Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce, and Science College, Ahmednagar (Autonomous)
(Affiliated to Savitribai Phule Pune University, Pune)

National Education Policy (NEP) Choice Based Credit System (CBCS)

Programme Skeleton and Syllabus of
B.Sc. Statistics (Major)

Implemented from

Academic Year 2023-24

Credit Distribution: B.Sc. Statistics (Major) including Minor and OE and other courses.

	Type of Courses	III Yr	IV Yrs (Honours)	IV Yrs Research
Major Statistics	Discipline-Specific Courses (DSC)	46	74	66
	Discipline Specific Elective (DSE)	08	16	16
	Skill Enhancement Courses (SEC)	06	06	06
	Vocational Skill Courses (VSC)	08	08	08
	On-Job Training (OJT)	04	08	04
	Field Project (FP)	04	04	04
	Community Engagement and Service (CEP)	02	02	02
	Research project	00	00	12
	Research Methodology	00	04	04
	Indian Knowledge System	02	02	02
	Total (I, II and III Year)	80	124	124
Minor	Minor	20	20	20
Other Courses	Open Elective (OE)/ Multidisciplinary Courses	12	12	12
	Co-Curricular Courses	08	08	08
	Ability Enhancement Courses	08	08	08
	Value Education Courses	04	04	04
	Total	132	176	176

B. Sc. Programme Framework: Credit Distribution

Year	Semester	Level	Major											Minor	OE	CC	AEC	VEC	Total
			DSC		DSE		SEC		VSC		FP/OJT/IN/CEP		IKS							
			T	P	T	P	T	P	T	P	T	P							
I	I	4.5	T	P	T	P	T	P	T	P	T	P		T/P	-	-	-	-	-
I	II	4.5	4	2	-	-	-	2	-	-	-	-	2	03	3	2	2	2	22
			6	-	-	-		2	-	2	-	-		03	3	2	2	2	22
Exit Option: Award of UG Certificate in Major with 44 credits and an additional 4 credit core NSQF course /Internship or Continue with Major and Minor																			
II	III	5.0	6	2	-	-		2	-	-	-	2		03	3	2	2	-	22
II	IV	5.0	6	2	-	-		-	-	2	-	2		03	3	2	2	-	22
Exit Option: Award of UG Diploma in Major with 88 credits and an additional 4 credit core NSQF course /Internship or Continue with major and minor																			
III	V	5.5	8	2	2	2		-	-	-	2		2	04	-	-	-	-	22
III	VI	5.5	6	2	2	2		-	-	-	2		4	04	-	-	-	-	22

Year	Sem	Level	DSC T	DSC P	DSE T	DSE P	SEC	VSC	FP/OJT/IN/CEP	IKS	Minor	OE	CC	AEC	VEC	Total
	Exit Option: Award of UG Degree in Major and Minor with 132 credits or continue with Major for a 4-year Degree															
IV	VII	6.0	8	6	2	2	RM-4	-	-	-	-	-	-	-	-	22
IV	VIII	6.0	8	6	2	2	-	-	4	-	-	-	-	-	-	22
			Four Year UG Degree(Honours) with Major and Minor with 176 credits												
IV	VII	6.0	6	4	2	2	RM-4	-	4	-	-	-	-	-	-	22
IV	VIII	6.0	6	4	2	2	-	0	8	-	-	-	-	-	-	22
			Four Year UG Degree (Honours with Research) with Major and Minor with 176 credits												

B. Sc. Programme Framework: Course Distribution

Year	Semester	Level	Major: DSC T	DSC P	DSE T	DSE P	SEC T	SEC P	VSC T	VSC P	FP/OJT/IN/CEP T	FP P	IKS	Minor T	Minor P	OE	CC	AEC	VEC	Total
I	-	-	T	P	T	P	T	P	T	P	T	P		T	P	-	-	-	-	-
I	I	4.5	2	1	-	-	-	1	-	-	-	-	1	1		1	1	1	1	10
	II	4.5	2	-	-	-	-	1	-	1	-	-		1		1	1	1	1	09
			Exit Option: Award of UG Certificate in Major with 44 credits and an additional 4 credit core NSQF course /Internship or Continue with major and minor																		
II	III	5.0	2	1	-	-	-	1	-	-	-	1		1		1	1	1	-	09
II	IV	5.0	2	1	-	-	-	-	-	1	-	1		1		1	1	1	-	09
			Exit Option: Award of UG Diploma in Major with 88 credits and an \additional 4 credit core NSQF course /Internship or Continue with major and minor																		
III	V	5.5	2	1	1	1	-	-	-	1	-	1		1		-	-	-	-	08
III	VI	5.5	2	1	1	1	-	-	-	1	-	1		1		-	-	-	-	08
			Exit Option: Award of UG Degree in Major and Minor with 132 credits or continue with Major for a 4-year Degree																		

IV	VII	6.0	3	3	1	1	0	1	-	-	-	-		-	-	-	-	-	-	09
IV	VIII	6.0	3	3	1	1	-	-	-	-	-	1		-	-	-	-	-	-	09
Four Year UG Degree(Honours) with Major and Minor with 176 credits																				
IV	VII	6.0	2	2	1	1	0	1	-	-	-	1		-	-	-	-	-	-	08
IV	VIII	6.0	2	2	1	1	-	-	-	-	-	1		-	-	-	-	-	-	07
Four Year UG Degree (Honours with Research) with Major and Minor with 176 credits																				

Programme Framework (Course Distribution): B.Sc. Statistics (Major)

