National Education Policy-2020

Common Minimum Syllabus for Uttarakhand State

Universities and Colleges

Subject: Statistics

FINAL STRUCTURE OF STATISTICS SYLLABUS

Effective from academic year 2025-2026

DEPARTMENT OF STATISTICS

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List of Papers (DSC, DSE) with Semester-wise Titles (Major Course)					
Year	**Sem.**	**Course Code**	**Paper Title**	**Theory/Practical**	**Credits (L+P+T)**
Certificate in Elementary Statistics					
1	I	DSC	Basic Statistics	Theory	3+1+0
			Basic Statistics Lab	Practical	
	II	DSC	Probability Theory and Theoretical Distributions	Theory	3+1+0
			Theoretical Distributions Lab	Practical	
Diploma in Basic Statistics					
2	III	DSC	Statistical Inference	Theory	4+0+0
		DSE-1	Indian Official Statistics, Psychological and Educational Statistics	Theory	4+0+0
	IV	DSC	Sampling Techniques	Theory	3+1+0
			Sampling Techniques Lab	Practical	
		DSE-2	Applied Statistics	Theory	3+1+0
			Applied Statistics Lab	Practical	
Degree in Bachelor of Science					
3	V	DSC	Linear Estimation, ANOVA and Design of Experiment	Theory	3+1+0
			Linear Estimation, ANOVA and DOE Lab	Practical	
		DSE-3	Numerical Analysis and Computer Methods	Theory	3+1+0
			Numerical Analysis and Computer Methods Lab	Practical	
	VI	DSC	Sampling techniques, Parametric and Non-Parametric tests	Theory	3+1+0
			Sampling techniques, Parametric and Non-Parametric tests Lab	Practical	
		DSE-4	Statistical Quality Control	Theory	3+1+0

			Statistical Quality Control Lab	Practical	
Bachelor (Research) of Science (Statistics)					
4	VII	DSC	Probability Theory	Theory	3
		DSE-1	Statistical Methods	Theory	3
		DSE-2	Advanced Analysis	Theory	3
		DSE-3	Matrix Theory And Non Parametric Methods	Theory	3
			Practical	Practical	4
			Dissertation	-	6
		DSE-4 /GE-1	Biostatistics	-	4
	VIII	DSC	Advanced Statistical Inference	Theory	3
		DSE-1	Linear Estimation And Regression Analysis	Theory	3
		DSE-2	Design Of Experiment	Theory	3
		DSE-3	Stochastic Processes	Theory	3
			Practical	Practical	4
			Dissertation	-	6
		DSE-4 /GE-1	Economic Statistics And Demography	-	4
Master of Science (Statistics)					
5	IX	DSC	Multivariate Analysis	Theory	3
		DSE-1	Reliability Theory	Theory	3
		DSE-2	Bayesian Inference	Theory	3
		DSE-3	Time Series Analysis	Theory	3
			Practical	Practical	4
			Dissertation	-	6
		DSE-4 /GE-1	Bioinformatics	-	4
	X	DSC	Advanced Sampling Theory	Theory	3
		DSE-1	Statistical Computing	Theory	3
		DSE-2	Econometrics	Theory	3
		DSE-3	Operation Research	Theory	3
			Practical	Practical	4
			Dissertation	-	6
		DSE-4 /GE-1	Actuarial Statistics	-	4

List of Discipline Specific Core (DSC) Papers for 1st -6th Semester	
Sl. No.	**Papers Name**
1.	Basic Statistics
2.	Probability Theory and Theoretical Distributions
3.	Statistical Inference
4.	Sampling Techniques
5.	Linear Estimation, ANOVA and Design of Experiment
6.	Sampling techniques, Parametric and Non-Parametric tests
List of Discipline Specific Electives (DSE) Papers for 1st -6th Semester	
1.	Indian Official Statistics , Psychological and Educational Statistics
2.	Applied Statistics
3.	Numerical Analysis and Computer Methods
4.	Statistical Quality Control

List of Discipline Specific Core (DSC) Papers for 7th -10th Semester	
Sl. No.	**Papers Name**
1.	Probability Theory
2.	Advanced Statistical Inference
3.	Multivariate Analysis
4.	Advanced Sampling Theory
List of Discipline Specific Electives (DSE) Papers for 7th -10th Semester	
1.	Statistical Methods
2.	Advanced Analysis
3.	Matrix Theory And Non Parametric Methods
4.	Biostatistics
5.	Linear Estimation And Regression Analysis
6.	Design Of Experiment
7.	Stochastic Processes
8.	Economic Statistics And Demography
9.	Reliability Theory
10.	Bayesian Inference
11.	Time Series Analysis
12.	Bioinformatics
13.	Statistical Computing

14.	Econometrics
15.	Operation Research
16.	Actuarial Statistics
List of General Electives (GE) Papers for 7th -10th Semester	
1.	Biostatistics
2.	Economic Statistics And Demography
3.	Bioinformatics
4.	Actuarial Statistics

