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 2024-25

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		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

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											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		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	Major											Total	
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP/PR		IKS		
			T	P	T	P	T	P	T	P	T	P	T	T	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/RP		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)

Sr. No.	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	**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	**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 Regression	**03**
12.	II	III	5.0	DSC-8	BS-ST233P	Practical-III	**02**
13.	II	III	5.0	SEC-3	BS-ST234P	Computational Tool–III (C Programming)	**02**
14.	II	III	5.0	FP-01	BS-ST235P	Field Project/ Internship	**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 and Demography	**03**
17.	II	IV	5.0	DSC-11	BS-ST243P	Practical-IV	**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	CEP	**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	**02**
23.	III	V	5.5	DSE-01	BS-ST355T	Operation Management / Actuarial Statistics	**02**
24.	III	V	5.5	DSE-02	BS-ST356P	Practical- VI	**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 / Internship	**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	**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	**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	-	**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**
38.	IV	VII	6.0	DSC-22	BS-ST475P	Practical X (Reliability Theory)	**02**
39.	IV	VII	6.0	DSC-23	BS-ST476P	Practical XI	**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	**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	**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	**02**
51.	IV	VIII	6.0	OJT-02	BS-ST487P	RST	**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. B. K. Thorve	Member
3.	Prof. K. B. Mane	Member
4.	Prof. B. P. Kharat	Member
5.	Prof. M. Z. Shaikh	Member
6.	Prof. S. S. Bansode	Member
7.	Prof. S.S. Dhadiwal	Member
8.	Prof. V. V. Khajekar	Member
9.	Prof. D. D. Kale	Member
10.	Dr. S.D Jagtap	Member
11.	Dr. B.P. Thakur	Member
12.	Prof. S.A Tarate	Member
13.	Dr.N.T Shelke	Member
14.	Dr. A.K. Khamborkar	Academic Council Nominee
15.	Dr. A.J. Shivagaje	Academic Council Nominee
16.	Prof. S. Kawale	Vice-Chancellor Nominee
17.	Dr. S.B.Pathare	Alumni
18.	Mr. Anirudha Deshmukh	Industry Expert
19.	Mr. Vijay Narkhede	Invited Member

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. honours 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: Continuous Probability Distributions-I								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-6	BS-ST231T	03	00	03	45	30	70	100

Learning Objectives:

1. The students learn the Scope of statistics in different fields.
2. They can understand about distributions on continuous scale.
3. They can learn different applications of continuous distributions in real life.
4. They can learn the use of continuous distributions on R.

Course Outcomes (COs):

a. On completion of this course students will get in depth knowledge of general concepts of univariate and bivariate probability distributions.
b. Students will get sound knowledge of a probability distributions with lot of applications in industrial field.
c. Students will get the complete idea about probability distributions that helps the comparison and to draw the inference.
d. Practice of learning of different concepts in this course using R coding will improve their logical thinking.

Detailed Syllabus:

Unit-I		**General Concepts in Continuous Univariate Distributions**	12L
	1.1	Continuous sample space: Definition, illustrations. Continuous random variable: Definition, probability density function (p.d.f.), cumulative distribution function (c.d.f.), properties of c.d.f., and probabilities of events related to random variable.	
	1.2	Expectation of continuous r.v., expectation of function of r.v., E [g(X)], mean, variance, geometric mean, harmonic mean, median, mode, Partition values: Quartiles (Q_1, Q_2, Q_3), Deciles, Percentiles. Raw and central moments, skewness, kurtosis, mean deviation about constant, about mean, about median, about mode.	
	1.3	Moment Generating Function (M.G.F.): Definition, Properties, Deriving the first four raw moments from MGF. Cumulant Generating Function(C.G.F.) : Definition, Properties, deriving the first four central moments from CGF.	
	1.4	Probability distribution of function of r.v. Y=g(X) using i) Jacobian of transformation for g(.) monotonic function and one-to-one, on to function, ii) Distribution function for $Y= X^2$, $Y= \|X\|$ etc. iii) M.G.F. of g(X).	

