



Date :- 01/08/2023

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Statistics (Sem. I & II)

Ref. :- Decision of the Academic Council at its meeting held on 26/07/2023.

The Syllabi of B. Sc. in Statistics (First and Second Semesters) as per **NATIONAL EDUCATION POLICY - 2020** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2023-24.

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

Sd/-
Chairman,
Board of Studies

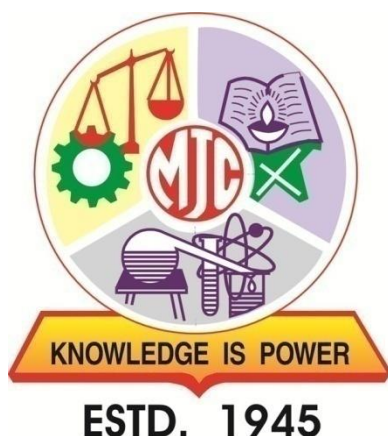
To :

- 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



Structure and Syllabus

B.Sc. Honours/Honours with Research

(FYBSc Statistics)

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

[w.e.f. Academic Year: 2023-24]

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.

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

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

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.

Program Specific Outcome PSO (B.Sc. Statistics):

After completion of this course, students are expected to:

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.

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

Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit										
Level 1	Sem	Major (Core) Subjects		Minor Subjects (MIN)	GE/ OE	VSC, SEC (VESC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int, RP	Cumulative Credits/Sem	Degree/ Cumulative Cr.
		Mandatory (DSC)	Elective (DSE)							
4.5	I	DSC-1 (2T) DSC-2 (2T) DSC-3 (2P)	—	MIN-1 (2T) MIN-2 (2P)	OE-1 (2T)	SEC-1 (2T) SEC-2 (1P)	AEC-1 (2T) (ENG) VEC-1 (2T) (ES) IKS (1T)	CC-1 (2)	22	UG Certificate 44
	II	DSC-4 (2T) DSC-5 (2T) DSC-6 (2P)	...	MIN-3 (2T) MIN-4 (2P)	OE-2 (2T)	SEC-3 (2T) SEC-4 (1P)	AEC-2 (2T) (ENG) VEC-2 (2T) (CI) IKS (1T)	CC-2 (2)	22	
	Cum. Cr	12	...	8	4	6	4+4+2	4	44	
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										
5.0	III	DSC-7 (2T) DSC-8 (2T) DSC-9 (2P) DSC-10 (2P)	...	MIN-5 (2T) MIN- 6 (2P)	OE-3 (2T) OE-4 (2P)		AEC-3 (2T) (MIL)	CC-3 (2) CEP (2)	22	UG Diploma 88
	IV	DSC-11 (2T) DSC-12 (2T) DSC-13 (2P) DSC-14 (2P)	...	MIN-7 (2T) MIN- 8 (2P)	OE- 5 (2T) OE-6 (2P)		AEC-4 (2T) (MIL)	CC-4 (2) FP (2)	22	
	Cum. Cr	28	...	16	10	6	8+4+2	8+2+2	88	
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 and Minor.										
5.5	V	DSC-15 (2T) DSC-16 (2T) DSC-17 (2T) DSC-18 (2P) DSC-19 (2P)	DSE-1 (2T) A/B DSE-2 (2P) A/B	MIN-9 (2T/P)	...	VSC-1 (2T) VSC-2 (2P)	...	OJT/Int(2)	22	UG Degree 132
	VI	DSC-20 (2T) DSC-21 (2T) DSC-22 (2T) DSC-23 (2P) DSC-24 (2P)	DSE-3 (2T) A/B DSE-4 (2P) A/B	MIN-10(2T/P)	—	VSC-3 (2T) VSC-4 (2P)	...	OJT/Int(2)	22	
	Cum. Cr.	48	08	20	10	8+6	8+4+2	8+2+2+4	132	
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										
6.0	VII	DSC-25 (4T) DSC-26 (4T) DSC-28 (4T) DSC-27 (2P)	DSE-5 (2T) A/B DSE-6(2P) A/B	RM (4T)	—	...	...	...	22	UG Honors Degree 176
	VIII	DSC-29 (4T) DSC-30 (4T) DSC-32 (4T) DSC-31 (2P)	DSE-7 (2T) A/B DSE-8(2P) A/B	...	—	...	...	OJT/Int (4)	22	
	Cum. Cr.	76	16	20+4	10	8+6	8+4+2	8+2+2+8	176	
Four Year UG Honors Degree in Major and Minor with 176 credits										
6.0	VII	DSC-25 (4T) DSC-26 (4T) DSC-27 (2P)	DSE-5 (2T) A/B DSE-6 (2P) A/B	RM (4T)	...	...	...	RP (4)	22	UG Honors with Research Degree 176
	VIII	DSC-29 (4T) DSC-30 (4T) DSC-31 (2P)	DSE-7 (2T) A/B DSE-8 (2P) A/B	...	...	...	...	RP (8)	22	
	Cum. Cr.	68	16	20+4	10	8+6	8+4+2	8+2+2+8+12	176	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