Abbreviations-

DSC-Discipline Specific Course, DSE- Discipline Specific Electives,

Programme Specific Outcomes (PSOs) **After this programme, the learners will be able to:**	
PSO 1	Knowledge of different concepts, principles, methodologies and tools (skills) of Statistics.
PSO 2	Ability to collect tabulate, represent graphically, analyze and interpret data/information by using appropriate statistical tools.
PSO 3	Ability to identify and solve a wide range of problems in real life/industry related to Statistics.
PSO 4	Familiarity with computational techniques and statistical software including programming language (e.g. R) for mathematical and statistical computation.
PSO 5	Capability to use appropriate statistical skills in interdisciplinary areas such as finance, health, agriculture, government, business, industry, telecommunication and bio-statistics.
PSO 6	Ability to compete with industrial/private sector demand in the field of data analysis, marketing survey, etc. in professional manner and pursue their future career in the field of Statistics.
PSO 7	Ability to develop original thinking for formulating new problems and providing their solutions. As a result, they will be able to pursue higher studies or research in the field of Statistics.
PSO 8-9	The degree of Bachelor (Research in Statistics) of science will encourage students to explore and learnadvanced topics / techniques used in Statistics and also will help them to develop the ability to formulate real life problems statistically and solve them using these techniques. They will be eligible to pursue their career in

	various fields of academics, researchand industry as well as to obtain master degree in Statistics.
PSO 9-10	The Master of Science in StatisticsProgramme provides the student a chance to acquire advanced Statistical ideas that are useful to solve complex problems. The student would get some research oriented experience by doing research projects in the last semester under the supervision of faculty. After completion of the course students are eligible to open up several career options in Statistics and other branches of Basic and Social sciences.

Purpose of the Program

The Importance of Statistics is well known. Statistical ideas not only help students to understand the theory of several disciplines of Basic as well as Social sciences but also to enhance their decision-making skills so that they can handle critical situation in a better way. The purpose of the postgraduate program in Statisticsat the university and college level istoprepare our students for all those fields where advanced Statistical and Analytical skill is requiredfor careers as well as professionals in various industries and research institutions.

Program Outcomes

PO 1. Students will have a firm foundation in the fundamentals and applications of Statistics and scientific theories.

PO 2. Students will develop skills in problem solving, critical thinking and analytical reasoning as
applied to scientific problems.

PO 3. Students will be able to explore new directions to pursue higher studies in science subjects.

PO 4. Students will be able to contest and qualify different competitive exams where graduation degree is one of the essential qualifications.

PO 5. Students will be able to function as a member of an interdisciplinary problem-solving team.

Pattern of examination theory papers

A. Theory

*Each theory paper shall consist two sections **A** and **B**.*

***Section A**: (Short answers type); 30 marks, eight questions of six marks each, any five have to be attempted).*

***Section B**: (Long answers type); 45 marks, five questions of fifteen marks each. Any three have to be attempted.*

B. Internal assessment

For each theory paper internal assessment shall be conducted periodically (in the form of class tests and/or assignments/ group discussion/ oral presentation/ overall performance) during the semester period. Total marks allotted to internal assessment shall be 25. The evaluated answer sheets/assignments have to be retained by the Professor In-Charge for the period of six months and can be shown to the students if students want to see the evaluated answer sheets. The marks obtained by the students shall be submitted to the Head of concerned department/ the Principal of the College for uploading onto the University examination portal.

C. Practical

The laboratory work of the students has to be evaluated periodically. The internal assessment in the form of lab test, lab record, internal evaluationand attendance of total 25 marks for each semester shall be conducted during the semester. A minimum of 10 experiments covering all kinds of exercises have to be conducted during a semester. In each semester practical examination of 75 marks has to be conducted by two examiners (External and internal) having duration of 3 hours for each Semester. The total number of students to be examined per batch should not be more than sixty. Marks obtained in the practical examination have to be submitted to the Head of the department/ Principal of the College. The Head of the Department/Principal of the College will make necessary arrangement for uploading the marks onto the University exam portal. The hard copy of the award list from portal has to be submitted to the Controller of Examination, Kumaun University, Nainital.

Department of Statistics

Semester-I

Undergraduate Certificate in Statistics

DISCIPLINE SPECIFIC COURSE (DSC-1)-

Basic Statistics

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Basic Statistics	**4**	**3**		**1**	Passed Class 12th with Mathematics	**Nil**

UNDERGRADUATE CERTIFICATE IN STATISTICS		
Programme/Class: Certificate	**Year: I**	**Semester: I Paper: DSC-1**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-	**Course Title: Basic Statistics**	

Course outcomes:

After completing this course a student will have:

- ✓ Knowledge of Statistics, its scope and importance in various fields.
- ✓ Ability to understand concepts of sample vs. population and difference between different types of data.
- ✓ Knowledge of methods for summarizing data sets, including common graphical tools (such as box plots, histograms and stem plots). Interpret histograms and box plots.
- ✓ Ability to describe data with measures of central tendency and measures of dispersion.
- ✓ Ability to understand measures of skewness and kurtosis and their utility and significance.
- ✓ Ability to understand Correlation and Regression

Credits: **03**	Core: **Compulsory**
Max.Marks:As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

Unit	Topic	No. of Hours
I	Definition and Scope of Statistics, Statistical data: Qualitative & Quantitative. Scales of measurement: Nominal, Ordinal, Interval and Ratio. Organization of data, Collection of data, Diagrammatic and Graphical representation of Data. Theory of Attributes-Definition, Consistency and independence of data with special reference to attributes.	**16**
II	Measures of Location (Mathematical and Positional)-Mean, Median, Mode, Quartiles, Deciles and Percentiles Measures of dispersion, Range, Quartile Deviation, Mean Deviation, Variance, Standard Deviation, Root Mean Square Deviation, Coefficient of Variation, Moments, Factorial moments, Skewness and Kurtosis. Sheppard's corrections and Charlier's Check.	**16**
III	Meaning of Correlation, Scatter diagram, Karl Pearson's Coefficient of Correlation. Assumptions Underlying Karl Pearson's Correlation Coefficient. Correlation coefficient for a Bivariate Frequency Distribution. Rank Correlation. Linear regression, Properties of Regression Coefficients. R^2, *Principle* of least squares and curve fitting.	**16**
IV	Multiple and Partial Correlation (Limited to 3 variables)	**12**