Year	Semester	Level	DSC T	DSC P	DSE T	DSE P	SEC T	SEC P	VSC T	VSC P	FP/OJT/IN/CEP/PR T	FP/OJT/IN/CEP/PR P	IKS T	Total T	Total P/PR
I	I	4.5	2	1	-	-	-	1	-	-	-	-	01	03	02
I	II	4.5	2	-	-	-	1	-	1	-	-	-		02	02
II	III	5.0	2	1	-	-	1	-	-	-	-	1		02	03
II	IV	5.0	2	1	-	-		-	1	-	-	1		02	03
III	V	5.5	2	1	1	1	-	-	-	1		1		03	04
III	VI	5.5	2	1	1	1	-	-	-	1		1		03	04
B.Sc. Honours															
IV	VII	6.0	3	3	1	1	RM-1		-	-	-	-		05	04
IV	VIII	6.0	3	3	1	1	-	-	-	-	-	1		04	05
B.Sc. Honours with Research															
IV	VII	6.0	2	2	1	1	RM-1		-	-	-	1		04	04
IV	VIII	6.0	2	2	1	1	-	-	-	-	-	1		03	04

Programme Framework (Credit Distribution): B.Sc. Statistics (Major)

Year	Semester	Level	Major											Total
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP/R P		IKS	
			T	P	T	P	T	P	T	P	T	P	T	
I	I	4.5	4	2	-	-	-	2	-	-	-	-	02	10
I	II	4.5	6	-	-	-		2	-	2	-	-		10
II	III	5.0	6	2	-	-		2	-	-	-	2		12
II	IV	5.0	6	2	-	-		-	-	2	-	2		12
III	V	5.5	8	2	2	2	-	-	-	2		2		18
III	VI	5.5	6	2	2	2	-	-	-	2		4		18
IV	VII	6.0	8	6	2	2	RM-4		-	-	-	-		22
IV	VIII	6.0	8	6	2	2	-	-	-	-	-	4		22
IV	VII	6.0	6	4	2	2	RM-4	-	-	-	-	4		22
IV	VIII	6.0	6	4	2	2	-	-	-	-	-	8		22

Programme Framework (Courses and Credits): B.Sc. Statistic (Major)

	Year	Semester	Level	Course Type	Course Code	Title	Credits
1.	I	I	4.5	DSC-1	BS-ST111T	Descriptive Statistics -I	02
2.	I	I	4.5	DSC-2	BS-ST112T	Basics of Probability	02
3.	I	I	4.5	DSC-3	BS-ST113P	Practical –I (Based on BS-ST111T)	02
4.	I	I	4.5	SEC-1	BS-ST114P	Computational Tool-I (MS-Excel)	02
5.	I	I	4.5	IKS-1	BS-ST115T	Statistical Heritage and Systems in India	02
6.	I	II	4.5	DSC-4	BS-ST121T	Descriptive Statistics –II	03
7.	I	II	4.5	DSC-5	BS-ST122T	Discrete Probability Distributions and Index Number	03
8.	I	II	4.5	SEC-2	BS-ST123P	Practical –II (Based on BS-ST121T)	02
9.	I	II	4.5	VSC-1	BS-ST124P	Computational Tool –II (Introduction to R)	02
10.	II	III	5.0	DSC-6	BS-ST231T	Continuous Probability Distributions-I	03
11.	II	III	5.0	DSC-7	BS-ST232T	Discrete Probability Distributions and Demography	03
12.	II	III	5.0	DSC-8	BS-ST233P	Practical-III	02

						(Based on BS-ST231T and BS-ST232T)	
13.	II	III	5.0	SEC-3	BS-ST234P	Computational Tool–III (Turbo C)	02
14.	II	III	5.0	FP-01	BS-ST235P	Field Project	02
15.	II	IV	5.0	DSC-9	BS-ST241T	Continuous Probability Distributions-II	03
16.	II	IV	5.0	DSC-10	BS-ST242T	Statistical Methods	03
17.	II	IV	5.0	DSC-11	BS-ST243P	Practical-IV (Based on BS-ST241T and BS-ST242T)	02
18.	II	IV	5.0	VSC-2	BS-ST244P	Computational Tool -IV (Introduction to Python)	02
19.	II	IV	5.0	CEP-01	BS-ST245P	Community Engagement and Service	02
20.	III	V	5.5	DSC-12	BS-ST351T	Distribution Theory	04
21.	III	V	5.5	DSC-13	BS-ST352T	Design of Experiments	04
22.	III	V	5.5	DSC-14	BS-ST353P	Practical-V (Based on BS-ST351T and BS-ST 352T)	02
23.	III	V	5.5	DSE-01	BS-ST355T	Operation Research / Actuarial Statistics	02
24.	III	V	5.5	DSE-02	BS-ST356P	Practical- VI (Based on BS-ST355T)	02
25.	III	V	5.5	VSC-3	BS-ST357P	Computational Tool-V (Data Analytics)	02
26.	III	V	5.5	FP-02	BS-ST358P	Field Project	02
27.	III	VI	5.5	DSC-15	BS-ST361T	Theory of Estimation	03
28.	III	VI	5.5	DSC-16	BS-ST362T	Testing of Hypotheses	03
29.	III	VI	5.5	DSC-17	BS-ST363P	Practical -VII (BS-ST361T and BS-ST 362T)	02
30.	III	VI	5.5	DSE-03	BS-ST364T	Sampling Theory / Statistical Ecology	02
31.	III	VI	5.5	DSE-04	BS-ST365P	Practical VIII (Based on BS-ST364T)	02
32.	III	VI	5.5	VSC-4	BS-ST366P	Computational Tool–VI (Advanced Excel)	02
33.	III	VI	5.5	OJT-01	BS-ST367P	On Job Training	04

