional mapping, interactions with elected Panchayat Leaders and government functionaries, observation of Gram Sabha, Field visit to various village institutions. * Fifty percentage classroom discussion and fifty percentage field visits.	

Assessment:

1. Readings from related literatures including e-content and reflections from field visits should be maintained by each student in the form of Field Diary (20 Marks),
2. Submission of assignments based on units (1-4) (20 Marks) and
3. Oral/Group discussion/Presentation (10 Marks)

S.Y. B.Sc. Statistics (Minor)
Semester-III
STA-MIN-231: Probability and Probability Distributions

Total Hours: 30

Credits: 2

Course Objectives	- To explain with illustration about the concept of sample space and events - To state axioms of probability and basic results of probability - To know moment generating function, cumulant generating functions with utility.	
Course Outcomes	After successful completion of this course, students are expected to: - Apply binomial and normal probability distribution in real life situations. - Identify discrete and continuous distribution. - Understand underlying assumptions for common probability distributions. - Make transformation of random variables.	
Unit	Contents	Hours
Unit I	Sample Space and Events - Meaning of experiment, random experiment, deterministic and non-deterministic models. - Definitions of the following terms: Outcome, sample space (finite and infinite), discrete sample space, Event, Elementary event, Compound event, Complementary event, Favorable event, Equally-likely events, Sure event, Impossible event. - Concept of occurrence of an event - Union and intersection of two or more events - Exhaustive events, Mutually exclusive events - Representation of sample space and events by Venn diagram - Occurrence of (i) at least one of the given events (ii) all of the given events (iii) none of the given events. - Examples and problem	5
Unit II	Probability (For finite sample space only) - Theory of Permutation and Combinations - Equiprobable sample space, probability of an event, certain event, impossible event, classical definition of probability and its limitations, relative frequency approach. - Non-equiprobable sample space, probability with reference to a finite sample space: probability assignment approach, probability of an event. - Axioms of probability - Probability of union of two events, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ and its generalization to three events (with proof). - Following results with proof $P(A') = 1 - P(A)$ - If $A \subseteq B$, then $P(A) \leq P(B)$ $P(\bigcup_{i=1}^n A_i) \leq \sum_{i=1}^n P(A_i)$, $n \geq 2$ - Examples and problems.	7
Unit III	Binomial Probability Distribution Concepts and definition of discrete random variable.	8

	- Probability mass function of a discrete random variable. - Binomial distribution p.m.f., Recurrence relation for successive probabilities, computation of probabilities of different events. - Computation of median for given parameters, mode of the distribution, real life situations. - Mean, variance, skewness (comments when $p = 0.5$, $p > 0.5$, $p < 0.5$), statement of additive property of binomial variables. - Examples and Problems	
Unit IV	Normal Probability distribution - Definition of continuous sample space, continuous random variable (r. v.), probability density function (pdf). - Normal distribution: pdf $f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right) \quad -\infty < x, \mu < \infty, \sigma > 0$ - Notation: $X \sim N(\mu, \sigma^2)$ - Identification of parameters μ and σ^2, nature of probability curve, symmetry of the distribution, point of inflexion. Standard normal distribution. - Definition of gamma function and different forms of gamma function. - Mean, median, mode and variance. - Real life situations. - Statement of Additive property, computation of probabilities using normal probability tables. - Examples and problems.	10
Study Resources	- Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Mathematical Statistics. S. Chand and Sons, New Delhi. - Rohatgi V. K. (1976). An Introduction to Probability theory and Mathematical Statistics. John Wiley and Sons, New York. - Hogg. R. V., M. McKean J. W. and Craig. A. J. (2019). Introduction to Mathematical Statistics. Pearson Education, Inc. - Weatherburn C. E. (1968). A first course in Mathematical Statistics. Cambridge University Press. - Kulkarni M.B. and Ghatpande S.B. (2007). Introduction to Discrete Probability and Probability Distributions. SIPF Academy.	