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta

4. New Mathematical Statistics: Bansi Lal and S. Arora.
5. Basic Statistics: B. L. Aggarwal.
6. Programmed Statistics: B. L. Aggarwal.
7. An Introduction to Theory of Statistics: G. Udny, M. G, Kendal.
8. Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.
9.http://mospi.nic.in

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Quiz/Assignment	**(05marks)**
Class Test-I	**(10marks)**
Class Test-II	**(10marks)**
Course prerequisites: To study this course, a student must have Mathematics of 12th standard.	

Programme/Class: **Certificate**	Year: **I**	Semester: **I**
Subject: **STATISTICS (Practical)**		
Course Code:-	Course Title: **Basic Statistics Lab**	

Course outcomes:

After completing this course a student will have:

- ✓ Ability to represent/summarize the data/information using appropriate Graphical methods including common graphical tools (such as box plots, histograms and stem plots) and also to draw inferences from these graphs
- ✓ Acquire the knowledge to identify the situation to apply appropriate measure of central tendency as per the nature and need of the data and draw meaningful conclusions regarding behavior of the data.
- ✓ Acquire the knowledge to identify the situation to apply appropriate measure of dispersion as per the nature and need of the data and draw meaningful conclusions regarding heterogeneity of the data.
- ✓ Ability to measure skewness and kurtosis of data and define their significance.
- ✓ Ability to deal with problems of Correlation and Regression.

Credits:01	Core: Compulsory	
Max.Marks:As per Univ. rule	Min. Passing Marks:As per Univ. rule	
	List of Practical	No. of Hours
	1. Problems based on graphical representation of data by Histogram,Frequencypolygons, frequency curves and Ogives, Stem and Leaf Plot, Box Plot. 2. Problems based on calculation of Measures of Central Tendency. 3. Problems based on calculation of Measures of Dispersion. 4. Problems based on Correlation and Regression	60
Suggested Readings: As suggested for Theory papers.		
Suggested Continuous Evaluation Methods:(25 Marks) Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:		
Practical File/Record		**(10 marks)**
Class Interaction		**(05 marks)**
Report Preparation/Presentation		**(10 marks)**
Suggested Practical Examination Evaluation Methods:(75 Marks) Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:		
Practical Exercise(Major) 03x15Marks		**45Marks**
Viva-voce		**15 Marks**
Practical Record and Attendance		**15 Marks**
Further Suggestions		

Semester-II

Undergraduate Certificate in Statistics

DISCIPLINE SPECIFIC COURSE (DSC-2)- Probability Theory and Theoretical Distributions

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course	Eligibility	Pre-

		Lecture	Tutorial	Practical/Practice	criteria	requisite of the course (if any)
DSC:Probability Theory and Theoretical Distributions	**4**	**3**		**1**	Passed Class $12^{th}$with Mathematics	**Nil**

UNDERGRADUATE CERTIFICATE IN STATISTICS		
Programme/Class: Certificate	**Year: I**	**Semester: II Paper: DSC-2**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-	**Course Title: Probability Theory and Theoretical Distributions**	

Course outcomes:

After completing this course a student will have:

- ✓ Knowledge of discrete distributions. Discuss appropriate distribution negative binomial, Poisson, etc. with their properties and application of discrete distribution models to solve problems.
- ✓ Knowledge of continuous distributions. Discuss the appropriate distribution (i.e. uniform, exponential, normal, etc.) with their properties and application of continuous distribution models to solve problems.
- ✓ Knowledge of the formal definition of order statistics.
- ✓ Ability to identify the application of theory of order statistics in real life problems.
- ✓ Ability to understand the concept of probability along with basic laws and axioms of probability.
- ✓ Ability to understand the terms mutually exclusive and independence and their relevance.
- ✓ Ability to identify the appropriate method (i.e. union, intersection, conditional, etc.) for solving a problem.
- ✓ Ability to apply basic probability principles to solve real life problems.
- ✓ Ability to understand the concept of random variable (discrete and continuous), concept of probability distribution.

Credits: **03**	Core: **Compulsory**
Max.Marks:As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

Unit	**Topic**	**No. of Hours**

I	Introduction: Brief History, Basic Terminology, and Mathematical (or Classical or 'a Priori') Probability-limitation of Mathematical Probability. Statistical (or Empirical) Probability, Limitation of Empirical Probability. Subjective Probability. Mathematical tools: Preliminary Notations of sets- Elements of sets, Operation on sets, Algebra of sets. Axiomatic approach to probability- Random experiment, Sample Space and Elementary events, Acceptable assignment of probabilities, Natural assignment of probabilities, Axiomatic Probability, Algebra of Events.	**12**
II	Some Theorems on Probability-Addition theorem of Probability, Extension of Addition theorem of Probability to n Events, Boole's Inequality, Conditional Probability, Multiplication Theory of Probability, Independent Events, Multiplication Theory of Probability for Independent Events- Extension of Multiplication theorem of Probability to n Events, Pair Wise Independent Events, Mutually Independent events, Probability of Occurrence of at least one of the events. Bayes' Theorem, Geometrical Probability.	**10**
III	Random variables: Discrete and Continuous, Distribution functions, probability mass function, and probability density function. Joint distribution of two random variables- marginal and conditional distribution, Independence of two random variables. Transformation of random variables. Expectation-theorem on expectation of sum of random variables and product of independent random variables, Conditional Expectation.	**10**
IV	Moments and Moment Generating function, Cumulant Generating function, Probability Generating function, Characteristic function, Uniqueness and Inversion Theorems (without proof). Chebyshev's inequality, Weak Law of Large numbers (without proof) and Central Limit Theorem (without proof).	**8**
V	Bernoulli distribution, Binominal distribution: Moments, recurrence relation for the moments, moment generating function (m.g.f.), additive property, characteristics function (c.f.), cumulants, probability generating function (p.g.f.) and recurrence relation for the probabilities of Binominal distribution, Poisson Distribution: Poisson distribution as a limiting case of Binominal distribution, moments, mode, recurrence relation for moments, m.g.f., c.f., cumulants and p.g.f. of poison distribution, additive property of independent poisson variates.	**10**