B.Sc. Statistic (Major with Honours)

34.	IV	VII	6.0	DSC-18	BS-ST471T	Linear Algebra	03
35.	IV	VII	6.0	DSC-19	BS-ST472T	Probability Distributions	03
36.	IV	VII	6.0	DSC-20	BS-ST473T	Sampling Theory and Methods	02
37.	IV	VII	6.0	DSC-21	BS-ST474P	Practical IX	02

						(Based on BS-ST471T)	
38.	IV	VII	6.0	DSC-22	BS-ST475P	Practical X (Based on Reliability Theory)	02
39.	IV	VII	6.0	DSC-23	BS-ST476P	Practical XI (Based on BS-ST473T)	02
40.	IV	VII	6.0	DSE-05	BS-ST477T	Exploratory Multivariate Analysis/ Data Mining	02
41.	IV	VII	6.0	DSE-06	BS-ST478P	Practical XII (Based on BS-ST477T)	02
42.	IV	VII	6.0	RM-01	BS-ST479T/P	Research Methodology	04
43.	IV	VIII	6.0	DSC-24	BS-ST481T	Statistical Inference	03
44.	IV	VIII	6.0	DSC-25	BS-ST482T	Regression Analysis	03
45.	IV	VIII	6.0	DSC-26	BS-ST483T	Probability Theory	02
46.	IV	VIII	6.0	DSC-27	BS-ST484P	Practical XIII (Based on Statistical Process and Product Control)	02
47.	IV	VIII	6.0	DSC-28	BS-ST485P	Practical XIV (Based on BS-ST482T)	02
48.	IV	VIII	6.0	DSC-29	BS-ST486P	Practical XV (Based on Numerical Analysis)	02
49.	IV	VIII	6.0	DSE-07	BS-ST487T	Inferential Multivariate Analysis / Categorical Data Analysis	02
50.	IV	VIII	6.0	DSE-08	BS-ST486P	Practical XVI (Practical Based on BS-ST487T)	02
51.	IV	VIII	6.0	OJT-02	BS-ST487P	On Job Training	04

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Board of Studies in Statistics

Sr. No.	Name	Designation
1.	Dr. A. A. Kulkarni	Chairman
2.	Dr. S.D Jagtap	Member
3.	Dr. B.P. Thakur	Member
4.	Prof. S.A. Tarate	Member
5.	Dr. N.T. Shelke	Member
6.	Dr. A.K. Khamborkar	Academic Council Nominee
7.	Dr. A.J. Shivagaje	Academic Council Nominee
8.	Prof. S. V. Kawale	Vice-Chancellor Nominee
9.	Dr. S. B. Pathare	Alumni
10.	Mr. Anirudha Deshmukh	Industry Expert
11.	Dr. Vijay Narkhede	Invitee Member
12.	Dr. B.K. Thorve	Member
13.	Prof. K.B. Mane	Member
14.		

1. Prologue/ Introduction of the programme:

It is known that in economic activities are of three types, agriculture, industrial and service. In the same way the subject Statistics is a SERVICE SCIENCE having potential to address the problems in these three fields. In research application of Statistics is mandatory. In the present days, apart from traditional field of career, Data Science, Data Analytics, Data Mining, Data Visualization are the upcoming field of career for Statistics students. In these field student must have mathematical ability, statistical thinking, computer (Software and programming) knowledge and communication (Verbal and written). These points are taken into consideration to design the syllabus and examination pattern of Statistics. In addition to academics, the department takes care to arrange a series of lectures on interview skills, preparation of CV, improve communication skill and overall personality development. The students are given the task of event management so that they can practice the principles of management such as leadership, creativity, communication, time management, group activity, team work, etc. In general, through curricular, co-curricular and extra-curricular activities student in three years is developed as thought provoker, problem solver, technologically sound, with command on communication, strong self-confidence.

B. Sc. in Statistics program is of three years' duration, with semester pattern for all the three years. The important feature of the syllabus is that, all practical's form first year to third year will be conducted on computer using MS-EXCEL/ R Suit, Python programming and Tableau.

The course on Tableau will give an opportunity to learn thousands of various data presentation types and to present the complex data by easy way. The practical examinations of all courses will be on computer. In short, maximum exposure is given to students to work on computer and evaluate them on computer.

The syllabus is framed with appropriate weightage of theory, applied and skill enhancement courses. After receiving B.Sc. degree, student is expected to have minimum knowledge of various courses and student will have ability to analyze the data with relevant interpretation of results. After completion of B.Sc. honors students get maximum knowledge about statistics, so that student can handle any big data.

2. Programme Outcomes (POs)

Students enrolled in the program complete a curriculum that exposes and trains students in a full range of essential skills and abilities. They will have the opportunity to master the following objectives.

1. Student will achieve the skill of understanding the data.
2. Student will be able to develop the data collection instrument.
3. Student will have skill to write a story using data visualization.
4. Student will understand the interdisciplinary approach to correlate the statistical concepts with concepts in other subjects.
5. Student will be made aware of history of Statistics and hence of its past, present and future role as part of our culture.
6. Students will demonstrate conceptual domain knowledge of the Statistics in an integrated manner.
7. Student will play the key role in management for effective functioning.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Statistics (Major)

Title of the Course: Descriptive Statistics-I								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical					
						CIE	ESE	Total
DSC-1	BS-ST111T	02	00	02	30	15	35	50

Learning Objectives:

1. To learn the Scope of statistics in different fields.
2. To understand about data collection methods
3. To learn different techniques of data visualizations.
4. To learn the elements of descriptive statistics.