Unit- II		**General Concepts in Continuous Bivariate Distributions**	13L
	2.1	Continuous bivariate random vector or variable (X, Y): Joint p. d. f., joint c. d. f, properties, probabilities of events related to random variables (events in terms of regions bounded by regular curves, circles, straight lines), marginal and conditional distributions.	
	2.2	Expectation of bivariate r.v. (X,Y), expectation of function of bivariate r.v. $E[g(X,Y)]$, joint moments, $Cov(X,Y)$, $Corr\ (X,Y)$, independence of random variables, conditional means ($E(X\|Y=y)\ and\ E(Y\|X=x)$),conditional variance, $E[E(X\|Y=y)]=E(X)$ and $E[E(Y\|X=x)]=E(Y)$, regression as a conditional expectation i.e. $E(X\|Y=y) = a + by$ and $E(Y\|X=x) = a' + b'$ x. Theorems on expectation: 1) $E\ (X+Y)=E(X)+E(X)$ 2) $E(XY)=E(X)E(Y)$, if X and Y are independent 3) $E(X_1 * X_2 * X_3 *** X_k) = E(X_1) * E(X_2) *** E(X_k)$ 4) $E(aX+bY+c)=a\,E(X)+b\,E(Y)+c$ 5) $V(aX+bY+c) = a^2\,Var(X) + b^2\,Var(Y) + 2\,ab\,Cov(X,Y)$ 6) $V(aX+bY+c) = a^2\,Var(X) + b^2\,Var(Y)$, if X and Y are independent	
	2.3	Moment generating function (MGF) $M_{(X,Y)}(t_1,t_2)$, MGF of marginal distribution of random variables(r.v.s.), Proof of the following properties. 1) $M_{(X,Y)}(t_1,t_2) = M_{(X,Y)}(t_1,0) * M_{(X,Y)}(0,t_2)$ if X and Y are independent r.v.s. 2) $M_{(X+Y)}(t,t) = M_{(X,Y)}(t,t)$ 3) $M_{(X+Y)}(t,t) = M_X(t) * M_Y(t)$ X and Y are independent Probability distribution of transformation of bivariate r. v.	
Unit-III		**Uniform or Rectangular Distribution**	05 L
		Probability density function (p.d.f.) $f(x)=\begin{cases}\frac{1}{(b-a)}, & a\le x\le b\\ 0, & Otherwise\end{cases}$ Notation: X→ U [a, b] p. d. f., sketch of p. d. f. & c. d. f., mean, median, mode, variance, standard deviation, C.V., symmetry, M.G.F. and C.G.F., first four raw moments based on M.G.F. and four central moments based on C.G.F., quartiles, deciles and percentiles. Measures of skewness and kurtosis based on moments and quartiles. Distributions of i) $\frac{X-a}{b-a}$, ii) $\frac{b-X}{b-a}$, iii) Y= F(X), where F(X) is the c. d. f. of continuous r. v. X. Model sampling from Uniform distribution. Distributions of X+Y, X-Y	
Unit-IV		**Normal or Gaussian Distribution**	15L
		Probability density function (p. d. f.) $f(x)=\begin{cases}\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}(\frac{x-\mu}{\sigma})^2}, & -\infty<X,\mu<\infty,\sigma>0\\ 0, & Otherwise\end{cases}$ Notation: X~ N (μ, σ^2) P. d. f. curve, identification of scale and location parameters, nature of probability curve, mean, median, mode, variance, standard deviation, C.V., M.G.F., C.G.F., central moments, cumulants, skewness, kurtosis, quartiles,	

		deciles, percentiles, points of inflexion of probability curve, mean deviation, additive property, probability distribution of : i) ($\frac{x-\mu}{\sigma}$) Standard Normal Variable (SNV), ii) aX+b, iii) aX+bY+c where X and Y are independent normal variates. Probability distribution of $\bar{X}$, the mean of n i.i.d. N(μ,σ^2) r. v s., computations of normal probabilities using R. Central Limit Theorem (CLT) for r.v.s. with finite variance (statement only), its illustration for Poisson and Binomial distributions. Box-Muller transformation and normal probability plot.	

Suggested Readings:

1. Fundamentals of Mathematical Statistics, by Gupta and V.K. Kapoor.
2. Continuous Univariate Distributions – 1, by Norman L. Johnson and Samuel Kotz

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 Distributions and Regression								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-7	BS-ST232T	03	00	03	45	30	70	100

Learning Objectives:

1. They can learn uses of different discrete probability distribution in real life.
2. They can calculate the probability of success based on number of trials required.
3. To fit and model multivariate data using regression concept.
4. To estimate and predict the regression coefficients.