Sem- Semester, **DSC-** Department Specific Course, **DSE-** Department Specific Elective, **T-** Theory, **P-** Practical, **CC-**Cocurricular **RM-** Research Methodology, **OJT-** On Job Training, **FP-** Field Project, **Int-** Internship, **RP-** Research Project,

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

F. Y. B. Sc. Statistics Course Structure

Semester	Course Module	Credit	Hours/ week	TH/ PR	Code	Title
I	DSC	2	2	TH	STA-DSC-111	Descriptive Statistics-I
	DSC	2	2	TH	STA-DSC-112	Probability and Probability Distributions-I
	DSC	2	4	PR	STA-DSC-113	Statistics Practical-I
	MIN	2	2	TH	STA-MIN-111	Basic Statistical Methods-I
	MIN	2	4	PR	STA-MIN-112	Practicals on Basic Statistical Methods-I
	OE/GE	2	2	TH	STA-OE-111	Statistical Techniques-I
	SEC	2	2	TH	STA-SEC-111	Computational Statistics using MS-Excel
	SEC	1	2	PR	STA-SEC-112	Practicals on Computational Statistics using MS-Excel
	AEC	2	2	TH	ENGs-AEC-111	English
	VEC	2	2	TH	ES -VEC-111	Environmental studies
	IKS	1	1	TH	IKS-111	Indian knowledge system
	CC	2	2	CC	NCC-CC-111 NSS-CC-111 SPT-CC-111 CUL-CC-111	NCC NSS Sports Cultural
II	DSC	2	2	TH	STA-DSC-121	Descriptive Statistics-II
	DSC	2	2	TH	STA-DSC-122	Probability and Probability Distributions-II
	DSC	2	4	PR	STA-DSC-123	Statistics Practical-II
	MIN	2	2	TH	STA-MIN-121	Basic Statistical Methods-II
	MIN	2	4	PR	STA-MIN-122	Practicals on Basic Statistical Methods-II
	OE/GE	2	2	TH	STA-OE-121	Statistical Techniques-II
	SEC	2	2	TH	STA-SEC-121	Data Analysis using R
	SEC	1	2	PR	STA-SEC-122	Practicals on Data Analysis using R
	AEC	2	2	TH	ENGs-AEC-121	English
	VEC	2	2	TH	CI-VEC-121	Constitution of India
	IKS	1	1	TH	IKS-121	Indian knowledge system
	CC	2	2	CC	NCC-CC-121 NSS-CC-121 SPT-CC-121 CUL-CC-121	NCC NSS Sports Cultural

DSC : Department-Specific Core course
DSE : Department-Specific elective
OE : Generic/ Open elective
SEC : Skill Enhancement Course
MIN : Minor course
AEC : Ability Enhancement Course
VEC : Value Education Courses

ENG : English
ES : Environmental studies
CI : Constitution of India
IKS : Indian Knowledge System
CC : Co-curricular course
TH : Theory
PR : Practical

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. while 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.

- External practical examination of SEC will be of 25 marks and there will be no internal exam for SEC practical.

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.