Course Outcomes (Cos):

After completion of this course:

1. Students will be aware of the variety of fields in which Statistics is used widely.
2. Students will have acquired knowledge of data collection methods.
3. Student will also gain the silent knowledge of different data types.
4. Student will be able to apply different statistical tools to solve real life situations.

Detailed Syllabus:

Unit-I	**Introduction of Statistics**	6
	Introduction to Statistics: Meaning of Statistics, Importance of Statistics, Scope of Statistics (Field of Industry, Medical Science, Economics, Social Science, Biological Science, Agriculture, Psychology, Clinical Trial, Computer Science, Insurance and finance.) Concepts of big data, properties of big data- velocity, volume, varsity.	
Unit-II	**Sampling Methods**	9
	Types of data: Primary data, Secondary data, Categorical data, directional data, Binary data, time series data, Panel data, Cross sectional data. Image, Voice, Audio, Animated images, Text and Video data Data collection methods: Census (Scope and Limitation), Sample Survey register, questionnaire, interview method Types of characteristics: Variable and Attribute, scaling methods Sampling methods: Definition of population and statistical population, sample, Finite population, Infinite population, Homogenous population, Heterogeneous population Advantages of sampling over census. Definition of sampling unit and sampling frame.	

	Sample selection ways: Non-random sampling and random sampling. Methods of achieving randomness. Sampling methods: Probability and Non probability sampling and their types (only description) Probability sampling: SRS, SRSWR, SRSWOR, Stratified, Systematic, Cluster sampling. Non-probability sampling: Judgment, Quota, Convenience, snowball sampling.	
Unit-III	**Measures of Central Tendency**	9
	Measures of Central Tendency: Concept and Definition of Central Tendency, Characteristics of good measures of Central Tendency. Types of central Tendency; Arithmetic Mean (A.M): Definition of Mean, formulae for ungrouped and grouped data (without proof), Properties of A.M., Trimmed AM, Weighted A.M. Median: Definition of Median, Formulae for ungrouped and grouped data, Graphical data representation, Partition values: Quartiles, Deciles, Percentiles, Quantiles, and their interrelationship Mode: Definition of Mode, formulae for ungrouped and grouped data. Graphical Representation. Empirical relation between mean, median and mode. Partition values: Quartiles, Deciles, Percentiles, Quantiles, and their interrelationship Geometric mean: Definition of G.M, formulae, merits and demerits. Harmonic Mean: Definition of H.M, formulae. merits and demerits of AM, Median, Mode, HM, GM, Relation between A.M, G.M and H.M Box and Whisker plot, Choice of average.	
Unit-IV	**Measures of dispersion**	6
	Measures of Dispersion: Concept and Definition of dispersion Characteristics of good measures of Dispersion. Types of Dispersion: Absolute and relative measures of dispersion Range: Definition, formula of range, for ungrouped and grouped data, merits and Demerits of range Coefficient of range Mean deviation: definition, formula. for ungrouped and grouped data Merits and demerit. Coefficient of mean deviation, minimal property of MD. Variance and Standard deviation: definition, formula. for ungrouped and grouped data. Merits and demerit, combined variance. Minimal property of variance (Mean square deviation, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation (C.V)	
	Raw moments for grouped and ungrouped data, Central moments for grouped and ungrouped, effect of change of origin and scale. Relation between central moments and raw moments, up to 4th order (without prof)	

Suggested Readings/Material:

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.
2. Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eleventh Edition, Sultan Chand and Sons Publishers, New Delhi.
3. 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.
4. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi.
5. Snedecor G. W. and Cochran W. G. (1989). Statistical Methods, Eighth Ed. East-West Press.
6. Gupta, S. C. and Kapoor, V. K. (1997). Fundamentals of Applied Statistics, 3rd Edition, Sultan Chand and Sons Publishers, NewDelhi.
7. Mukhopadhyay P. (2015). Applied Statistics,Publisher: Books & Allied (P) Ltd.
8. Agarwal, B. L. (2003). Programmed Statistics, 2nd Edition, New Age International Publishers, NewDelhi.
9. Gore Anil, Pranjape Sharayu, Kulkarni Madhav. Statistics for everyone. SIPF Acadamy Publisher, Nashik
10. Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, NewDelhi.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Statistics (Major)

Title of the Course: Basics of Probability								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-2	BS-ST112T	02	00	02	30	15	35	50

Learning Objectives:

1. To learn certain and uncertain situations.
2. To learn the concept of probability.
3. Able to understand the basic laws and axioms of probability.
4. To understand concept of random variable and their types.
5. To learn concept of probability distributions.

Course Outcomes (Cos):

After completion of this course,
1. The course will give the overall idea about the uncertain situations that are expressed in probabilistic form.
2. Statistical thinking will help one's success in life and career by quantifying uncertainty using probability.
3. Student will learn the use of probability for better decisions.
4. student will get an opportunity to collect the data related to uncertain situation and interpret the probabilities.
5. Student will able to apply basic probability principles to solve real life problems.

Unit-I	**Introduction to Probability**	9
	Basics of Probability: Counting Principles: Additive principle, multiplicative principle. Counting Rules: Permutations and combinations. Rules and relationship between Permutations and combinations (without proof). Concept of deterministic and non-deterministic models (Random experiments) Definitions of sample space and types of sample space: Sample space, Types of sample space: finite, countably infinite and uncountable. Real life examples. Definitions of Event and types of event: Event and concept of occurrence of an event Elementary event, complement of an event, certain event, impossible event, Relative complement event, Mutually exclusive events or Disjoint events (for two and three events), mutually Exhaustive events (for two and three events), mutually exclusive and exhaustive events, Partition of sample space. Algebra of events including De Morgan's rules and its representation in set theory notation.	