Course Outcomes (COs):

a. On completion of this course students will get in depth knowledge of general concepts of bivariate probability distributions.
b. Students will get sound knowledge of a probability distributions with lot of applications in industrial field.
c. Students will get the complete idea about bivariate probability distributions that helps the comparison and to draw the inference.
d. Practicing learning of different concepts in this course using R coding will improve their logical thinking.

Detailed Syllabus:

Unit-I		**Poisson Distribution**	10L
	1.1	**Poisson Distribution**: Poisson distribution as a model for the situations where chances of occurrence of an event in a short time interval is with high probability, real life situations, definition of Poisson distribution, Notation, mean and variance, MGF, deduction of raw and central moments from MGF, CGF, all the cumulants are equal for the Poisson distribution, central moments using CGF, coefficient of skewness and kurtosis, interpretation from these coefficients, nature of distribution $as\ m \to \omega$, additive property, generalization of additive property, conditional distribution of X_1 given $X_1 + X_2 = n$, Recurrence relation for the probabilities of Poisson distribution, Poison distribution as a limiting form of binomial distribution, fitting of Poisson distribution, mode of Poisson distribution.	
Unit-II		**Geometric distribution and Negative Binomial Distribution**	12L
	2.1	**Geometric distribution**: Genesis of p.m.f. of geometric distribution (for both forms), definition of Geometric distribution, Notation, Geometric distribution as waiting time distribution, mean, variance, mode, relation between mean and variance, moment generating function, deduction of mean and variance from MGF, CGF, deduction of first four central moments from	

		CGF, recurrence relation between probabilities, distribution function, Lack of memory property and its interpretation, real life applications.	
	2.2	**Negative Binomial Distribution (NBD)**: Sum of two (or more) geometric random variables as a NBD, derivation of p.m.f. of negative binomial distribution, mean, variance, relation between mean and variance, factorial moments, MGF, CGF, deduction of mean, variance and third central moment from CGF, coefficient of skewness, additive property of NBD.	
Unit-III		**Multinomial Distribution**	**08L**
	3.1	Genesis of the Multinomial distribution, Joint p.m.f. of $(X_1, X_2, \ldots\ldots X_k)$ $P(X_1 = x_1,\ X_2 = x_2, \ldots\ldots X_k = x_k) = \frac{n!}{\prod_{i=1}^{k} x_k!}\ \prod_{i=1}^{k} {p_i}^{x_i}$, $,\ x_i = 01,2, \ldots\ldots n\ , \sum_{i=1}^{n} x_i = n,$ $0 \leq\ p_i\ \leq\ 1$ and $\sum_{i=1}^{n} p_i = 1$ Notation: $(X_1, X_2, \ldots\ldots X_k) \sim$ MD (n, p_1, p_2, ……. p_k), verification of joint p.m.f., real life situations.	
	3.2	MGF, PGF and CGF of multinomial distribution, Moment from MGF and CGF, Variance-Covariance Matrix, Correlation matrix.	
	3.3	Marginal distribution, conditional distribution, Conditional mean and conditional variance, Additive property, numerical examples.	
Unit-IV		**Multiple Linear Regression and Model**	15L
	4.1	Introduction to multiple regression, trivariate sample data and Notations, correlation matrix, fitting of regression plane by the method of least squares; obtaining normal equations, solutions of normal equations. Interpretation of regression coefficients, Properties of regression coefficients, Residuals, order of residuals, Properties of residuals, variance of residuals. Real life applications of mulmultiple regression.	
	4.2	Definition of multiple correlation coefficient. Derivation of the expression for the multiple correlation coefficient. Properties of multiple correlation coefficient (All six properties), Adjusted R –square, coefficient of multiple determination and its interpretation as proportion of variation explained by the linear regression, use of coefficient of multiple determination for variable selection,	
	4.3	Definition and interpretation of partial regression coefficients, its Properties of partial correlation coefficient (All six properties). Partial coefficient of determination.	