S.Y. B.Sc. Statistics (Minor)
Semester-III
STA-MIN-232: Statistical Methods-I

Total Hours: 30

Credits: 2

Course Objectives	- To introduce multiple linear regression model. - To introduce multiple correlation model. - To present introductory part of statistical process control.	
Course Outcomes	After successful completion of this course, students are expected to: - Understand multiple linear regression models and its utility in real life situations. - Understand chance causes of variation and assignable causes of variation. - Explain basic statistical process control techniques. - Apply simple random sampling in real life situations.	
Unit	Contents	Hours
Unit I	Multiple Correlation - Definition of multiple correlation coefficient $R_{Y.X_1X_2}$. Derivation of the expression for the multiple correlation coefficient. Properties of multiple correlation coefficient i) $0 \leq R_{Y.X_1X_2} \leq 1$, ii) $R_{Y.X_1X_2} \geq \min(r_{YX_1}, r_{YX_2})$. - Interpretation of coefficient of multiple determination $R_{Y.X_1X_2}^2$ as i) proportion of variation explained by the linear regression ii) $R_{Y.X_1X_2}^2 = 1$, iii) $R_{Y.X_1X_2}^2 = 0$. - Definition of partial correlation coefficient $r_{YX_1.X_2}$ and $r_{YX_2.X_1}$. - Properties of partial correlation coefficient: i) $-1 \leq r_{YX_1.X_2} \leq 1$ and $-1 \leq r_{YX_2.X_1} \leq 1$, ii) $b_{YX_1.X_2} b_{YX_2.X_1} = r_{YX_1.X_2}^2$ - Examples and problems.	8
Unit II	Multiple Linear Regression - Notion of multiple linear regression, Yule's notation (trivariate case). - Fitting of regression plane of Y on X_1 and X_2, by the method of least squares; obtaining normal equations, solutions of normal equations. - Residuals: Definition, order, derivation of variance, properties. - Definition and interpretation of partial regression coefficients and . - Examples and problems.	8
Unit III	Basics of Statistical Process Control - Introduction: Meaning and purpose of Statistical Process Control, quality of a product, need of quality control, chance and assignable causes of variation. - Control chart: Statistical basis of control chart, 3σ limits, justification of 3σ limits and criteria for detecting lack of control. - Control charts for variables: Preliminary decisions, construction of control chart for the mean and range when (i) standards are given and (ii) no standard given. Revised control limits, interpretation from the charts and determination of process mean and standard deviation from the charts. Application of control charts.	8

	▪ Examples and problems	
Unit IV	Simple Random Sampling ▪ Simple random sampling with and without replacement ▪ Definitions of population mean, population total and population variance. ▪ Results: 1. Sample mean as an unbiased estimator of population mean. 2. $N\bar{y}$ is an unbiased estimator of population total. 3. $\text{Var}(\bar{y}) = \frac{N-n}{Nn} S^2$ and $\text{SE}(\bar{y})$ in case of SRSWOR. 4. $\text{Var}(\bar{y}) = \frac{N-1}{Nn} S^2$ and $\text{SE}(\bar{y})$ in case of SRSWR. ▪ Simple random sampling without replacement for proportions. ▪ Results: 1. Sample proportion is an unbiased estimator of Population proportion 2. Np is an unbiased estimator of NP 3. $\text{Var}(p) = \frac{(N-n)P(1-P)}{N-1} \frac{1}{n}$ and $\text{SE}(p)$ ▪ Examples and problems. Note: Derivations are not expected.	6
Study Resources	▪ Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Mathematical Statistics. S. Chand and Sons, New Delhi. ▪ Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Applied Statistics. S. Chand and Sons, New Delhi. ▪ Montgomery D.C. (2013). Introduction to Statistical Quality Control. John Wiley and Sons. ▪ Snedecor G.W and Cochran W.G. (1991). Statistical Methods. Wiley ▪ Roxy Peck and Jay L. Devore. (2012). Statistics: The Exploration and Analysis of Data. Cengage Learning.	

S.Y. B.Sc. Statistics (Minor)
Semester-III
STA-MIN-233: Practical on STA-MIN-231 & 232

Total Hours: 60

Credits: 2

General Instructions	- All practical must be carried out by using computers based on R/MS-Excel/MINITAB software. - Student must complete all the practical to the satisfaction of concerned teacher. - Students must be encouraged to collect live data from real life situations for practical.	
Course Objectives	- To make students aware about data objects and built-in functions in R. - To illustrate approach to represent data using R. - To apply normal distribution in the real-life situations.	
Course Outcomes	After successful completion of this course, students are expected to: - Use R software for statistical computations. - To apply Binomial and Normal distribution in the real life situations. - To fit regression equation, to compute and interpret multiple and partial correlation coefficient - To construct and interpret control charts for quality control purposes.	
Sr. No.	Contents	Hours
1	Problems based on probability	4
2	Fitting of Binomial distribution	4
3	Model sampling of binomial distribution	4
4	Applications of binomial distribution	4
5	Model sampling of normal distribution	4
6	Fitting of normal distribution	4
7	Applications of normal distribution	4
8	Multiple linear regression	4
9	Multiple Correlation coefficient	4
10	Partial Correlation coefficient	4
11	X bar and R chart	4
12	Simple RandomSampling with replacement	4
13	Simple RandomSampling without replacement.	4
14	Real life data analysis-I	4
15	Real life data analysis-II	4
Study Resources	- Purohit S.G., Gore S.D. and Deshmukh S.R. (2008). Statistics Using R. Narosa Pub. - Peter Dalgaard. (2002). Statistics and computing: Introductory Statistics with R. Springer - Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Mathematical Statistics. S. Chand and Sons, New Delhi. - Montgomery D.C. (2013). Introduction to Statistical Quality Control. John Wiley and Sons. - Snedecor G.W and Cochran W.G. (1991). Statistical Methods. Wiley	