VI	Normal distribution as a limiting form of binominal distribution, chief characteristic of Normal distribution: mode, median, m.g.f., c.g.f. and moments of Normal distribution, a linear combination of independent normal variates, points of inflexion, mean deviation about mean, area property of Normal distribution, importance and fitting of normal distribution.	**10**

Suggested Reading

1. Fundamental of Mathematical Statistics: S.C. Gupta and V.K. Kapoor
2. Mathematical Statistics: Kapoor &Saxsena
3. Mathematical Statistics: O.P Gupta & B.D. Gupta
4. New Mathematical Statistics:Bunshi Lal & S. Arora
5. Fundamental of Applied Statistics: S.C. Gupta & V.K. Kapoor
6. Fundamental of Statistics Vol – II: A.M. Goon, M.K. Gupta & B. Das Gupta

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Quiz/Assignment	**(05marks)**
Class Test-I	**(10marks)**
Class Test-II	**(10marks)**
Course prerequisites: To study this course, a student must have passed Sem-I Theory DSC-2	

Programme/Class: **Certificate**	Year: **I**	Semester: **II**
Subject: **STATISTICS (Practical)**		
Course Code:-	Course Title: **Theoretical Distributions Lab**	
Course outcomes: After completing this course a student will have: 1. Ability to fit Binomial, Poisson and Normal distribution for given data.		

2. Acquire the knowledge to compute conditional probabilities based on Baye's Theorem.		
Credits:01	**Core: Compulsory**	
Max.Marks:As per Univ. rule	**Min. Passing Marks:As per Univ. rule**	
	List of Practical	**No. of Hours**
	1. Fit Binomial, Poisson and Normal distribution for given data. **2.** Computation of conditional probabilities based on Bayes theorem	**60**
Suggested Continuous Evaluation Methods:(25 Marks) Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:		
Practical File/Record		**(10 marks)**
Class Interaction		**(05 marks)**
Report Preparation/Presentation		**(10 marks)**
Suggested Practical Examination Evaluation Methods:(75 Marks) Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:		
Practical Exercise(Major) 03x15Marks		**45Marks**
Viva-voce		**15 Marks**
Practical Record and Attendance		**15 marks**
Further Suggestions: In practical classes a series of lectures for any statistical software (e.g. Excel or R) maybe organized for students and they may be asked to use it to perform practical problems assigned to them.		

Semester-III

Undergraduate Diploma in Statistics

DISCIPLINE SPECIFIC COURSE (DSC-3)- Statistical Inference

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC:	**4**	**4**	**-**	**-**	To study	**Nil**

Statistical Inference					this course, a student must have passed Certificate Course in Elementary Statistics.	

UNDERGRADUATE DIPLOMA IN STATISTICS		
Programme/Class: Diploma	**Year: II**	**Semester: III** **Paper: DSC-3**
Subject: STATISTICS		**Credits:4+0+0**
Course Code:-	**Course Title: Statistical Inference**	

Course outcomes:

After completing this course a student will have:

- ✓ Knowledge of the terms like null and alternative hypotheses, two-tailed and one-tailed alternative hypotheses, significant and insignificant, level of significance and confidence, p value etc.
- ✓ Ability to understand the concept of MP, UMP and UMPU tests
- ✓ Ability to understand under what situations one would conduct the small sample and large sample tests (in case of one sample and two sample tests).
- ✓ Ability to understand the difference between parameter & statistic and standard error &standard deviation.
- ✓ Knowledge of the concept of Point and Interval Estimation and discuss characteristics of a good estimator.
- ✓ Ability to understand and practice various methods of estimations of parameters.

Credits: **03**	Core: **Compulsory**
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

Unit	**Topic**	**No. of Hours**
I	Point Estimation: Introduction, Estimators and Estimate. Characteristics/Properties of Estimators: Unbiasedness, Consistency, Efficiency- Most Efficient Estimator, Minimum Variance Unbiased (MVU) Estimators, Sufficiency- Factorization Theorem(Neyman), Invariance property of Sufficient Estimator, Fisher-Neyman Criterion for Sufficient Estimator. Cramer-Rao inequality and MVB estimators. Baye's Estimators, Prior and	**20**