	Occurrence of following events (with the help of listing and Venn diagram). Complement of an event, at least one of the two given events, At least one of the three given events, None of the given two events, None of the given three events, Simultaneous occurrence of the two events, Simultaneous occurrence of the three events, Mutually exclusive events (for two and three events), Mutually exhaustive events (for two and three events), mutually exclusive and exhaustive events (for two and three events), Partition of sample space, Exactly one event out of the two events, Exactly one event out of the three events, Verification of De Morgan's rules.	
Unit-II	**Theory of Probability**	6
	Classical definition of probability and its limitations. Equiprobable and non-equiprobable sample space, classical definition of probability, Addition theorem on probability, limitations of classical definition. Situations where classical definition of probability is applicable. Axiomatic approach of probability. Axioms of Probability, Situations where axiomatic approach of probability is applicable. Addition theorem on probability and its generalization. Various results on Probability Boole's inequality. Numerical examples and problems.	
Unit-III	**Conditional Probability and Independence**	7
	Definition of independence of two events, $P(A \cap B) = P(A) * P(B)$, Pairwise independence and mutual independence for three events. Definition of conditional probability of an event. Results on conditional probability, Multiplication theorem. $P(A \cap B) = P(B)*P(A|B)$. Generalization to $P(A \cap B \cap C)$. Prior and posterior probabilities. Bayes' theorem. Applications of Bayes' theorem in real life. Concept of True positive (TP, Sensitivity), False positive (FP), True negative (TN, Specificity), False negative (FN). Numerical examples and problems	
Unit-IV	**Univariate Probability Distributions**	8
	Univariate Probability Distributions (Defined on Discrete Sample Space): Univariate probability mass function (p.m.f.): Concept and definition of a random variable. Types of random variable. Concept and definition of a discrete random variable. Probability mass function (p.m.f) and cumulative distribution function (c.d.f), F(.) of discrete random variable, properties of c.d.f., graphical representation of p.m.f. and c.d.f. Mode and median of discrete probability distribution. Numerical examples and problems.	
	Mathematical Expectation (Univariate Random Variable): Definition of expectation (mean) of a random variable, expectation of a function of a random variable, m.g.f. and c.g.f. properties of m.g.f. and c.g.f. Definitions of variance, standard deviation(s.d.) and coefficient of variation(C.V.) of univariate probability distribution, effect of change of origin and scale on mean, variance and s.d. Definition of raw, central and factorial raw moments of univariate probability distribution, and their interrelations (without proof). Coefficients of skewness and kurtosis based on moments. Numerical examples and problems.	

Suggested Readings/Material:

1. Agarwal B. L. (2003). Programmed Statistics, second edition, New Age International Publishers, New Delhi.
2. Devore/ Peck: Statistics (The Exploration and Analysis of Data), Duxbury.
3. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
4. Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
5. Hogg, R. V. and Craig R. G. (1989). Introduction to Mathematical Statistics, Ed. 4. MacMillan Publishing Co., New York.
6. Mayer, P. (1972). Introductory Probability and Statistical Applications, Addison Wesley Publishing Co., London.
7. Statistical Methods: Welling, Khandeparkar, Pawar, Naralkar Manan Publications. First edition.
8. Theory and Problems of Statistics: Spiegel M.R. – Schaums Publishing Series, Tata Mcgraw - Hill. First edition
9. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia)
10. Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics. - Sultan & Chand
11. Mukhopadhyay P. (2006): Probability. Books and Allied (P) Ltd

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Statistics (Major)

Title of the Course: Practical-I (Based on BS-ST111T)								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical					
						CIE	ESE	Total
DSC-3	BS-ST113P	00	02	02	60	15	35	50

List of Practical:

Sr. No.	Title of the Practical	No. of Practical's
1	Diagrammatic Representation of Data	1
2	Graphical Representation of Data	1
3	Sampling Methods	1
4	Classification and Tabulation	2
5	Measures of Central Tendency for ungrouped data	1
6	Measures of Central Tendency for grouped data	1
7	Measures of Dispersion for ungrouped data	1
8	Measures of Dispersion for grouped data	1
9	Computation of Moments for ungrouped and grouped data.	2
10	Project (Equivalent to 3 Practical)	3
	Total	**14**

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Statistics (Major)

Title of the Course: Computation Tool -I (MS-Excel)								
Year: I				**Semester: I**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
SEC-1	BS-ST114P	00	02	02	60	15	35	50

List of Practical:

Sr. No.	Title of the Practical	No. of Practical's
1	Introduction Excel	2
2	Working with basic Excel function	2
3	Formatting data in an Excel Worksheet	2
4	Addition and Multiplication Principles of Probability	1
5	Computation of Probability of different events	2
6	Computation of probability using classical definition and Axiomatic Approach	2
7	Computation Conditional Probability and Independence of Events.	1
8	Univariate Probability distribution(Drawing p.m.f., c.d.f. and Computation of mean, mode and median)	2
9	Univariate Mathematical Expectation	1
	Total	**15**

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Statistics (Major)

Title of the Course: Statistical Heritage and Systems in India								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
IKS-1	BS-ST115T	02	00	02	30	15	35	50

Learning Objectives:

1. To learn about India's contributions from traditional to modern to the world of science and technology.
2. To learn about the torchbearers, ancient and modern, of Indian Knowledge System.
3. To understand the scientific value of the traditional knowledge of India.
4. To learn how Indian wisdom translates to the applied aspect of the modern scientific paradigm.
5. To trace the evolution of Statistics as a subject in India.
6. To learn about renowned Indian Statisticians and their works.
7. To understand the working of various Statistical organizations in India.