***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Statistics (Open Elective)
Semester-III
STA-OE-231: Applied Statistics-I

Total Hours: 30

Credits: 2

Course Objectives	▪ To introduce sample survey and sampling methods. ▪ To introduce introductory part of time series. ▪ To develop understanding of theory of attributes.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Apply sample survey in real life situation. ▪ Obtain simple random sample with replacement and without replacement. ▪ Use time series models in real life situations. ▪ Apply theory of attributes in real life situation.	
Unit	Contents	Hours
Unit I	Sample Survey ▪ Concept of distinguishable elementary units, sampling units, sampling frame. ▪ Objectives of a sample survey. ▪ Designing questionnaire, characteristics of good questionnaire. ▪ Planning, execution and analysis of a sample survey. Practical problems in planning, execution and analysis of a sample survey. ▪ Sampling and non-sampling errors with illustrations. ▪ Study of some surveys illustrating the above ideas.	6
Unit II	Sampling ▪ Population, finite population, infinite population, statistical population, homogeneous population and heterogeneous population. ▪ Census method and Limitations of census method. ▪ Definitions of population mean, population total and population variance. ▪ Sampling and objectives of sampling. ▪ Simple random sampling with replacement (SRSWR) and simple random sampling without replacement (SRSWOR) with real life situations. ▪ Notion of sample and random sample. Definition of sample mean, sample variance, sample standard deviation ▪ Discussion on estimation of population mean and population variance using random sample. ▪ Stratified random sampling with real life situations. ▪ Difference between SRSWR and SRSWOR ▪ Difference between SRSWOR and stratified sampling	8
Unit III	Time Series ▪ Introduction: meaning and usefulness. ▪ Components: Secular trend, seasonal variations. cyclical variations, irregular variations ▪ Additive and multiplicative models. ▪ Measurement of trend, Moving average method, Least square method. ▪ Measurement of seasonal variations, method of simple average, ratio to trend method, ratio to moving average method.	8

	▪ Examples and problems.	
Unit IV	Theory of Attributes ▪ Concept of attribute, dichotomy, manifold classification, Notations. ▪ Class frequency, order of class, positive class frequency, negative class frequency, contra class frequency, ultimate class frequency ▪ Relation between class frequencies ▪ Method of dot operator to express any class frequency in terms of positive class frequencies. ▪ Fundamental set of class frequencies: Definition, determination whether a set of frequencies is fundamental set of or not (two attributes). ▪ Independence and association of two attributes ▪ Yule's coefficient of association (Q) and its interpretation. ▪ Properties of $Q(-1 \leq Q \leq 1)$ and interpretation of (Q). ▪ Examples and problems. NOTE: DERIVATIONS ARE NOT EXPECTED	8
Study Resources	▪ Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Mathematical Statistics. S. Chand and Sons, New Delhi. ▪ Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Applied Statistics. S. Chand and Sons, New Delhi. ▪ Medhi J. (2009). Statistical Methods. New Age International Publishers, New Delhi. ▪ Agarwal, B. L. (2017). Programmed Statistics, Third Edition, New Age International Publishers, New Delhi.	

SEMESTER-IV

S.Y. B.Sc. Statistics (Major)
Semester-IV
STA-DSC-241: Probability and Probability Distributions-II

Total Hours: 30

Credits: 2

Course Objectives	▪ To introduce the concepts of univariate and bivariate random variables. ▪ To teach students how to derive the mathematical expectation. ▪ To demonstrate some standard discrete probability distributions.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the concepts of univariate random variable and mathematical expectation ▪ Compute probabilities of events in bivariate probability distribution ▪ Derive bivariate mathematical expectation ▪ Apply standard discrete distributions in real life situations	
Unit	Contents	Hours
Unit I	Mathematical Expectation (Univariate Random Variable) ▪ Definition of expectation of a random variable, expectation of a function of a random variable. ▪ Definitions of mean, variance of univariate probability distribution, effect of change of origin and scale on mean and variance. ▪ Probability generating function (PGF), Simple properties, mean and variance using PGF. ▪ Definition of raw, central and factorial moments of univariate probability distributions and their interrelations. ▪ Concept of standardized random variable. ▪ Examples and problems.	6
Unit II	Bivariate Probability distribution (Finite sample space) ▪ Definition of two-dimensional discrete random variable, its joint p.m.f. and its distribution function and their properties. ▪ Computation of probabilities of events in bivariate probability distribution. ▪ Concepts of marginal and conditional probability distributions. ▪ Independence of two discrete random variables. ▪ Examples and problems.	6
Unit III	Mathematical expectation (Bivariate Random Variable) ▪ Definition of Mathematical Expectation of two-dimensional discrete random variable. ▪ Theorems on expectations of sum and product of two jointly distributed random variables. ▪ Conditional expectation. ▪ Definitions of conditional mean and conditional variance. ▪ Definition of raw and central moments. ▪ Definition of covariance, correlation coefficient, independence and uncorrelatedness between two variables. ▪ Variance of linear combination of two variables with proof. ▪ Examples and Problems	6