F.Y.B.Sc
Semester I
STA-DSC-111: Descriptive Statistics-I

Total Hours: 30

Credits: 2

Course objectives	- To provide knowledge about various data types and presentation of data - To make students aware about the historical development of statistics in India - To specify the scope of measures of central tendency - To specify the scope of measures of dispersion	
Course outcomes	After successful completion of this course, students are expected to: - Understand about the representation of data in a neat, compact and clear form - Explore about the various Statistical institutes and organizations: ISI, NSS, Bureau of Economics and Statistics in States, Indian Institute of Population Sciences (IIPS) - Compute and interpret measures of central tendency - Compute and interpret measures of dispersion	
Unit	Contents	Hours
Unit I	Statistics and Presentation of Data - Meaning of Statistics: numerical information, science, decision making science, general definition of statistics as science. - Scope of Statistics: In the field of Industry, Biological Sciences, Medical Sciences, Economics Sciences, Social Sciences, Management Sciences, Agriculture, Insurance, Information Technology, Education and Psychology. - Limitations of statistics. - Population, statistical population, census, sample, sampling. - Objectives of sampling. Advantages of sampling over census. - Methods of sampling: Simple random sampling with and without replacement, Stratified sampling and Systematic sampling. Illustrations from real life situations. - Meaning of data, raw data, qualitative and quantitative data. - Attributes and Variables, continuous and discrete variables. - Primary data and Secondary data, Sources of secondary data. - Measurement scales: nominal, ordinal, ratio and interval scales. - Tabulation: Meaning of table, Parts of table and Construction of table. - Frequency distribution: Meaning of frequency, class, exclusive and inclusive classes, open-end classes, class width, mid-value, class boundaries and limit, relative frequency. - Cumulative frequency distribution: less than, more than type. Guidelines for construction of classes. Histogram (equal & unequal classes) and Pareto diagram.	8
Unit II	Indian Knowledge System in Statistics - Introduction to the Indian Knowledge System and its relevance in Statistics - Historical overview of statistics in India - Introduction to statistical surveys in India and their significance - Statistical institutes and organizations: ISI, NSS, CSO, Bureau of Economics and Statistics in Maharashtra, Indian Institute of Population Sciences (IIPS). - Contribution of ISI to statistical research and education in India - Notable statisticians and their contributions (Indian Perspective) - Dr. P. C. Mahalanobis, Dr. P. V. Sukhatme, Dr. V. S. Huzurbazar,	7

	Dr. C. R. Rao	
Unit III	Measures of Central Tendency • Meaning of central tendency of data, objectives, and requirements of a good measure of Central Tendency. • Arithmetic mean (A.M.): Definition, effect of change of origin and scale, sum of deviations from A.M., combined mean for k groups, merits and demerits. Weighted A.M. • Geometric mean (G.M.): Definition, merits, demerits and its uses. • Harmonic Mean (H.M.): Definition, merits and demerits, uses • Median: Definition, computation formula (without derivation), graphical method of determining median, merits and demerits, • Mode: Definition, computation formula (without derivation), graphical method of determining median, merits and demerits, • $A.M. > G.M. > H.M.$ (for 2 and 3 values) • Use of appropriate measure of central tendency in different situation. • Partition values:-Quartiles, deciles, & percentiles (Definition and Computation for ungrouped and grouped data). Box plot. • Examples and problems.	8
Unit IV	Measures of Dispersion • Meaning of Dispersion of data and objective. Requirements of a good measure of dispersion. • Range .Definition, Merits and Demerits, uses. • Quartile Deviation (Q.D.): Definition, computation, merits and demerits. • Mean deviation (M.D.), Definition, computation, merits and demerits Minimal Property of Mean Deviation without proof. • Definition of Standard deviation and variance with computation, Properties of variance and Standard Deviation i) Combined Variance and Standard deviation for two groups (with proof) and its extension for k groups ii) Effect of change of origin and scale iii) $S.D. \geq M.D.$ • Absolute and relative measures of dispersion: Coefficient of range, Coefficient of Q.D., Coefficient of M.D., Coefficient of variation (C.V.), Uses of C.V. • Examples and problems.	7
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. • 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. • Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. • Snedecor G. W. and Cochran W. G. (1989). Statistical Methods, Eighth Ed. East-West Press. • Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996): Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.	

F.Y.B.Sc
Semester I
STA-DSC-112: 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 - To make students aware about univariate probability distribution	
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 (i) $P(A') = 1 - P(A)$ (ii) If $A \subseteq B$, then $P(A) \leq P(B)$ (iii) $P(\cup_{i=1}^n A_i) \leq \sum_{i=1}^n P(A_i)$, $n \geq 2$ - Examples and problems.	10
Unit III	Conditional Probability and Independence Independence of events, pair wise and mutual independence for three events.	7

	• 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.	
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.	

F.Y.B.Sc
Semester I
STA-DSC-113: Statistics Practical-I

Total Hours: 60

Credits: 2

Course Objectives	- To familiarize students with MS-Excel for statistical analysis. - To explore various methods of drawing sample using MS-Excel. - To explain computation of various measures of central tendency and dispersion using MS-Excel. - To enhance skills in computing probabilities using MS-Excel.	
Course Outcomes	After successful completion of this course, students are expected to: - Draw random sample using sampling methods - Construct tables and frequency distributions - Compute measures of central tendency and dispersion - Solve problems on probability and probability distributions	
Sr. No.	Contents	Hours
1	Drawing random sample using SRSWR, SRSWOR	4
2	Drawing random sample using Systematic sampling and Stratified sampling	4
3	Diagrammatic representation of data	4
4	Graphical representation of data	4
5	Construction of tables	4
6	Construction of frequency distributions	4
7	Measures of central Tendency I	4
8	Measures of central Tendency II	4
9	Measures of dispersion I	4
10	Measures of dispersion II	4
11	Problems based on probability I	4
12	Problems based on probability II	4
13	Problems based on univariate probability distributions I	4
14	Problems based on univariate probability distributions II	4
15	Data analysis	4
Study Resources	- Nigam M. (2023). Data Analysis with Excel, BPB Publications, New Delhi. - 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. - 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. • Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. • Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press.	
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F.Y.B.Sc