Suggested Readings:

1. Fundamentals of Mathematical Statistics, Gupta and V.K. Kapoor. Sultan Chand Publication.
2. Discrete Multivariate Distributions, Norman L. Johnson, Samuel Kotz and N. Balakrishnan.
3. Introduction to Linear Regression. D. C. Montomery.

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 III								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-8	BS-ST233P	00	02	02	30	15	35	50

List of Practical:

Sr. No.	**Title of the Practical**	No. of Practical's
1	Fitting of Poisson and Test of Goodness of Fit.	01
2	Fitting of Geometric Distribution and Test of Goodness of Fit.	01
3	Fitting of Negative Binomial Distribution and Test of Goodness of Fit.	01
4	Application of Poisson, Geometric and Negative Binomial Distribution	01
5	Applications of Uniform & Multinomial Distribution.	01
6	Model sampling from the given distributions & Normal Distribution (using Box-Muller Transformation and Distribution Function method)	01
7	Applications of Normal distribution	01
8	Fitting of Normal distribution, computation of expected frequencies, Goodness of fit test.	01
9	Fitting of multiple regression plane.	01
10	Calculation of partial and multiple regression coefficient.	01
11	Short project equivalent to **TWO** practical's in a group of size 4 to 5 students	02
	Total	**12**

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

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

Title of the Course: Computational Tool- III (C Programming)								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
SEC-3	BS-ST234P	00	02	02	30	15	35	50

Theory to be Covered:

Unit-I		**C fundamentals and Control Structures**
	1.1	
		Introduction-Getting Started with C, Working and installation of turbo C and Dev- C++ Algorithms and flowcharts, Introduction to procedural language, middle level language, higher level language, general language structure, character set, keywords, identifiers, comments, instructions. Data types: Numeric and character data types, Numeric and character constants, string constants, symbolic constants. Operators: Numeric, logical, arithmetic, unary, relational, equality, decrement, increment, conditional assignments, precedence of operator expressions and their evaluation. Data input/output, numeric and character data, printf( ), scanf ( ), etchar ( ), putchar ( ), gets ( ), puts ( ). Formatted output
	1.2	**Control Structures:** Introduction- Importance and Uses. If, if else, while, do.... while, for, switch, goto, break, continue, nested loops, programs using control structures.
Unit II		**Arrays, Functions and Pointers**
	2.1	Array: Introduction & Concept. declaration, definition, initialization of array, problem using arrays, passing to function, arrays. String operations, string functions like strcpy(), strcat(), strlen(), strcmp(), strrev().
	2.2	**Functions and Pointers:** Functions: Introduction, Declaration, definition, recursion, user defined functions, library function, calling a function by reference and by value, local and global variables. Pointers: Introduction, Basic concept and relation to one dimensional array.

List of Practical:

Sr. No.	Title of the Practical	No. of Practical's
1	**Introduction to C**	01
2	**C fundamentals** i. Converting °C temperature to °F ii. To carry out arithmetic calculations (addition, subtraction, multiplication, division). iii. To find area and perimeter of triangle, rectangle and square. To find area and circumference of circle.	02
3	**Control Structures** i. To find roots of quadratic equation and print the outputs according to Discriminant using switch and do while operations. ii. To check whether given number is odd or even. iii. To check whether given number m is divisible by n or not. iv. To find maximum of 2 numbers or 3 numbers. v. To check whether integer is prime or not.	02
4	**Arrays** i. To find arithmetic mean, geometric mean, harmonic mean, median, variance and coefficient of variation of frequency distribution and raw data. ii. To find correlation coefficient and least square regression line of Y on X for a given bivariate data. iii. To arrange the given data in increasing/decreasing order of magnitude. iv. To obtain addition of two matrices, multiplication of two matrices. v. To test palindrome string using string function. vi. To sort a string using string function. vii. To search string using string function. viii. To combine given two strings using string function. ix. To copy the string using string copy function. x. To find the length of the given string using string length function (strlen()). xi. To reverse the given string using string reverse function (strrev()). xii. To concatenates destination and source string (strcat()). xiii. To compare two strings using string compare function (strcmp()).	03
5	**Functions** i. To find factorial of integer number (both recursive and non-recursive). ii. To find the value of X_n where n is integer (both recursive and non-recursive). iii. To prepare a 2X2 contingency table for chi square test and to find the value of test statistic and to check whether two attributes are independent.	01

	iv. To fit a Binomial distribution to given data.	
6	**Pointers** i. To print the address of the stored variable. ii. To print addition/ subtraction of two numbers using pointers.	02
	Total	**11**

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

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

Title of the Course: Continuous Probability Distributions-II								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-9	BS-ST241T	03	00	03	45	30	70	100

Learning Objectives:

1. The students learn the different tests of statistics.
2. They understand about various sampling distributions.
3. They understand about various continuous distributions used in real life.