Unit IV	Some standard discrete probability distributions ▪ Discrete Uniform distribution on integers 1 to n: p.m.f., c.d.f., mean, variance of Uniform distribution, real life situations, comment of mode and median. ▪ Bernoulli distribution, Its p.m.f., mean, variance, moments, distribution of sum of independent and identically distributed Bernoulli variables. ▪ Binomial Distribution: Its p.m.f., Recurrence relation for successive probabilities, computation of probabilities of different events, computation of median for given parameters, mode of the distribution, real life situations. ▪ Mean, variance, moments, skewness (comments when $p = 0.5$, $p > 0.5$, $p < 0.5$), p.g.f., additive property of binomial variables, conditional distribution of X given $X + Y$, where X and Y are independent, $B(n_1, p)$ and $B(n_2, p)$ variables. ▪ Poisson distribution, Its p.m.f. mean, variance, mode, p.g.f. and additive property. Derivation of Poisson distribution as a limiting case of binomial distribution. ▪ Recurrence relation for probabilities, real life situations, recurrence relation for raw and central moments of Poisson distribution, Conditional distribution of X given $X+Y=n$ when X and Y independent Poisson variables. ▪ Examples and problem	12
Study Resources	▪ Agarwal, B. L. (2017). Programmed Statistics, Third Edition, New Age International Publishers, New Delhi. ▪ Gupta, S. C. and Kapoor, V. K. (2019). Fundamentals of Mathematical Statistics, Eleventh Edition, Sultan Chand and Sons Publishers, New Delhi. ▪ Hogg, R. V. and Craig R. G. (1995). Introduction to Mathematical Statistics, Ed. 7. MacMillan Publishing Co., New York. ▪ Miller, Irwin and Miller, Marylees (2014). John E. Freund's Mathematical Statistics with Applications, (8th Edn.), Pearson Education, Asia. ▪ Mood, A.M. Graybill, F.A. and Boes, D.C. (2007). Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd. ▪ Ross S. (2019). A First Course in Probability, Ninth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc. ▪ Hogg, R.V., Tanis, E.A. and Rao J.M. (2011). Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi. ▪ Myer, P.L. (1970). Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi.	

S.Y. B.Sc. Statistics (Major)
Semester-IV
STA-DSC-242: Statistical Techniques-II

Total Hours: 30

Credits: 2

Course Objectives	- To introduce general univariate continuous probability distributions. - To introduce some standard univariate distributions. - To know moment generating function, cumulant generating functions with utility.	
Course Outcomes	After successful completion of this course, students are expected to: - Identify discrete and continuous distribution. - Understand underlying assumptions for common probability distributions. - Understand chance causes of variation and assignable causes of variation. - Apply statistical process control techniques in real life situations.	
Unit	Contents	Hours
Unit I	Univariate continuous probability distributions - Definition of continuous sample space, continuous random variable (r. v.), functions of continuous r. v., probability density function (pdf), distribution function, statement of properties of distribution function. - Expectation of a random variable, expectation of a function of a r. v. - Moments, raw and central moments, evaluation of mgf, cgf. - Mode, median and quartiles. - Transformation of variables, statement of theorem, pdf of simple monotone functions and pdf of only. - Examples and problems.	5
Unit II	Normal distribution - Normal distribution: pdf $f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right) \quad -\infty < x, \mu < \infty, \sigma > 0$ Notation: $X \sim N(\mu, \sigma^2)$ - Identification of parameters μ and σ^2, nature of probability curve, symmetry of the distribution, point of inflexion. Standard normal distribution. - Definition of gamma function and different forms of gamma function. - Mean, median, mode and variance. - Mgf, cgf, moments, recurrence relation for central moments, cumulants, $\beta_1, \beta_2, \gamma_1, \gamma_2$ - Real life situations. - Additive property, computation of probabilities using normal probability tables. - Normal approximation to binomial and Poisson, distribution of X^2 where, $X \sim N(0,1)$. - Examples and problems.	10
Unit III	Basics of Statistical Process Control - Introduction: Meaning and purpose of Statistical Process Control, quality of a product, need of quality control, chance and assignable causes of variation. - Control chart: Statistical basis of control chart, 3σ limits, justification of 3σ	8