Semester I

STA-MIN-111: Basic Statistical Methods-I

Total Hours: 30

Credits: 2

Course objectives	• To introduce students to various data types and presentation of data • To enable students to explore and analyze the applications of measures of central tendency and dispersion • To introduce concept of sample space and events • To facilitate students in understanding the fundamentals of probability and probability computation	
Course outcomes	After successful completion of this course, students are expected to: • Understand about the collection of the data and methods of sampling • Compute and interpret measures of central tendency and dispersion • Understand the concepts of Sample space and events • Understand the concept of Probability and probability axioms	
Unit	Contents	Hours
Unit I	Statistics and Presentation of Data • Definition, Importance, Scope and Limitations of Statistics. • Population, statistical population, census, sample, sampling. • Objectives of sampling. Advantages of sampling over census. • Methods of sampling: Simple random sampling with and without replacement, Stratified sampling and Systematic sampling. Illustrations from real life situations. • Meaning of data, Raw data, and Qualitative and Quantitative data. • Attributes and Variables, continuous and discrete variables. • Primary data and Secondary data, Sources of secondary data. • Measurement scales: nominal, ordinal, ratio and interval scales. • Tabulation: Meaning of table, Parts of table and Construction of table. • Frequency distribution: Meaning of frequency, class, exclusive and inclusive classes, open-end classes, class width, mid-value, class boundaries and limit, relative frequency. • Cumulative frequency distribution: less than, more than type. Guidelines for construction of classes. Histogram (equal & unequal classes) and Pareto diagram.	8
Unit II	Measures of Central Tendency and Dispersion • Meaning of central tendency of data, objectives, and requirements of a good measure of Central Tendency. • Arithmetic mean (A.M.): Definition, sum of deviations from A.M., combined mean for k groups, merits and demerits. Weighted A.M. • Median: Definition, computation formula (without derivation), graphical method of determining median, merits and demerits, • Mode: Definition, computation formula (without derivation), graphical	9

	method of determining median, merits and demerits, • Use of appropriate measure of central tendency in different situation. • Partition values:-Quartiles and Deciles (Definition and Computation for ungrouped and grouped data). Box plot. • Meaning of Dispersion of data and objective. Requirements of a good measure of dispersion. • Range .Definition, Merits and Demerits, uses. • Quartile Deviation (Q.D.): Definition, computation, merits and demerits. • Mean deviation (M.D.), Definition, computation, merits and demerits. • Definition of Standard deviation and variance with computation. • Coefficient of variation (C.V.), Uses of C.V. • Examples and problems.	
Unit III	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 and Mutually exclusive events. • Examples and problems	5
Unit IV	Probability • Permutations 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, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$. • Following results without proof ○ $P(A') = 1 - P(A)$ ○ If $A \subseteq B$, then $P(A) \leq P(B)$ ○ $P(\cup_{i=1}^n A_i) \leq \sum_{i=1}^n P(A_i)$, $n \geq 2$ • Independence of events, pair wise and mutual independence for three events. • Conditional probability of an event • Multiplication theorem of probability (without proof) • 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. • 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.	

	• Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. • Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press. • Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996). Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.	
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F.Y.B.Sc
Semester I
STA-MIN-112: Practicals on Basic Statistical Methods-I

Total Hours: 60

Credits: 2

Course objectives	• To familiarize students with MS-Excel for statistical analysis • To teach various methods of drawing sample using MS-Excel • To equip students with the knowledge and skills to effectively compute various measures of central tendency and dispersion using MS-Excel. • To empower students with the ability to compute various probabilities using MS-Excel	
Course Outcomes	After successful completion of this course, students are expected to: • Draw random sample using sampling methods • Construct tables and frequency distributions • Compute measures of central tendency and dispersion • Solve problems on probability	
Sr. No.	Contents	Hours
1	Introduction to MS Excel I	4
2	Introduction to MS Excel II	4
3	Drawing random sample using SRSWR, SRSWOR	4
4	Drawing random sample using Systematic sampling and Stratified sampling	4
5	Construction of tables	4
6	Construction of frequency distributions	4
7	Diagrammatic representation of data	4
8	Graphical representation of data	4
9	Measures of central Tendency I	4
10	Measures of central Tendency II	4
11	Measures of dispersion I	4
12	Measures of dispersion II	4
13	Problems based on probability I	4
14	Problems based on probability II	4
15	Data Analysis	4