Course Outcomes (COs):

a. On completion of this course students will get in depth knowledge of theoretical background of exact statistical tests.
b. Students will understand the basic difference between various sampling distributions.
c. Students will understand the difference between probability distributions and sampling distributions.

Detailed Syllabus:

Unit- I		**Exponential and Gamma Distribution**	**12L**
	1.1	**Exponential Distribution:** Probability density function (p. d. f.) $$f(x) = \begin{cases} \alpha e^{-\alpha x}, & x \geq 0, \alpha > 0 \\ 0, & Otherwise \end{cases}$$ Notation: X~ Exp(α) Nature of density curve, interpretation of α as a inter-arrival rate of customer's joining the queue and $\frac{1}{\alpha}$ as mean, mean, median, mode, variance, standard deviation, C.V., M.G.F., C.G.F., moments based on M.G.F., C.G.F., skewness, kurtosis, c.d.f., graph of c.d.f., lack of memory or forgetfulness property, quartiles, deciles, percentiles, mean deviation about mean, Additive property. Distribution of min (X, Y) and max (X, Y) with X, Y i.i.d. exponential random variables.	

	1.2	**Gamma Distribution:** Probability density function (p. d. f.) $f(x) = \frac{\alpha^{\lambda}}{\Gamma\lambda} e^{-\alpha x} x^{\lambda-1}$, $x \geq 0, \alpha > 0, \lambda > 0$ = 0 , Otherwise Notation: X~ G (α, λ) Nature of density curve, mean, median, mode, variance, standard deviation, C.V., special cases (i) α = 1, (ii) λ = 1, M.G.F., C.G.F., moments based on M.G.F. and C.G.F., cumulants, Measures of skewness and kurtosis based on moments, Additive property. Distribution of sum of n i.i.d. exponential variables. Relation between distribution function of Poisson and gamma variates, Recurrence relation between moments.	
Unit - II		**Chi-Square (χ^2_n) Distribution**	**13L**
	2.1	**Chi-Square (χ^2_n) Distribution** Concept of Degrees of Freedom. Definition and derivation Chi-Square distribution as a square of Standard Normal Variate (SNV). Definition and derivation of pdf of Chi Square distribution with n degrees of freedom as a sum of squares of i.i.d. SNV (using MGF and Mathematical Induction). R coding to plot density curve of Chi-Square distribution for various degrees of freedom. Mean, mode and variance of Chi-Square distribution. MGF, raw moments using MGF, CGF, central moments using CGF, Coefficients of skewness and kurtosis using moments. For given degrees of freedom R code to obtain quantiles of Chi-Square distribution. Additive property of Chi-Square distributions. Computations of various probabilities using R. Real life applications of Chi-Square distribution, examples and problems. Normal approximation to Chi-Square distribution.	
	2.2	Joint Distribution of $\bar{X}$ and $\frac{nS^2}{\sigma^2} = \frac{1}{\sigma^2}\sum_{i=1}^{n}(xi - \bar{x})^2$ for a random sample from a normal distribution. Independence of $\bar{X}$ and S^2 using orthogonal transformation.	
Unit III		**Student's t-distribution (t_n)**	**08L**
	3.1	Definition and derivation of Student's 't' distribution with 'n' degrees of freedom. R coding to plot density curve of t distribution for various degrees of freedom. R code to compare graphically the density curve of SNV and 't' distribution with various degrees of freedom.	
	3.2	Mean, mode, median and variance of 't' distribution. MGF and CGF of 't' distribution. Raw and central moments and coefficient of Skewness and Kurtosis of 't' distribution. Properties of central moments. Recurrence relation between moments of 't' distribution. Real life applications of 't' distribution, examples and problems.	