	Posterior Distributions, Different types of Priors	
II	Method of Estimation: Method of Moments, Method of Maximum Likelihood Estimation, Properties of Maximum Likelihood Estimators, Method of Minimum Variance, Method of Least Squares	**12**
III	Testing of Hypothesis: Statistical Hypothesis-Simple and Composite, Test of a Statistical Hypothesis, Null Hypothesis, Alternative Hypothesis, Critical Region, Two Type of Errors, Level of Significance, Power of the Test, Steps in Solving Testing of Hypothesis Problem, Optimum Test Under Different Situations-Most power test(MP test), Uniformly Most Powerful Test(UMP test), Neyman and Pearson Lemma and its application in testing simple Vs Simple hypothesis, Likelihood Ratio Test-Properties of Likelihood Ratio Test and its solution for testing simple hypothesis against composite alternative hypothesis. A Wald's Sequential Probability Ratio Test for testing of hypothesis.	**20**
IV	Interval Estimation: Confidence Interval and Confidence limits-concept of best confidence intervals, Confidence Intervals for Large Samples.	**8**

Suggested Reading

1. Fundamental of Mathematical Statistics: S.C. Gupta and V.K. Kapoor
2. Mathematical Statistics: Kapoor &Saxsena
3. Mathematical Statistics: O.P Gupta & B.D. Gupta
4. New Mathematical Statistics:Bunshi Lal & S. Arora
5. Fundamental of Applied Statistics: S.C. Gupta & V.K. Kapoor
6. Fundamental of Statistics Vol – II: A.M. Goon, M.K. Gupta & B. Das Gupta

SuggestedOnlineLinks/Readings:

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- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Quiz/Assignment	**(05marks)**
Class Test-I	**(10marks)**
Class Test-II	**(10marks)**
Course prerequisites: To study this course, a student must have passed Certificate Course in Elementary Statistics.	

Semester-III

Undergraduate Diploma in Statistics

DISCIPLINE SPECIFIC ELECTIVES (DSE-1)- Indian Official Statistics, Psychological and Educational Statistics

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Indian Official Statistics, Psychological and Educational Statistics	**4**	**4**	**-**	**-**	To study this course, a student must have passed Certificate Course in Elementary Statistics.	**Nil**

UNDERGRADUATE DIPLOMA IN STATISTICS

Programme/Class: Diploma		Year: II	Semester: III Paper: DSE-1
Subject: STATISTICS			**Credits:4+0+0**
Course Code:-DSE-1	**Course Title: Indian Official Statistics, Psychological and Educational Statistics**		

Course outcomes:

After completing this course a student will have:

- ✓ Gain knowledge about Indian Official Statistics
- ✓ Gain knowledge about Educational Statistics
- ✓ Ability to understand the Scaling individual test item in terms of difficulty.
- ✓ Ability to understand the Z score and Z-scaling.
- ✓ Ability to understand the T- scores, uses of T score and Z score.

Credits: **04**	Core: **Compulsory**
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

Unit	Topic	No. of Hours
	Indian Official, Psychological& Educational Statistics	
I	Indian Statistical System: Present official Statistical System in India, Methods of collection of official Statistics, their reliability and limitation and the principal publications containing such statistics on the topics- population, agriculture, industry, trade, price, labour and employment, transport and communication, banking and finance. Methods of collecting official statistics in Uttarakhand, Present Official Statistical system in Uttarakhand, Publication of Official Statistics in Uttarakhand.	**20**
II	Importance or statistics in psychology and educt1tion. Levels of measurement: nominal ordinal interval and ratio scales. Distinction between psychological and physical measurements. General problems and sources of errors in measurement. Meaning and types of tests in psychology and education. History of psychological measurement and testing. Uses and limitations of test. Varieties of tests. Characteristics of a good test. General steps of test construction. Test administration and scoring. Item writing and item analysis: Meaning and types of test items, Purpose and methods for evaluating test items.	**20**
III	Reliability: definition Methods of determining reliability: Test-retest or parallel forms, Spill half technique, Rational equivalence.	**20**

	Effect upon reliability of lengthening or repeating or test. Reliability coefficient as a measure of true variance. Estimating true scores by way of regression equation and reliability coefficient, Index of reliability. Validity: meaning: Estimation of validity; Types of validity: validity and test length; comparison between reliability and validity	

Suggested Reading

1. Fundamental of Mathematical Statistics: S.C. Gupta and V.K. Kapoor
2. Mathematical Statistics: Kapoor &Saxsena
3. Mathematical Statistics: O.P Gupta & B.D. Gupta
4. New Mathematical Statistics:Bunshi Lal & S. Arora
5. Fundamental of Applied Statistics: S.C. Gupta & V.K. Kapoor
6. Fundamental of Statistics Vol – II A.M. Goon, M.K. Gupta & B. Das Gupta

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Quiz/Assignment	**(05marks)**
Class Test-I	**(10marks)**
Class Test-II	**(10marks)**
Course prerequisites: To study this course, a student must have passed Certificate Course in Elementary Statistics.	