Study Resources	• Nigam M. (2023). Data Analysis with Excel, BPB Publications, New Delhi. • 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. • 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. • Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. • Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press.	
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F.Y.B.Sc
Semester I
STA-OE-111: Statistical Techniques-I

Total Hours: 30

Credits: 2

Course objectives	• To develop understanding of the concept of sample, population and sampling • To make students aware about measures of central tendency and dispersion • To explore concept of bivariate data and correlation • To explain linear and nonlinear regression	
Course outcomes	After successful completion of this course, students are expected to: • Understand about the collection of the data, condensation and summarization into a compact form • Compute and interpret measures of central tendency and dispersion • Study correlation between two variables • Use regression lines	
Unit	Contents	Hours
Unit I	Statistics and Presentation of Data • Definition, Importance, Scope and Limitations of Statistics. • Population, statistical population, census, sample, sampling. • Objectives of sampling. Advantages of sampling over census. • Methods of sampling: Simple random sampling with and without replacement, Stratified sampling and Systematic sampling. Illustrations from real life situations. • Meaning of data, Raw data, and Qualitative and Quantitative data. • Attributes and Variables, continuous and discrete variables. • Primary data and Secondary data, Sources of secondary data. • Measurement scales: nominal, ordinal, ratio and interval scales. • Tabulation: Meaning of table, Parts of table and Construction of table. • Frequency distribution: Meaning of frequency, class, exclusive and inclusive classes, open-end classes, class width, mid-value, class boundaries and limit, relative frequency.	8

	Cumulative frequency distribution: less than, more than type. Guidelines for construction of classes. Histogram (equal & unequal classes) and Pareto diagram.	
Unit II	Measures of Central Tendency and Dispersion - Meaning of central tendency of data, objectives, and requirements of a good measure of Central Tendency. - Arithmetic mean (A.M.): Definition, sum of deviations from A.M., combined mean for k groups, merits and demerits. Weighted A.M. - Median: Definition, computation formula (without derivation), graphical method of determining median, merits and demerits, - Mode: Definition, computation formula (without derivation), graphical method of determining median, merits and demerits, - Use of appropriate measure of central tendency in different situation. - Partition values:-Quartiles and Deciles (Definition and Computation for ungrouped and grouped data). Box plot. - Meaning of Dispersion of data and objective. Requirements of a good measure of dispersion. - Range .Definition, Merits and Demerits, uses. - Quartile Deviation (Q.D.): Definition, computation, merits and demerits. - Mean deviation (M.D.), Definition, computation, merits and demerits. - Definition of Standard deviation and variance with computation. - Coefficient of variation (C.V.), Uses of C.V. - Examples and problems.	7
Unit III	Correlation - Meaning of correlation between two variables, positive & negative correlation, - Scatter diagram, Construction of scatter diagram and interpretation. - Product moment correlation (Karl Pearson's correlation coefficient) and its properties, interpretation.(without proof) - Rank correlation: Spearman's rank correlation coefficient. - Examples and Problems	8
Unit IV	Regression - Meaning of regression, concept of linear and non-linear regression. - Concept of method of least squares. - Linear regression: Fitting of lines of regression by method of least squares. - Regression coefficients and their properties (without proof). - Coefficient of determination. - Examples and Problems	7
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. - 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. - Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. - Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed.	

	East-West Press. • Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996). Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.	
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F.Y.B.Sc
Semester I
STA-SEC-111: Computational Statistics using MS-Excel

Total Hours: 30

Credits: 2

Course objectives	- To introduce MS-Excel for statistical computation - To acquaint students with MS-Excel built-in functions - To explore use of various graphical and diagrammatic techniques and interpretation. - To develop skills to compute and interpret various statistical measures in excel.	
Course outcomes	After successful completion of this course, students are expected to: - Understand the basic concepts and features of Microsoft Excel - Apply formulas and functions to perform calculations and data analysis - Create charts and graphs to visualize and present data effectively - Solve statistics problems using MS-Excel	
Unit	Contents	Hours
Unit I	Getting Started with Excel - Workbook and Worksheets - Navigation with Keyboard - Tabs and Ribbons - File Menu - Excel Options - Create a New Workbook, Print and Save - Understanding Worksheet Basics - Protecting Excel Workbook and Worksheet - Importing Data into Excel - Exporting Data from Excel	8
Unit II	Formulas and Functions - Understanding Formulas - Operators in Formula - Defined Names - Calculations - Functions in Formula - Logical Functions - Summarizing Functions - Text Function - Lookup and Reference functions - Data and Time Function - Maths Functions - Statistical Functions - Problems and Examples	9
Unit III	Visualization and Presentation of Data Diagrammatic representation of statistical data: simple and subdivided bar diagrams	5