Course Outcomes:

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

1. To acknowledge, appreciate and value the rich heritage offered by India in areas of Science and Technology.
2. To gauge the immensity of the contributions made by Indian scientists to world knowledge.
3. To identify the erstwhile lesser known applications of Statistics since ancient times in India.
4. To recognize the significance of contributions of Indian Statisticians.
5. To identify the role of Statistical organizations towards the progress and development of India.

Detailed Syllabus:

Unit-I	**History of Science in India.**	8
	India's indigenous discoveries and developments in the areas of water management, farming techniques, Physics, Astronomy, healthcare medicine and surgery, plant and animal science, Mathematics (special attention to Kerala School of Mathematics), Indian Traditional Knowledge on Environmental Conservation etc. Nobel Laureates of Indian Origin/Relevance: Sir Ronald Ross, Sir C. V. Raman, Subrahmanyan Chandrasekhar, Har Govind Khorana, Amartya Sen, Venkataraman Ramakrishnan, Abhijit Banerjee, C.R. Rao.	
Unit -II	**History of Statistics in India**	8
	Statistics in ancient times, Probability in ancient India, Antiquity of the Mean, Statistics and Mathematics in ancient Indian poetry, Inferential Statistics and Statistical Economics before and during 4CE (Vishalaksha's contributions to inference and Kautilya's Arthashastra), Statistical System during British India,	

	Statistical System in Independent India, Research Teaching and Training in Statistics,	
Unit-III	**Statistical Heritage of India**	9
	P. C. Mahalanobis, Pandurang Vasudeo Sukhatme, Balvant Vasudeo Sukhatme, Raghu Raj Bahadur, Debabrata Basu, Gopinath Kallianpur, Keshav Raghavan Nair, Calyampudi Radhakrishna Rao, Vasant Shankar Huzurbazar. K.C. Shreedharan Pillai, S. N. Roy Indian Statistical Institute	
Unit-IV	**Official Statistics in India - Past and Present**	6
	Historical perspective of Official Statistics in India. Overview of present Indian Statistical System: Statistical organizations and their functions: Indian Statistical Institute (ISI), Central Statistics Office (CSO), National Sample Survey Organization (NSSO), Indian Institute for Population Science (IIPS), Ministry of Statistics and Programme Implementation (MSPI), National Statistical Commission (NSC)	

Suggested Readings/Material:

1. Buchanan, F. (1807) Survey of Eastern India, Report submitted to the Court of Directors, London.
2. Chaudhuri, S. B. (1964) History of the Gazetteers of India, Publication Division, New Delhi.
3. Dutta A. K., The Conncept of Arithmetic Mean in Ancient India, in 25 Years Gone By, ISIREA(2017):158-192.
4. Ghosh, J. K., Mitra, S. K., and Parthasarathy, K. R. (1992) Glimpses of India's Statistical Heritage, Wiley Eastern, New Delhi.
5. Ghosh, J. K, Maiti, P., Rao, T. J., and Sinha, B. K. (1999) Evolution of Statistics in India, International Statistical Review, 67, 13-34.
6. Glaz Sarah, Poetry Inspired by Mathematics: A Brief Journey through History, J. of Mathematics and the Arts 5, 171-183, 2011
7. Glaz Sarah, Mathematical Ideas in Ancient Indian Poetry, Proceedings of Bridges Enschede, July 2013
8. Indian Contributions to Science - Compiled by Vijnana Bharati.
9. Jarret, H. S. (1894) Translation of Ain-i-Akbari, Asiatic Society of Bengal, Vol. II, p. vii.
10. Mukhopadhyay, N. (1997) A conversation with Sujit Kumar Mitra, Statistical Science, 12, 61-75.
11. https://pragyata.com/the-untold-foundations-of-modern-economics-did-adam-smithplagiarise-kautilya/
12. https://unstats.un.org/unsd/wsd/docs/India_wsd_history.pdf
13. Raju, C. K. 'Probability in Ancient India'. In Handbook of Philosophy of Statistics, edited by Paul Thagard Dov M. Gabbay and John Woods, 7:1175–96. Handbook of Philosophy of Science. Elsevier, 2011.
14. Rangarajan L. N., Kautilya - The Arthashastra, Penguin Books India (P) Ltd.
15. Rao, Talluri. (2010). Official Statistics in India: The Past and the Present. Journal of Official Statistics. 26. 215-231.
16. Sihag Balbir S., Kautilya's Arthashastra: The Origin of Statistical Economics During -4CE, JRSA, Vol. 2, No. 1, June-2013, pp 1-14

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Statistics (Major)

Title of the Course: Descriptive Statistics -II								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical					
						CIE	ESE	Total
DSC-4	BS-ST121T	03	00	03	45	30	70	100

Learning Objectives:

1. To understand measures of skewness and kurtosis, their utility and significance
2. To perceive the knowledge of Visualization of bivariate data, correlation and its importance.
3. To get sound knowledge of about regression models.
4. To get idea about the concept in categorical data.

Course Outcomes (Cos):

1. Student will learn basics of explanatory data analysis.
2. Visualization of relationship between bivariate data.
3. Student will learn basics of Statistical models for prediction.
4. Student will be exposed to concept of categorical analysis.