Semester-IV

Undergraduate Diploma in Statistics

DISCIPLINE SPECIFIC COURSE (DSC-4)- Sampling Techniques

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Sampling Techniques	**4**	**3**		**1**	To study this course, a student must have passed Certificate Course in Elementary Statistics.	**Nil**

UNDERGRADUATE DIPLOMA IN STATISTICS			
Programme/Class: Diploma		**Year: II**	**Semester: IV** **Paper: DSC-4**
Subject: STATISTICS			**Credits:3+1+0**
Course Code:-	**Course Title: Sampling Techniques**		
Course outcomes: After completing this course a student will have: ✓ Ability to understand the concept of sampling and how it is different from complete enumeration. ✓ Knowledge of various probability and non-probability sampling methods along with estimates of population parameters ✓ Ability to identify the situations where the various sampling techniques shall be used. ✓ Knowledge of sampling and non-sampling errors.			
Credits: **03**		Core: **Compulsory**	
Max. Marks: As per Univ. rule		**Min. Passing Marks:As per Univ. rule**	
Unit	**Topic**		**No. of Hours**
Sampling Techniques			

I	Introduction, Type of Sampling- Purposive sampling, Probability sampling, Parameter and Statistic- Sampling Distribution of Statistic, Standard Error, Sampling vs complete enumeration, sampling units and frame, sampling and non-sampling errors, precision and efficiency of sampling estimators.	**12**
II	Simple random sampling with and without replacement, definition and procedure of selecting a sample, Estimates of: population mean, total and proportion, variance of these estimates, estimates of their variances and sample size determination. Simple Random Sampling of Attributes.	**12**
III	Stratified random sampling: Technique, estimates of population mean and total, variances of these estimates, proportional and optimum, Neyman allocations and their comparison with SRS. Practical difficulties in allocation, estimation of gain in precision, post stratification and its performance.	**12**
IV	Systematic sampling: Technique, estimates of population mean and total, variances of these estimates (N=nk). Comparison of systemic sampling with SRS and stratified sampling in the presence of linear trend.	**12**
V	Introduction to Ratio and regression methods of estimation, first approximation to the population mean and total (for SRS of large size), variance of these estimates and estimates of these variances, variances in terms of correlation coefficient for regression method of estimation and their comparison with SRS.	**12**

Suggested readings:

1. Design and Analysis of Experiments: M.N.Das and N.C.Giri.
2. Fundamentals of Statistics. Vol.II: A.M. Goon, M.K. Gupta and B.Dasgupta.
3. Applied Statistics: P. Mukhopadhyay.
4. Fundamental of Applied Statistics: S.C. Gupta and V.K. Kapoor
5. Sampling Techniques: W.G.Cochram
6. Sampling Theory: Des Raj and Chandok
7. Sample Theory of Surveys with Applications: V.G. Panse and P.V. Sukhatme.
8. Sampling Techniques: Daroga Singh and F.S. Chaudhary
9. Survey Sampling: P. Mukhopadhyay

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Quiz/Assignment	**(05marks)**
Class Test-I	**(10marks)**
Class Test-II	**(10marks)**
Course prerequisites: To study this course, a student must have passed Sem-III Theory DSC-3	

Programme/Class: **Diploma**	Year: **II**	Semester: **IV**
Subject: **STATISTICS (Practical)**		
Course Code:-	Course Title: **Sampling Techniques Lab**	
Course outcomes: After completing this course a student will have: Ability to draw a simple random sample with the help of table of random numbers. 1. Ability to estimate population means and variance in simple random sampling. 2. Ability to deal with problems based on Stratified random sampling for population means (proportional and optimum allocation). 3. Ability to deal with problems based on Systematic random sampling.		
Credits:01	**Core: Compulsory**	
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**	

	List of Practical	**No. of Hours**
	1. Problems based on drawing a simple random sample with the help of table of random numbers. **2.** Problems based on estimation of population means and variance in simple random sampling. **3.** Problems based on Stratified random sampling for population means (proportional and optimum allocation). **4.** Problems based on Systematic random sampling.	**60**
Suggested Readings:As suggested for Theory papers.		
Suggested Continuous Evaluation Methods:(25 Marks)		

Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:	
Practical File/Record	**(10 marks)**
Class Interaction	**(05 marks)**
Report Preparation/Presentation	**(10 marks)**
Suggested Practical Examination Evaluation Methods:(75 Marks) Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:	
Practical Exercise(Major) 03x15Marks	**45Marks**
Viva-voce	**15 Marks**
Practical Record and Attendance	**15 marks**
Further Suggestions: In practical classes a series of lectures for any statistical software may be organized for students and they may be asked to use it to perform practical problems assigned to them.	

Semester-IV

Undergraduate Diploma in Statistics

DISCIPLINE SPECIFIC ELECTIVES (DSE-2)- Applied Statistics

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Applied Statistics	**4**	**3**		**1**	To study this course, a student must have passed Certificate Course in Elementary Statistics.	**Nil**

UNDERGRADUATE DIPLOMA IN STATISTICS		
Programme/Class: Diploma	**Year: II**	**Semester: IV** **Paper: DSE-2**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-	**Course Title: Applied Statistics**	

Course outcomes:

After completing this course a student will have:

- ✓ Familiarity with different aspects of Applied Statistics and their use in real life situations.
- ✓ Ability to understand the concept of Time series along with its different components.
- ✓ Knowledge of Index numbers and their applications along with different types of Index numbers.
- ✓ Familiarity with various demographic methods and different measures of mortality and fertility.
- ✓ Ability to understand the concept of life table and its construction.