	limits and criteria for detecting lack of control. - Control charts for variables: Preliminary decisions, construction of control chart for the mean and range when (i) standards are given and (ii) no standard given. Revised control limits, interpretation from the charts and determination of process mean and standard deviation from the charts. Application of control charts. - Examples and problems.	
Unit IV	Control Charts for Attributes - Control chart for fraction defective (p-chart for fixed sample size): Preliminary decisions, construction of control chart when (i) standards are given and (ii) no standard given. Revised control limits, interpretation from the chart and standardized control chart for variable sample size. - Control chart for number of defects per unit: Preliminary decisions, construction of control chart when (i) standards are given and (ii) no standard given. Revised control limits, interpretation from the charts and applications of control chart. - Examples and problems.	7
Study Resources	- Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Mathematical Statistics. S. Chand and Sons, New Delhi. - Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Applied Statistics. S. Chand and Sons, New Delhi. - Montgomery D.C. (2013). Introduction to Statistical Quality Control. John Wiley and Sons. - Snedecor G.W and Cochran W.G. (1991). Statistical Methods. Wiley - Roxy Peck and Jay L. Devore. (2012). Statistics: The Exploration and Analysis of Data. Cengage Learning.	

S.Y. B.Sc. Statistics (Major)
Semester-IV
STA-DSC-243: Statistics Practical-IV

Total Hours: 60

Credits: 2

General Instructions	- All practical must be carried out by using computers based on R/MS-Excel/MINITAB software. - Student must complete all the practical to the satisfaction of concerned teacher. - Students must be encouraged to collect live data from real life situations for practical.	
Course Objectives	- To introduce built-in functions regarding to sampling distributions. - To introduce control charts using software. - To develop statistical problem-solving skills.	
Course Outcomes	After successful completion of this course, students are expected to: - To apply Binomial and Normal distribution in the real life situations. - To obtain model sample from Binomial and Normal distribution. - To apply standard discrete distributions in real life situations - To construct and interpret control charts for quality control purposes.	
Sr. No.	Contents	Hours
1	Problems on bivariate probability distributions	4
2	Fitting of binomial distribution	4
3	Applications of binomial distribution	4
4	Fitting of Poisson distribution	4
5	Applications of Poisson distribution	4
6	Model sampling from uniform, binomial and Poisson distribution	4
7	Problems based on univariate probability distributions	4
8	Model sampling from normal distribution	4
9	Fitting of normal distribution	4
10	Applications of normal distribution	4
11	X bar and R chart	4
12	Problems based on p chart	4
13	Problems based on c chart	4
14	Real life data analysis-I	4
15	Real life data analysis-II	4
Study Resources	- Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Mathematical Statistics. S. Chand and Sons, New Delhi. - Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Applied Statistics. S. Chand and Sons, New Delhi. - Montgomery D.C. (2013). Introduction to Statistical Quality Control. John Wiley and Sons. - Roxy Peck and Jay L. Devore. (2012). Statistics: The Exploration and Analysis of Data. Cengage Learning - Purohit S.G., Gore S.D. and Deshmukh S.R. (2008). Statistics Using R.	

	Narosa Pub ▪ Peter Dalgaard. (2002). Statistics and computing: Introductory Statistics with R. Springer ▪ Gardener, M. (2012). Beginning R: The Statistical Programming Language. Wiley & Sons ▪ Acharya, S. (2018). Data Analytics using R. McGraw Hill Education.	
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***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Statistics (Major)
Semester-IV
STA-SEC-241: Data Analysis Using SPSS

Total Hours: 30

Credits: 2

Course Objectives	▪ To make student aware about introduction to SPSS. ▪ To explain computations of descriptive statistics using SPSS. ▪ To describe construction of regression lines using SPSS.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Apply SPSS software to compute descriptive statistics. ▪ Construct charts and graphs using SPSS software. ▪ Apply SPSS software to compute correlation coefficient and fit regression equation. ▪ Write SPSS commands to analyze data.	
Unit	Contents	Hours
Unit I	An Overview of SPSS ▪ Introduction to SPSS ▪ Opening a Data File in SPSS ▪ SPSS Data Editor - Variable View - Data View - Entering Data into the Data Editor - Saving the Data File - Statistical Analysis ▪ SPSS: general description, functions, menus, commands ▪ Editing and Manipulating Data ▪ Missing Values ▪ Editing and copying SPSS output ▪ Printing from SPSS and closing SPSS ▪ Importing Data	10
Unit II	Descriptive Statistics with SPSS ▪ Descriptive Statistics: - Frequencies - Measure of central tendency - Measure of Dispersion - Skewness - Kurtosis ▪ Charts and Graphs: - Bar charts - Pie chart - Scatter Plots ▪ Line Graphs and Histogram ▪ Examples and problems	6
Unit III	Correlation ▪ Correlation simple and multiple ▪ Rank correlation ▪ Simple linear regression	6