Unit-IV		**Fishers 'Z' distribution and Snedecore's F- distribution**	**12L**
	4.1	**Fishers 'Z' distribution.** Definition and derivation of 'Z' distribution. MGF of Fishers 'Z' distribution. Moments of Fishers 'Z' distribution using moments. Mean and variance of Fishers 'Z' distribution. Fishers 'Z' transformation and applications	
	4.2	**Snedecore's F- distribution ($F_{n1,n2}$):** Definition and derivation of F distribution. R coding to plot density curve of F distribution for various combinations of degrees of freedoms. Mean, mode and variance of F distribution. r^{th} raw moment of F distribution. Quartiles of 'F' Distribution. Proof of Property P[X<a] + P[$\frac{1}{X}$ > a] = 1. Distribution of reciprocal of random variable with F distribution. Interrelations between Chi-Square, 't' and F distributions. Normal approximation to 'F' distribution. Real life applications of 'F' distribution, examples and problems.	

Suggested Readings:

1. Fundamentals of Mathematical Statistics, by Gupta and V.K. Kapoor.
2. Continuous Univariate Distributions – 1, by Norman L. Johnson and Samuel Kotz

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 Methods and Demography								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-10	BS-ST242T	03	00	03	45	30	70	100

Learning Objectives:

1. They can learn about use of statistical tests in real life.
2. Students can get in depth knowledge of theoretical background of exact statistical tests.
3. They can acknowledge the use of vital statistics in real life.

Course Outcomes (COs):

a. On completion of this course students will get basic idea about statistical approach to confirm the logical claims or guess.
b. This course will give an opportunity of applying statistical tests in various fields.
c. Use of R coding on real life data will improve the programming ability of students.

Detailed Syllabus:

Unit-I		**General Concepts of Testing of Hypothesis**	6L
	1.1	Definition of Random sample, Parameter and Statistic, Sampling distribution of a statistic, standard error of a statistic with illustrations (normal, exponential etc), Concept of testing of hypothesis.	
	1.2	Statistical hypothesis, null and alternative hypothesis, simple and composite hypothesis, one sided and two sided alternative hypotheses, critical region, acceptance region, Type-I & Type-II errors, probability of type I error as a level of significance (α), probability of type II error, power of the test, confidence coefficient, p -value. Testing of hypotheses using i) critical region approach, ii) p-value approach and iii) confidence interval approach. One sided and Two sided confidence intervals.	
Unit II		**Large Sample Tests for Mean and Proportion**	9L
	2.1	Tests for Population Mean(s) i) Ho: $\mu = \mu_0$ against $H_1 : \mu \neq \mu_0$, $H_1 : \mu < \mu_0$, $H_1 : \mu > \mu_0$ (Variance is known) ii) Ho: $\mu_1 = \mu_2$ against $H_1 : \mu_1 \neq \mu_2$, $H_1 : \mu_1 < \mu_2$, $H_1 : \mu_1 > \mu_2$ (Variance is known and equal) iii) Ho: $\mu_1 = \mu_2$ against $H_1 : \mu_1 \neq \mu_2$, $H_1 : \mu_1 < \mu_2$, $H_1 : \mu_1 > \mu_2$ (Variance is known and unequal) iv) Testing of (i), (ii) and (iii) using confidence interval.	