	• Multiple bar diagram • Pie diagram • Graphical representation of data: Histogram • Frequency curve and ogive curves	
Unit IV	Statistical Applications • Construction of frequency distribution • Computation of mean, median and mode • Computation of partition values • Determination of measures of dispersion • Computation of probabilities • Problems and Examples	8
Study Resources	• Nigam M. (2023). Data Analysis with Excel, BPB Publications, New Delhi. • Ash N. S. (2009). Data Analysis using Microsoft Excel, Published by EXCEL BOOKS, New Delhi. • Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. • Cornell P. (2005). Beginning Excel What-If Data Analysis Tools, Apress, USA.	

**F.Y.B.Sc
Semester I**

STA-SEC-112: Practicals on Computational Statistics using MS-Excel

Total Hours: 30

Credits: 1

Course objectives	• To familiarize about spreadsheets. • To make aware about various formulas and functions. • To introduce sorting and filtering of data. • To develop skills in creating graphs and charts.	
Course Outcomes	After successful completion of this course, students are expected to: • Create and format spreadsheet • Perform computations using MS-Excel • Use built-in functions • Compute summary statistics using statistical functions	
Sr. No.	Contents	Hours
1	Creating and Formatting a Basic Spreadsheet	4
2	Performing Simple Calculations	4
3	Sorting and Filtering Data	4
4	Data Validation and Conditional Formatting	4
5	Working with Formulas and Logical Functions	4
6	Working with statistical functions	4
7	Real Life Data Analysis with Excel Tools	4

Study Resources	• Nigam M. (2023). Data Analysis with Excel, BPB Publications, New Delhi. • Ash N. S. (2009). Data Analysis using Microsoft Excel, Published by EXCEL BOOKS, New Delhi. • Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. • Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press.	
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F.Y.B.Sc
Semester II
STA-DSC-121: Descriptive Statistics-II

Total Hours: 30

Credits: 2

Course objectives	- To explain measures of skewness and Kurtosis - To explore the concept of bivariate data and correlation - To make students acquainted with linear and nonlinear regression - To develop understanding of theory of attributes	
Course outcomes	After successful completion of this course, students are expected to: - Compute and interpret measures of skewness and kurtosis - Understand the concepts of Bivariate data, Correlation, types of correlation - Fit regression lines for forecasting - Apply theory of attributes in real life situation	
Unit	Contents	Hours
Unit I	Moments, Skewness and Kurtosis - Raw & central moments; Effect of change of origin and scale on central moments. - Moments about an arbitrary constant for grouped and ungrouped data. - Relation between central moments and raw moments (up to 4-th order). - Concept of Skewness of a frequency distribution; Positive and negative skewness, symmetric frequency distribution - Bowley's coefficient of skewness, Limits of Bowley's coefficient of skewness - Karl Pearson's coefficient of skewness. - Kurtosis: Meaning, Types of Kurtosis: -leptokurtic, mesokurtic & platykurtic. - Measures of skewness and kurtosis based on moments. - Examples and Problems.	7
Unit II	Correlation - Bivariate data. Ungrouped and grouped. - Meaning of correlation between two variables, positive & negative correlation, - Scatter diagram, Construction of scatter diagram and interpretation. - Covariance between two variables: Definition, Effect of change of origin and scale - Product moment correlation (Karl Pearson's correlation coefficient) and its properties, interpretation. - Rank correlation: Spearman's rank correlation coefficient, derivation of the formula of rank correlation coefficient (without ties). Rank correlation with ties - Simple numerical examples and problems.	8
Unit III	Regression - Meaning of regression, concept of linear and non-linear regression. - Concept of method of least squares. - Linear regression: Fitting of lines of regression by method of least squares. - Regression coefficients and their properties (statement and proof). - Angle between the two lines of regression.	9

	- Standard error of regression estimate. - Explained and unexplained variation and coefficient of determination. - Non-linear regression: Fitting of non-linear curves of the following type (i) $y = a + bx + cx^2$ (ii) $y = ax^b$ (iii) $y = ab^x$ - 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.	6
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. - 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. - Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. - Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press. - Montgomery, D. C; Peck, E. A.; Vining, G. G. (2006). Introduction to Linear Regression Analysis, John Wiley and Sons. - Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996). Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.	

F.Y.B.Sc
Semester II
STA-DSC-122: 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. - To provide real-life scenarios where probability distributions are applicable.
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.	4
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	14

	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 problems.	
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.	