Credits: **03**	Core: **Compulsory**
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

Unit	Topic	No. of Hours
	Applied Statistics	
I	Economic Time Series: Definition, component of time series – trends, seasonal, cyclic and irregular components with their illustrations Additive and multiplicative models, determination of trend- graphic method, semi-averages methods, method of curve fitting by principal of least squares, moving average method. Analysis of seasonal fluctuations, construction of seasonal indices using method of simple averages, ratio to trend method, ratio to moving average method and link relative method.	**15**
II	Index Numbers : Definition, problems involved in the construction of index numbers, calculation of index numbers- simple aggregate method, weighted aggregates method, simple average of price relatives, weighted average of price relatives, link relatives, chain indices, value index numbers, price and quantity index numbers, Laspeyre's, Paasche's, Marshall-Edgeworth and Fisher's index numbers.	**15**
III	Time and factor reversal tests of index number, consumer price index number and its uses. Base shifting, splicing and deflation of	**15**

	index numbers.	
IV	Vital Statistics: Introduction, measurements of population, rates and ratios of vital events. Measurement of mortality: CDR, SDR (w.r.t. Age and sex), IMR, Standardized death rates, Life (mortality) tables: definition of its main functions and uses. Measurement of fertility and reproduction: CBR, GFR and TFR. Measurement of population growth: GRR, NRR-birth, death and fertility rates, gross and net reproduction rates, elements of life table.	**15**

Suggested readings:

1. Design and Analysis of Experiments: M.N.Das and N.C.Giri.
2. Fundamentals of Statistics. Vol.II: A.M. Goon, M.K. Gupta and B.Dasgupta.
3. Applied Statistics: P. Mukhopadhyay.
4. Fundamental of Applied Statistics: S.C. Gupta and V.K. Kapoor
5. Sampling Techniques: W.G.Cochram
6. Sampling Theory: Des Raj and Chandok
7. Sample Theory of Surveys with Applications: V.G. Panse and P.V. Sukhatme.
8. Sampling Techniques: Daroga Singh and F.S. Chaudhary
9. Survey Sampling: P. Mukhopadhyay

SuggestedOnlineLinks/Readings:

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- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Quiz/Assignment	**(05marks)**
Class Test-I	**(10marks)**
Class Test-II	**(10marks)**

Course prerequisites: To study this course, a student must have passed Certificate Course in Elementary Statistics.

Programme/Class: **Diploma**	Year: **II**	Semester: **IV**
Subject: **STATISTICS (Practical)**		
Course Code:-	Course Title: **Applied Statistics Lab**	

Course outcomes:
After completing this course a student will have:
1. Ability to solve Problem based on Time Series
2. Ability to solve Problem based on Index Numbers
3. Ability to solve Problem based on Vital Statistics

Credits:**01**	Core: **Compulsory**
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

	Topic	**No. of Hours**
	1. Problem based on Time Series 2. Problem based on Index Numbers 3. Problem based on Vital Statistics	**60**

Suggested Readings:As suggested for Theory papers.

Suggested Continuous Evaluation Methods: (25 marks):

Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:

Practical File/Record	**(10marks)**
Class Interaction	**(05 marks)**
Report Preparation/Presentation	**(10 marks)**

Suggested Practical Examination Evaluation Methods:(75 Marks)

Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:

Practical Exercise (Major) 03x15Marks	**45 Marks**
Viva-voce	**15 Marks**
Practical Record and Attendance	**15 marks**

Further Suggestions:
In practical classes a series of lectures for any statistical software may be organized for students and they may be asked to use it to perform practical problems assigned to them.

Semester-V

BACHELOR OF STATISTICS

DISCIPLINE SPECIFIC COURSE (DSE-3)–Linear Inference, ANOVA and Design of Experiment

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Linear Inference, ANOVA and Design of Experiment	**4**	**3**		**1**	To study this course, a student must have passed Undergraduate Diploma in Statistics	**Nil**

BACHELOR OF STATISTICS		
Programme/Class: Bachelor of Statistics	**Year: III**	**Semester: V Paper: DSE-5**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-	**Course Title: Linear Inference, ANOVA & Design of Experiment**	

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand linear modeling.
- ✓ Ability to perform ANOVA for one way and two classifications.
- ✓ Ability to perform post-hoc analysis
- ✓ Ability to perform post-hoc analysis
- ✓ Knowledge of the concept of Design of experiment and its basic principles.
- ✓ Ability to perform the basic symmetric designs CRD, RBD and LSD with and

without missing observations.		
Credits: **03**	Core: **Compulsory**	
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**	

Unit	Topic	No. of Hours
I	Basics of Matrix Theory, Rank of a matrix, Gauss Markoff Theorem (without proof), Simple and Multiple Linear Regression Models, Estimation of Parameters.	**10**
II	Introduction to Analysis of Variance (ANOVA) and Definition, Causes of Variation Classification of ANOVA, one way classification with one observation per cell, One way classification with 'm' observations per cell, Two way classification with one observation per cell: Mathematical model, Sum of squares for various causes of variation, Expected value of Sum of Squares, Degrees of freedom for Sum of Squares, ANOVA Table and related tests of Significance.	**20**
III	Design of Experiments: Introduction, need and principles of design of experiments- Replication, Randomization and Local control and their importance in Design Theory.	**10**
IV	Completely randomized design- Layout, Statistical Analysis and Efficiency Comparisons with other designs. Randomized Block Design- Layout, Statistical Analysis and Efficiency Comparisons with other designs. Latin square Design-Layout, Statistical Analysis and Efficiency Comparisons with other designs. Missing plot techniques-Analysis of Designs with missing Observations.	**20**

Suggested Readings:

1. An Introduction to Multivariate Statistical Analysis: T.W. Anderson
2. Multivariate Analysis: A.M. Kshirsagar.
3. Multivariate Analysis- Theory & Applications: K.C. Bhuyan
4. Nonparametric Statistical Inference: J.D. Gibbons and S. Chakraborty
5. Linear Estimation and Design of Experiment: D.D. Joshi.