	2.2	Tests for Population Proportion(s) (large sample / approximate tests) i) Ho: $P = P_0$ against $H_1 : P \neq P_0$, $H_1 : P < P_0$, $H_1 : P > P_0$ ii) Ho : $P_1 = P_2$ against $H_1 : P_1 \neq P_2$, $H_1 : P_1 < P_2$, $H_1 : P_1 > P_2$ iii) Testing of (i) and (ii) using confidence interval.	
Unit-III		**Small Sample Tests – Based on Chi-Square, t and F distribution**	18L
	3.1	Tests based on t – distribution i) Ho: $\mu = \mu_0$ against $H_1 : \mu \neq \mu_0$, $H_1 : \mu < \mu_0$, $H_1 : \mu > \mu_0$ (Variance is known) ii) Ho : $\mu_1 = \mu_2$ against $H_1 : \mu_1 \neq \mu_2$, $H_1 : \mu_1 < \mu_2$, $H_1 : \mu_1 > \mu_2$ (Variance is known and equal) iii) Ho : $\mu_1 = \mu_2$ against $H_1 : \mu_1 \neq \mu_2$, $H_1 : \mu_1 < \mu_2$, $H_1 : \mu_1 > \mu_2$ (Variance is known and unequal) iv) Testing of (i) , (ii) and (iii) using confidence interval. v) Paired t-test for one sided and two sided alternatives vi) Ho: $\rho = 0$ against H_1: $\rho \neq 0$ Ho: $\beta = 0$ against H_1: $\beta \neq 0$, β as a regression coefficient	
	3.2	Tests based on chi-square distribution i) Test for independence of two attributes arranged in 2 X 2 Contingency table (with Yate's correction). ii) Test for independence of two attributes arranged in r X s Contingency table, Mc Nemar's test. iii) Test for goodness of fit. iv) Ho : $\sigma^2 = \sigma_0^2$ against one-sided and two-sided alternatives (known mean, unknown mean).	
	3.3	Test based on F – distribution Test for Ho: $\sigma_1^2 = \sigma_2^2$ against $H_1 : \sigma_1^2 \neq \sigma_2^2$, $H_1 : \sigma_1^2 > \sigma_2^2$, $H_1 : \sigma_1^2 < \sigma_2^2$ when μ known, unknown Illustration of computation of power of the test Use of R for testing the above hypothesis	
	3.4	Tests based on Z transformation i) Ho: $\rho = \rho_0$ against H_1: $\rho \neq \rho_0$, H_1: $\rho > \rho_0$, H_1: $\rho < \rho_0$ ii) Ho: $\rho_1 = \rho_2$ against H_1: $\rho_1 \neq \rho_2$, H_1: $\rho_1 > \rho_2$, H_1: $\rho_1 < \rho_2$	
Unit-IV		**Demography**	12L
	4.1	Vital events, vital statistics, methods of obtaining vital statistics, rates of vital events, demographic ratio: sex ratios, dependency ratio. Death/Mortality rates: Crude death rate, specific (age, sex) death rate, standardized death rate (direct and indirect), infant mortality rate	
	4.2	Fertility/Birth rate: Crude birth rate, general fertility rate, specific (age, sex) fertility rates, total fertility rate. Growth/Reproduction rates: Gross reproduction rate, net reproduction rate.	
	4.3	Interpretations of different rates, uses and applications. Trends in vital rates as revealed in the latest census.	

Suggested Readings:

1. Fundamentals of Mathematical Statistics, Gupta and V.K. Kapoor, Sultan Chand.
2. Fundamental of Applied Statistics, Gupta and V.K. Kapoor.

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 IV (Based on BS-ST241T and 242T)								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-11	BS-ST243P	00	02	02	30	15	35	50

List of Practical:

Sr. No.	**Title of the Practical**	No. of Practical's
1	Model sampling from chi-square, t and f-distribution	1
2	Calculation various probabilities from chi-square, t and f-distribution	1
3	Large Sample Tests for Mean and Construction of confidence Interval	2
4	Large Sample Tests for Proportion Construction of confidence Interval	1
5	Chi-square test of independence of attributes and Mc Nemar's test	2
6	Chi-square test of goodness of fit and test for population variance	1
7	Test based on t-distribution	1
8	Test based on F-distribution and Z transformation	1
9	Crude death rate, specific (age, sex) death rate, standardized death rate	1
10	Crude birth rate, general fertility rate, specific (age, sex) fertility rates, total fertility rate	1
11	Growth/Reproduction rates: Gross reproduction rate, net reproduction rate	1
	Total	**13**

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

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

Title of the Course: Computational Tool- IV (Introduction to Python)								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
VSC-2	BS-ST244P	00	02	02	60	15	35	50

List of Practical:

Sr. No.	**Title of the Practical**	No. of Practical's
1	Introduction and Installation of Anaconda Distribution	1
2	List and Tuple	1
3	Dictionary and Set	1
4	Introduction to Formatted Strings	1
5	Creating and Formatting tables using Python	1
6	Control Structure and Defining Function	1
7	Descriptive Statistics using NumPy Library	2
8	Introduction to Pandas	2
9	Simple bar diagram, Subdivided bar diagram, Multiple bar diagram using Matplotlib & Seaborn	1
10	Histogram, Rod or Spike Plot, density and contour plot using Matplotlib & Seaborn	1
	Total	**12**