F.Y.B.Sc
Semester II
STA-DSC-123: Statistics Practical-II

Total Hours: 60

Credits: 2

Course objectives	• To teach about computation and interpretation of correlation coefficient using MS-Excel. • To familiarize curve fitting • To teach students how to form probability distributions using MS-Excel. • To provide real-life scenarios where standard distributions is applicable.	
Course Outcomes	After successful completion of this course, students are expected to: • Analyse bivariate data • Solve problems on bivariate probability distributions • Simulate data from standard distributions • Apply standard distributions in real life situations	
Sr. No.	Contents	Hours
1	Measures of skewness and kurtosis	4
2	Scatter diagram, correlation coefficient (ungrouped data)	4
3	Correlation coefficient for bivariate frequency distribution.	4
4	Rank correlation coefficient	4
5	Fitting of lines of regression	4

6	Fitting of second degree curve and exponential curve	4
7	Problems on bivariate probability distributions	4
8	Fitting of binomial distribution	4
9	Applications of binomial distribution	4
10	Fitting of Poisson distribution	4
11	Applications of Poisson distribution	4
12	Model sampling from uniform, binomial and Poisson distribution.	4
13	Problems based on univariate probability distributions I	4
14	Problems based on univariate probability distributions II	4
15	Identification of probability distributions	4
Study Resources	• Nigam M. (2023). Data Analysis with Excel, BPB Publications, New Delhi. • 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. • 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. • Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. • Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press.	

F.Y.B.Sc
Semester II
STA-MIN-121: Basic Statistical Methods-II

Total Hours: 30

Credits: 2

Course objectives	• To make students aware about measures of skewness and Kurtosis • To make students acquainted with the concept of bivariate data and correlation • To introduce linear and nonlinear regression • To develop a understanding of standard probability distributions	
Course outcomes	After successful completion of this course, students are expected to: • Compute and interpret measures of skewness and kurtosis • Understand the concepts of Bivariate data, Correlation, types of correlation • Fit regression lines for forecasting • Apply standard distributions in real life situation	
Unit	Contents	Hours

Unit I	Moments, Skewness and Kurtosis - Raw & central moments. - Moments about an arbitrary constant for grouped and ungrouped data. - Relation between central moments and raw moments (up to 4-th order). - Concept of Skewness of a frequency distribution; Positive and negative skewness, symmetric frequency distribution - Bowley's coefficient of skewness, Limits of Bowley's coefficient of skewness - Karl Pearson's coefficient of skewness. - Kurtosis: Meaning, Types of Kurtosis: leptokurtic, mesokurtic & platykurtic. - Measures of skewness and kurtosis based on moments. - Examples and Problems.	7
Unit II	Correlation - Bivariate data. Ungrouped and grouped. - Meaning of correlation between two variables, positive & negative correlation, - Scatter diagram, Construction of scatter diagram and interpretation. - Covariance between two variables. - Product moment correlation (Karl Pearson's correlation coefficient) and its properties, interpretation. - Rank correlation: Spearman's rank correlation coefficient, derivation of the formula of rank correlation coefficient (without ties). Rank correlation with ties - Simple numerical examples and problems.	8
Unit III	Regression - Meaning of regression, concept of linear and non-linear regression. - Concept of method of least squares. - Linear regression: Fitting of lines of regression by method of least squares. - Regression coefficients and their properties (statement only). - Standard error of regression estimate. - Explained and unexplained variation and coefficient of determination. - Non-linear regression: Fitting of non-linear curves of the following type (i) $y = a + bx + cx^2$ (ii) $y = ax^b$ (iii) $y = ab^x$ - Examples and problems. NOTE: DERIVATIONS ARE NOT EXPECTED	7
Unit IV	Some Standard Discrete Probability Distributions - Concept of random variable and standardized random variable. - Definition of expectation of a random variable, expectation of a function of a random variable. Concept of univariate probability distribution. - Definition of raw and central moments of univariate probability distributions and their interrelations. - 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.	8

	- 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 $p = 0.5$, $p > 0.5$, $p < 0.5$), 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 and additive property. 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 problems. NOTE: DERIVATIONS ARE NOT EXPECTED	
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. - 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. - Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. - Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press. - Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1996). Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd. - 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.	