	▪ Multiple regression ▪ Examples and problems	
Unit IV	Regression ▪ Simple linear regression ▪ Simple linear regression equation ▪ Scatter plot and the line of best fit. ▪ Regression and one way anova ▪ Simple regression with SPSS ▪ Multiple regression analysis ▪ Multiple regression with SPSS ▪ Examples and Problems	8
Study Resources	▪ A. Rajathi and Chandran (2006). SPSS for you, MJP Publishers ▪ K. Pandya, Smruti Bulsari, Sanjay Sinha (2011). SPSS in Simple Steps, Dreamtech Press ▪ Robert H. Carver and Jane Gradwohl Nash (2011). Doing Data Analysis with SPSS, Cengage Learning. ▪ Andy Field (2009). Discovering Statistics Using SPSS, Third edition, SAGE	

S.Y. B.Sc. Statistics (Major)
Semester-IV
STA-SEC-242: Practical on SPSS

Total Hours: 60

Credits: 2

General Instructions	▪ All practicals must be carried out by using computers based on SPSS software. ▪ Student must complete all the practicals to the satisfaction of concerned teacher. ▪ Students must be encouraged to collect live data from real life situations for practicals.	
Course Objectives	▪ To make student aware about introduction to SPSS. ▪ To explain computations of descriptive statistics using SPSS. ▪ To describe construction of regression lines using SPSS.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Apply SPSS software to compute measures of central tendency and dispersion. ▪ Use SPSS software to represent data graphically. ▪ Understand statistical hypothesis testing procedure using SPSS software. ▪ Perform ANOVA using SPSS software.	
Sr. No.	Contents	Hours
1	Introduction to SPSS software	4
2	Data Import and Export from excel	4
3	Data objects and built in functions used in SPSS	4
4	Diagrammatic representation of data	4
5	Graphical representation of data	4
6	Frequency distribution of data	4
7	Computations of measures of central tendency	4
8	Computations of measures of dispersion	4
9	Computation of correlation coefficient	4
10	Fitting of regression equation	4
11	Test based on t distributions-I	4
12	Test based on t distributions-II	4
13	Chi-square test	4
14	Performing an ANOVA	4
15	Real life data analysis	4
Study Resources	▪ A. Rajathi and Chandran (2006). SPSS for you, MJP Publishers ▪ K. Pandya, Smruti Bulsari, Sanjay Sinha (2011). SPSS in Simple Steps, Dreamtech Press ▪ Robert H. Carver and Jane Gradwohl Nash (2011). Doing Data Analysis with SPSS, Cengage Learning. ▪ Andy Field (2009). Discovering Statistics Using SPSS, Third edition, SAGE	

***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Statistics (Major)
Semester-IV
STA-FP-241: Field Project

Total Hours: 60

Credits: 2

Course Overview	▪ The Field Project Paper is designed to provide undergraduate statistics students with hands-on experience and a deeper understanding of socio-economic issues in both rural and urban settings. ▪ This project-based course will enable students to apply statistical methods to real-world problems, observe socio-economic contexts, and understand development-related issues through direct field experience.
Course Objectives	▪ To provide students with practical exposure to socio-economic contexts in rural and urban settings. ▪ To enhance student's understanding of development -related policies, regulations and organizational structures. ▪ To foster critical thinking and problem-solving skills in addressing socio-economic issues.
Course Outcomes	After successful completion of this course, students are expected to: ▪ Collect and analyze socio-economic data using appropriate statistical methods. ▪ Understand and critique policies and programs related to socio-economic development. ▪ Identify and propose solutions to complex socio-economic problems. ▪ Communicate findings and recommendations effectively in written and oral forms.
	Contents
Unit I	Orientation and Preparation ▪ Overview of socio-economic development issues in rural and urban contexts. ▪ Training on data collection and analysis techniques
Unit II	Field Work Field visit to rural or urban areas ▪ Observe and collect data on rural or urban socio-economic conditions. ▪ Activities: Interviews, surveys, and observations. ▪ Compilation and preliminary analysis of data collected.
Unit III	Data Analysis and Report Writing ▪ Data cleaning and preparation for analysis. ▪ Data analysis using statistical software. ▪ Writing the field project report, including introduction, methodology, results, discussion and conclusion
Unit IV	Presentation and Evaluation ▪ Preparations of presentations. ▪ Presentation of findings to peers and faculty followed by a Q & A session

Assessment:

- Field work participation, field note book, team work etc. (10 Marks)
- Data Collection and Analysis (15 Marks)
- Field project report (15 Marks)
- Presentation of findings (10 Marks)

S.Y. B.Sc. Statistics (Minor)
Semester-IV
STA-MIN-241: Statistical Methods-II

Total Hours: 30

Credits: 2

Course Objectives	▪ To introduce R. ▪ To introduce introductory part of time series. ▪ To present introductory part of testing of hypothesis.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand how to download and install R software. ▪ Construct null hypothesis and alternative hypothesis. ▪ Understand types of errors in testing of hypothesis. ▪ Apply large sample tests in real life situations.	
Unit	Contents	Hours
Unit I	Overview of R ▪ Downloading and installation of R ▪ Features of R, to start R and exit from R, Introduction to R screen. ▪ Meaning of package, base (standard package) package, to install a package, to load a package, to delete a package, learning about a package, getting help. ▪ Meaning of workspace, saving a workspace, loading a workspace, deleting a workspace. ▪ Data Types (Modes) in R: numeric, character, logical. ▪ Meaning of object, function. Types of function: built-in function and user defined function, Naming an object. ▪ Data objects, Types of data object: scalar, vector, factor, data frame, list, array, matrix ▪ Functions for working with objects: mode (), length(), cbind(), rbind(), names(), ls(), rm() ▪ Types of operators: arithmetic operators, relational operators, logical operators. ▪ Expression: arithmetic expression, relational expression, logical expression. ▪ Precedence rule of arithmetic operators and logical operators.	10
Unit II	Time Series ▪ Introduction: meaning and usefulness. ▪ Components: Secular trend, seasonal variations. cyclical variations, irregular variations ▪ Additive and multiplicative models. ▪ Measurement of trend, Moving average method, Least square method. ▪ Measurement of seasonal variations, method of simple average, ratio to trend method, ratio to moving average method. ▪ Examples and problems.	8
Unit III	Testing of Hypothesis ▪ Introduction ▪ Notation of hypothesis, statistical hypothesis, null hypothesis, alternative	6

	hypothesis - Two types of errors, critical region, critical value, level of significance - Test of hypothesis, one tailed and two tailed tests, general procedure of testing of hypothesis - Discussion on examples based on determination of types of error, critical region for given test - Concept of p-value.	
Unit IV	Large Sample Tests $H_0 : \mu = \mu_0$ verses a) $H_1 : \mu \neq \mu_0$ b) $H_1 : \mu < \mu_0$ c) $H_1 : \mu > \mu_0$ $H_0 : \mu_1 = \mu_2$ verses a) $H_1 : \mu_1 \neq \mu_2$ b) $H_1 : \mu_1 < \mu_2$ c) $H_1 : \mu_1 > \mu_2$ $H_0 : P = P_0$ verses a) $H_1 : P \neq P_0$ b) $H_1 : P < P_0$ c) $H_1 : P > P_0$ $H_0 : P_1 = P_2$ verses a) $H_1 : P_1 \neq P_2$ b) $H_1 : P_1 < P_2$ c) $H_1 : P_1 > P_2$ $H_0 : \rho = \rho_0$ verses a) $H_1 : \rho \neq \rho_0$ b) $H_1 : \rho > \rho_0$ c) $H_1 : \rho < \rho_0$ - Examples and Problems	6
Study Resources	- Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Mathematical Statistics. S. Chand and Sons, New Delhi. - Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Applied Statistics. S. Chand and Sons, New Delhi. - Snedecor G.W and Cochran W.G. (1991). Statistical Methods. Wiley - Roxy Peck and Jay L. Devore. (2012). Statistics: The Exploration and Analysis of Data. Cengage Learning. - Purohit S.G., Gore S.D. and Deshmukh S.R.(2008): Statistics Using R., Narosa Pub.	

S.Y. B.Sc. Statistics (Minor)
Semester-IV
STA-MIN-242: Practical on STA-MIN-241

Total Hours: 60

Credits: 2

General Instructions	- All practical must be carried out by using computers based on R/MS-Excel/MINITAB software. - Student must complete all the practical to the satisfaction of concerned teacher. - Students must be encouraged to collect live data from real life situations for practical.	
Course Objectives	- To make students aware about data objects and built-in functions in R. - To illustrate representation of data using R. - To develop statistical testing problem solving skills.	
Course Outcomes	After successful completion of this course, students are expected to: - Understand how to import and export data in R - Use R software for statistical computations. - To apply time series in the real-life situations. - To apply large sample test in the real life situations.	
Sr. No.	Contents	Hours
1	Introduction to R software-I	4
2	Introduction to R software-II	4
3	Data import and Export	4
4	Data objects and built in functions used in R	4
5	Diagrammatic representation of data	4
6	Graphical representation of data	4
7	Measurement of Trend-I	4
8	Measurement of Trend-II	4
9	Measurement of Seasonal Indices-I	4
10	Measurement of Seasonal Indices-II	4
11	Large sample test-I	4
12	Large sample test-II	4
13	Large sample test-II	4
14	Real life data analysis-I	4
15	Real life data analysis-II	4
Study Resources	- Purohit S.G., Gore S.D. and Deshmukh S.R. (2008). Statistics Using R. Narosa Pub. - Peter Dalgaard. (2002). Statistics and computing: Introductory Statistics with R. Springer - Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Mathematical Statistics. S. Chand and Sons, New Delhi.	