Detailed Syllabus:

Unit-I	**Skewness and Kurtosis**	7
	Concept of skewness of frequency distribution and their types, Karl Person's coefficient of Skewness, Bowley's coefficient of skewness and their interpretation, Coefficient of Skewness based on moments. Importance of skewness. Concept of Kurtosis of frequency distribution and their types, coefficient of kurtosis based on moments, Importance of kurtosis.	
Unit -II	**Correlation**	10
	Concept of Bivariate data, examples of bivariate data, concept of correlation, types of correlation with illustration, scatter diagram, interpretation of scatter diagram according to pattern of plotted points, merits and demerits of scatter diagram, definition of Covariance for bivariate raw data and bivariate frequency distribution, proof of the following properties of Covariance 1) $Cov\,(X,X) = Var(X)$ 2) Effect of Change of Origin and Scale 3) If X, Y, Z are three random variables, then $Cov\,(X + Y, Z) = Cov\,(X, Z) + Cov(Y, Z)$ Karl Pearson's coefficient of Correlation: Definition, formula in terms of covariance, Variance of Linear Combination.	

	Proof of the following properties: 1) Effect of change of Origin and scale 2) $Corr\ (X, X) = 1$ 3) Correlation coefficient always lies between -1 and 1. Merits and Demerits of Karl Pearson's coefficient, Ranking, Rank, tie, Spearman Rank Correlation, derivation of formula for Spearman rank correlation, Spearman rank correlation lies between -1 and 1, rank correlation with ties.	
Unit-III	**Linear and Non-Linear Regression**	**15**
	Concept of dependent (response) and independent (predictor) variables, Identification of response and predictor variables and relation between them, Meaning of regression, difference between correlation and regression, assumptions of regression, Fitting of line $Y = a + bX + \epsilon$ and $X = a_1 + b_1 X + \epsilon_1$, a, a_1 b and b_1 are estimated using method of least squares, Regression coefficient, interpretation of regression coefficient. Proof of following Properties of Regression Coefficient: 1) Correlation and regression coefficient have same algebraic sign 2) Correlation coefficient is a geometric mean of the regression coefficients 3) Both the regression coefficients cannot exceed unity simultaneously 4) Regression coefficient are invariant to change of origin but not the change of scale. 5) If r = $\pm$ 1 then regression coefficients are reciprocal of each other. Explained and unexplained variation, coefficient of determination, standard error of an estimate of line of regression, analysis of residuals.	
	Necessity and importance of drawing second degree curve, Fitting of second-degree curve $Y = a + b\ X + cX^2$, Fitting of exponential curves of the type $Y = a\ b^X$ and Y =ae^{bX} , unknowns a, b, c are estimated by using the method of least squares.	
Unit-IV	**Theory of Attributes**	13
	Concept of attributes, dichotomous and manifold classification of attributes, Likert's Scale, Analysis of response using Likert's scale, class, class frequency, Positive and negative attributes, Positive and negative class, ultimate class frequencies, total number of class frequencies, relation among the class frequencies.	
	Relation between the frequencies with three attributes, methods of dot operator, Consistency of data, independence of attributes, Association and Dissociation, Yule's coefficient of association, coefficient of colligation.	

Suggested Readings/Material:

1. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
2. Agarwal B. L. (2003). Programmed Statistics, second edition, New Age International Publishers, New Delhi.
3. Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
4. Hogg R.V. and Craig R.G. (1989). Introduction to Mathematical Statistics, MacMillan Publishing Co., New York.
5. Mood, A. M. and Graybill, F. A. and Boes D.C. (1974). Introduction to the Theory of Statistics, Ed. 3, McGraw Hill Book Company.
6. Rao, VLS Prakash (2008). First Course in Probability and Statistics, New Age International Publishers, New Delhi.
7. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, INC.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Statistics (Major)

Title of the Course: Discrete Probability Distribution and Index Number								
Year: I				**Semester: II**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-5	BS-ST122T	03	00	03	45	30	70	100

Learning Objectives:

1. Able to understand the concept of bivariate probability distribution and its characteristic property
2. To be familiar with the different discrete distribution defined on countable finite support.
3. To get an idea about the integration among different discreet distributions under certain conditions.
4. To learn different types of Index number and inflation.

Course Outcomes (Cos):

1. Understand the applicability of probability model in real life
2. They will apply appropriate probability distribution to the problems in real life.

3. Learn interrelation among the different probability distributions with real life problems
4. Understanding of concept of Index and its real life applications.
5. Understand the appropriateness of probability distribution in particular real life application.

Unit-I	**Bivariate Probability Distribution**	10
	Discrete bivariate random vector or variable (X, Y): Joint p. m. f. and its properties, joint c. d. f. and its properties, probabilities of events related to random variables, marginal distribution.	
	Independence of two random variables and its extension to k random variables. conditional distributions, mathematical expectation of bivariate random variable, expectation of function of r.v. $E[g(X,Y)]$, Theorems on expectation: i) $E(X + Y) = E(X) + E(Y) \,\&\, E(aX + bY + c)$ ii) $E(XY) = E(X) * E(Y)$ if X and Y are independent and its generalization to k variables.	
	Covariance, effect of change of origin & scale on covariance, $Var(aX + bY + c), corr(X,Y)$, effect of change of origin & scale on correlation, independence Vs uncorrelatedness, conditional mean, proof of $E\{E[X|Y = y]\} = E[X] \,\&\, E\{E[Y|X = x]\} = E[Y]$, regression as a conditional expectation, conditional variance, raw & central moments of	