F.Y.B.Sc
Semester II
STA-MIN-122: Practicals on Basic Statistical Methods-II

Total Hours: 60

Credits: 2

Course objectives	- To introduce computation of measures of skewness & kurtosis with Excel - To teach students how to compute and interpret correlation coefficient using MS-Excel - To familiarize students with curve fitting - To explain with illustrations how to fit standard distributions
Course Outcomes	After successful completion of this course, students are expected to: - Analyse bivariate data - Fit standard distribution for given data set - Simulate data from standard distributions

	• Apply standard distributions in real life situations	
Sr. No.	Contents	Hours
1	Measures of skewness and kurtosis I	4
2	Measures of skewness and kurtosis II	4
3	Scatter diagram, correlation coefficient (ungrouped data)	4
4	Correlation coefficient for bivariate frequency distribution.	4
5	Rank correlation coefficient I	4
6	Rank correlation coefficient II	4
7	Fitting of lines of regression	4
8	Fitting of second degree curve and exponential curve	4
9	Fitting of binomial distribution	4
10	Applications of Uniform distribution	4
11	Applications of binomial distribution	4
12	Fitting of Poisson distribution	4
13	Applications of Poisson distribution	4
14	Model sampling from uniform, binomial and Poisson distribution.	4
15	Identification of distribution	4
Study Resources	• Nigam M. (2023). Data Analysis with Excel, BPB Publications, New Delhi. • 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. • 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. • Sarma, K. V. S. (2010). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi. • Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press.	

F.Y.B.Sc
Semester II
STA-OE-121: Statistical Techniques-II

Total Hours: 30

Credits: 2

Course objectives	- To acquaint students with the concept of death rate and birth rate - To explain procedure of construction of life table - To present applications of Index numbers - To teach students how to apply decision theory in real life situations	
Course outcomes	After successful completion of this course, students are expected to: - Compute measures of fertility and mortality - Construct life table - Compute index numbers - Apply decision theory	
Unit	Contents	Hours
Unit I	Demography - Vital Statistics, uses, measurement of population. - Measures of mortality: crude death rate, specific death rates (age wise, sex wise). - Standardized death rates (based on age-specific death rates) direct and indirect method, comparative study of these measures, infant mortality rate. - Measures of fertility, Crude birth rate, specific rate (age and sex), total fertility rate, - Comparative study of these measures. - Reproduction rates: G.R.R., N.R.R., comparison and interpretation. - Simple numerical problems.	10
Unit II	Life Tables - Introduction and Meaning - Construction of a life table - Uses of a life table - Numerical Problems	5
Unit III	Index Numbers - Meaning and utility of index numbers - Basic problems involved in the construction of index numbers - Weighted and unweighted index numbers - Various types of index numbers - Construction of consumer price index number - Limitations of index numbers - Examples and problems.	8
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.	7

	- Decision under risk: Decision rules (i) Expected value criterion and (ii) Expected opportunity loss criterion. - Examples and problems.	
Study Resources	- Gupta S.C. and Kapoor V. K. (2017). Fundamentals of Applied Statistics. S. Chand and Sons, New Delhi. - Parimal Mukhopadhyay. (2005). Applied Statistics. Books and Allied P Ltd, Kolkata. - Kanti Swarup, Gupta P. K. and Man Mohan.(2004). Operations Research, S. Chand & Sons - Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-West Press.	

F.Y.B.Sc
Semester II
STA-SEC-121: Data Analysis using R

Total Hours: 30

Credits: 2

Course objectives	- To teach about installation of R software - To focus on developing programming skills using R - To familiarize with R graphics - To provide knowledge about using R for statistical applications	
Course outcomes	After successful completion of this course, students are expected to: - Know how to download and install R software. - Know various R packages with their utility. - Understand data structures in R. - Use R software for exploratory data analysis.	
Unit	Contents	Hours
Unit I	Introduction to 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 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.	8

	• Precedence rule of arithmetic operators and logical operators.	
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 data frame, 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. • Examples and Problems	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. 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 Golemund, 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. Manning Publications.	

F.Y.B.Sc
Semester II
STA-SEC-122: Practicals on Data Analysis using R

Total Hours: 30

Credits: 1

Course objectives	- To make students aware about data objects and built-in functions in R - To illustrate approach to represent data using R. - To train in the skills of computation of summary statistics using R. - To demonstrate the process of creating graphs and charts.	
Course Outcomes	After successful completion of this course, students are expected to: - Understand how to import and export data in R - Know data structures in R. - Use R software for statistical computations. - Use R software for exploratory data analysis.	
Sr. No.	Contents	Hours
1	Introduction to R software.	4
2	Data import and Export	4
3	Data objects and built in functions used in R.	4
4	Diagrammatic representation of data.	4
5	Graphical representation of data.	4
6	Computation of measures of central tendency.	4
7	Computation of measures of dispersion.	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 - Maindonald, J. and Braum, J. (2007). Data Analysis and Graphics Using R: An example-based approach. 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.	