***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Statistics (Open Elective)
Semester-IV
STA-OE-241: Applied Statistics-II

Total Hours: 30

Credits: 2

Course Objectives	▪ To explain Indian Official Statistics. ▪ To introduce statistics in education and psychology. ▪ To acquaint students with elements of annuities and demand and supply analysis.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand about the agencies responsible for collection of data on official statistics and their important publications. ▪ Explain different types of annuities . ▪ Study statistics in psychology and education. ▪ Understand the Demand and Supply analysis.	
Unit	Contents	Hours
Unit I	Indian Official Statistics ▪ Present official statistical system in India. Methods of collection of official statistics, their reliability and limitations. ▪ Role of Ministry of Statistics and Program Implementation (MoSPI), National Statistical Office (NSO), Central Statistical Office (CSO), National Sample Survey Office (NSSO), and National Statistical Commission.	8
Unit II	Statistics in Psychology and Education ▪ Introduction ▪ Scaling individual test items ▪ Scaling of scores on a test Z scores, Standard scores, normalised scores, T scores, percentile scores ▪ Reliability of test scores ▪ Methods of determining test reliability - i)Test retest method - ii)Parallel forms method - iii)Split half method - iv)Kuder-Richardson method ▪ Validity of test scores ▪ I.Q. and E.Q. ▪ Examples and problems.	8
Unit III	Annuities ▪ Accumulation and amount functions ▪ The effective rate of interest and discount ▪ Nominal rate of interest and discount ▪ Annuities: annuity certain, annuity due, annuity immediate, perpetuity ▪ Examples and problems	6
Unit IV	Demand and Supply Analysis ▪ Demand: meaning, statement of law, assumptions, exceptions and determinants of demand, individual and market demand..	8

	▪ Supply: meaning, statement of law, assumptions, exceptions and determinants of supply, individual and market supply ▪ Elasticity of demand: definition : i) price elasticity of demand ii) income elasticity of demand iii) cross elasticity of demand ▪ Method of measuring elasticity of demand: i) percentage method, ii) point method iii) total outlay method iv) ARC Method ▪ Demand forecasting: meaning need and methods of forecasting ▪ Examples and problems	
Study Resources	▪ Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Applied Statistics. S. Chand and Sons, New Delhi. ▪ Gun, Gupta and Dasgupta. (2016). Fundamentals of Statistics Vol. II. World Press. ▪ Parimal Mukhopadhyay. (2005). Applied Statistics. Books and Allied P Ltd, Kolkata. ▪ Roxy Peck and Jay L. Devore. (2012). Statistics: The Exploration and Analysis of Data. Cengage Learning. ▪ Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi. (Refer website-http://mospi.nic.in/) ▪ Kerry Pechter. (2008). Annuities for Dummies. For Dummies.	

Skills acquired and Job prospects for the BSc Statistics students:

B.Sc. Statistics programme emphasizes both theory and applications of statistics and is structured to provide knowledge and skills in depth necessary for the employability of students in industry, other organizations, as well as in academics.

After successful completion of three years degree course in Statistics, student will be well versed with relevant generic skills and global competencies such as

1. **Problem-solving skills** that are required to solve different types of Statistics related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries;
2. **Investigative skills**, including skills of independent investigation of Statistics related issues and problems;
3. **Communication skills** involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature;
4. **Analytical skills** involving paying attention to detail and ability to construct logical arguments using correct technical language related to Statistics and ability to translate them with popular language when needed;
5. **ICT skills**;
6. **Personal skills** such as the ability to work both independently and in a group.

Job Opportunities:

- The student who has thoroughly studied this syllabus of T.Y.B.Sc.(Statistics) can join for higher education at PG level towards M.Sc.(Statistics)
- Students with B.Sc.(Statistics) degree are expected to served as Statisticians/ Administrators / Investigators in the private as well as government sections.
- Students with B.Sc.(Statistics) degree under this syllabus will find better opportunities of Statistician/Analyst in Manufacturing (SQC unit), Pharmaceutical Industries, Service Industries such as Banking and Insurance, Railway, Forest, Telecom, Transports, Hotel etc services.