	bivariate random variable.	
	Moment Generating Function (MGF): definition, applications, $M_{X,Y}(t_1, t_2)$, properties, MGF of marginal distribution of random variables, Proofs of the following properties: i) $M_{X,Y}(t_1, t_2) = M_X(t_1, 0) M_Y(0, t_2)$ if X and Y are independent r.v.s., ii) $M_{X+Y}(t) = M_{X,Y}(t, t)$ iii) $M_{X+Y}(t) = M_X(t) M_Y(t)$ if X and Y are independent r.v.s. Deduction of joint moments. Probability Generating Function (PGF): applications and properties. Cumulant Generating Function (CGF): applications and properties, deduction of central moment.	
Unit -II	**Degenerate distribution**, **Discrete Uniform distribution and Bernoulli distribution**	13
	Concept of Probability Model, need of the probability model, patterns of probability model, independent and identical trials (Random variables) **Degenerate distribution/Singular distribution:** Concept of degenerate distribution, situations where one-point distribution is used, probability mass function (p.m.f.), mean and variance, applications of one-point distribution in probability theory.	
	Discrete uniform distribution: Real life situations, definition, plot of p.m.f., cumulative distribution function (CDF), plot of CDF, first four raw and central moments, coefficient of skewness and kurtosis, moment generating function (MGF), distribution of sum of two independent discrete uniform random variables.	
	Bernoulli Distribution: Concept of Bernoulli trials, genesis of p.m.f. of Bernoulli distribution, definition of Bernoulli distribution with parameter p, notation, real life situations, plot of probability mass function, cumulative distribution function (CDF), plot of CDF, raw and central moments of Bernoulli distribution, condition under which Bernoulli distribution is symmetric, MGF, deduction of raw moments from MGF., distribution of sum of independent and identical Bernoulli random variables, distribution of product of n independent Bernoulli random variable with parameter p.	
Unit-III	**Binomial distribution and Hypergeometric distribution**	12
	Binomial distribution: Definition of binomial distribution with parameters n and p, notation, distribution of number of successes in n independent Bernoulli trial as a Binomial distribution with parameters n and p, conditions for the applications of binomial distribution, an illustration of use of binomial distribution in SRSWR, real life situations, raw and central moments, coefficient of skewness and kurtosis (different cases such as $p > 0.5$, $p < 0.5$ and $p = 0.5$), MGF, deduction of raw moments by using MGF, cumulant generating function (CGF), distribution of $n - X$ if X has $B(n, p)$, recurrence relation between probabilities of binomial distribution, mode of the binomial distribution (case when $(n + 1)p$ is integer and not integer), recurrence relation between raw moments , recurrence relation between central moments, additive property of binomial distribution, conditional distribution of X given $X + Y = n$	

	Hypergeometric Distribution: Failure of assumptions of binomial distribution in SRSWR, genesis of p.m.f. of hypergeometric distribution with parameters N, M and n, difference between hypergeometric and binomial distribution, conditions for the applications of hypergeometric distribution, real life situations, mean and variance, r^{th} factorial moment, binomial approximation to Hypergeometric distribution	
Unit-IV	**Index Number**	10
	Introduction and scope of Index Numbers, Various types of Index Numbers like Human Development Index, Happiness Index BSE sensitivity Index, Definition and Meaning of Index Number, Problems/considerations in the construction of index numbers.	
	Simple and weighted price index numbers based on price relatives, Simple and weighted price index numbers based on aggregates, Laspeyre's, Paasche's and Fisher's Index numbers, Consumer price index number: Considerations in its construction. Methods of construction of consumer price index number - (i) family budget method (ii) aggregate expenditure method.	
	Shifting of base, splicing, deflating, purchasing power	

Suggested Readings/Material:

1. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
2. Agarwal B. L. (2003). Programmed Statistics, second edition, New Age International Publishers, New Delhi.
3. Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
4. Hogg R.V. and Craig R.G. (1989). Introduction to Mathematical Statistics, MacMillan Publishing Co., New York.
5. Mood, A. M. and Graybill, F. A. and Boes D.C. (1974). Introduction to the Theory of Statistics, Ed. 3, McGraw Hill Book Company.
6. Rao, VLS Prakash (2008). First Course in Probability and Statistics, New Age International Publishers, New Delhi.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Statistics (Major)

Title of the Course: Practical - II (Based on BS-ST231T and BS-ST232T)								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical					
						CIE	ESE	Total
SEC-2	BS-ST123P	00	02	02	60	15	35	50

List of Practical:

Sr. No.	Title of the Practical	No. of Practical's
1	Coefficient of Skewness	1
2	Coefficient of Kurtosis	1
3	Scatter diagram, Karl Pearson's coefficient of Correlation and Rank Correlation.	2
4	Linear Regression and Residual Analysis	1
5	Non-linear Regression	2
6	Theory of Attributes	1
7	Index Number	1
8	Plotting of p.m.f. and c.d.f.	1
9	Applications od Discrete Probability Distribution.	2
10	Project (Equivalent to 3 Practical)	3
	Total	**15**

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Statistics (Major)

Title of the Course: Computational Tool -II (Introduction to R)								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical					
						CIE	ESE	Total
VSC-2	BS-ST124P	00	02	02	60	15	35	50

Learning Objectives:

1. To learn different imputation tools in R.
2. To discriminate between hardware and software.
3. To understand the different data visualization using R.
4. To learns how to compute descriptive statistics using R.
5. To develop overall logical thinking as a base of data science will be improved.

Course Outcomes (Cos):

1. Student will have sufficient computational skill through R- programming software.
2. Student will understand the difference in data visualization using R.
3. Student will understand the difference in output of analysis using R.
4. The overall logical thinking as a base of data science will be improved.
5. Student will have skill of result interpretation.

List of Practical:

Sr. No.	Title of the Practical	No. of Practical's
1	Introduction to R	1
2	Data Input Methods	2
3	Diagrammatic Representation	1
4	Graphical Representation of Data	1
5	Measures of Central Tendency	2
6	Measures of Dispersion	2
7	Measures of Skewness and Kurtosis	2
8	Plotting of probability mass function, cumulative distribution function.	1
9	Applications od Discrete Probability Distribution.	2
	Total	**14**