6. Introduction Methods of Numerical Analysis: S.S. Sastry
7. Numerical Analysis: Bhupender Singh
8. Numerical Analysis: Goyal & Gupta
9. Fundamentals of Applied Statistics: S.C Gupta & V.K Kapoor

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Quiz/Assignment	**(05marks)**
Class Test-I	**(10marks)**
Class Test-II	**(10marks)**
Course prerequisites: To study this course, a student must have passed Undergraduate Diploma in Statistics	

Programme/Class: **Bachelor of Statistics**	Year: **III**	Semester: **V**
Subject: **STATISTICS (Practical)**		
Course Code:-	Course Title: **ANOVA &DOE Lab**	

Course outcomes:

After completing this course a student will have:

- ✓ Ability to conduct test of significance based on One Way ANOVA
- ✓ Ability to conduct test of significance based on Two Way ANOVA
- ✓ Ability to analyze data in a CRD
- ✓ Ability to analyze data in a RBD
- ✓ Ability to analyze data in a LSD
- ✓ Ability to perform missing plot analysis

Credits:01	**Core: Compulsory**
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

	List of Practical	**No. of Hours**
	1. Problems based on One way ANOVA 2. Problems based on Two way ANOVA 3. Problems based on CRD 4. Problems based on RBD 5. Problems based on LSD	**60**

	6. Problems based on MISSING PLOTS	
Suggested Readings:As suggested for Theory papers.		
Suggested Continuous Evaluation Methods:(25 Marks) Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:		
Practical File/Record		**(10 marks)**
Class Interaction		**(05 marks)**
Report Preparation/Presentation		**(10 marks)**
Suggested Practical Examination Evaluation Methods:(75 Marks) Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:		
Practical Exercise(Major) 03x15Marks		**45Marks**
Viva-voce		**15 Marks**
Practical Record and Attendance		**15 marks**
Further Suggestions: Students may be asked to perform practical problems assigned to them by using MS-Excel/any Statistical software.		

Semester-V

BACHELOR OFSTATISTICS

DISCIPLINE SPECIFIC ELECTIVES (DSC-5)- Numerical Analysisand Computer Methods

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Numerical Analysis and	**4**	**3**		**1**	To study this course, a student must have passed	**Nil**

Computer Methods					Undergraduate Diploma in Statistics	

BACHELOR OF STATISTICS		
Programme/Class: Bachelor of Statistics	**Year: III**	**Semester: V** **Paper: DSC-5**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-	**Course Title: Numerical Analysis and Computer Methods**	

Course outcomes:

After completing this course a student will have:

- ✓ Ability of understand finite Differences
- ✓ Ability of understand Relationship between Δ and E
- ✓ Ability of understand Interpolation for equal and unequal interval-Newton's forward and backward formula,
- ✓ Ability of understand Lagrange's interpolation formula,
- ✓ Ability of understand Newton's divided differences formula,
- ✓ Ability of understand Central difference formula,
- ✓ Ability of understand Newton- Gauss forward and backward formula,
- ✓ Ability of understand Stirling &Bessel's formula
- ✓ Ability of understand Trapezoidal rule, Simpson's rule and Weddle's rule and numerical problems based on these rules.
- ✓ Ability to understand the Basics of computer
- ✓ Ability to understand the Flow Charts and Algorithm
- ✓ Ability to understand the Basics of Excel and R Language.

Credits: **03**	Core: **Compulsory**
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

Unit	**Topic**	**No. of Hours**
I	Finite differences: Definition of Δ and E operations, Relationship between Δ and E, Properties of operator's Δ and E with their associated mathematical problems.	**10**

II	Interpolation: Interpolation for equal and unequal interval- Newton's forward and backward formula, Lagrange's interpolation formula, Newton's divided differences formula, Central difference formula, Newton- Gauss forward and backward formula,Stirling &Bessel's formula- Derivation and problems based on these formulae.	**10**
III	Numerical integration- Trapezoidal rule, Simpson's rule and Weddle's rule and numerical problems based on these rules.	**10**
IV	Basics of computer- Introduction, origin, Development, Uses and Limitation of Computers. Type of Computers, Computer Structure, Input-unit, Output unit, CPU, secondary storage, High Level and Low Level languages, compiler and interpreter. Number systems- Binary, decimal, octal and hexadecimal number systems and their conversions into each other.	**10**
V	Flow Charts and Algorithm: Concepts of chart, algorithm and programming. Flow charts and algorithms for the following: Mean, Standard Deviation, Coefficient of Correlation, Straight line fitting. Trapezoidal rule, Simpson's 1/3 and $3/8^{th}$ rules.	**10**
VI	Basics of Excel and R Software: use of Excel and R as a calculator	**10**

Suggested Reading

1. Fundamental of Mathematical Statistics: S.C. Gupta and V.K. Kapoor
2. Mathematical Statistics: Kapoor &Saxsena
3. Mathematical Statistics: O.P Gupta & B.D. Gupta
4. New Mathematical Statistics:Bunshi Lal & S. Arora
5. Fundamental of Applied Statistics: S.C. Gupta & V.K. Kapoor
6. Fundamental of Statistics Vol – II: A.M. Goon, M.K. Gupta & B. Das Gupta

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Quiz/Assignment	**(05marks)**
Class Test-I	**(10marks)**
Class Test-II	**(10marks)**
Course prerequisites: To study this course, a student must have passed Undergraduate Diploma in Statistics	

Programme/Class: **Bachelor of Statistics**	Year: **III**	Semester: **V**
Subject: **STATISTICS (Practical)**		
Course Code:**-DSE-3**	Course Title: **Numerical Analysis and Computer Methods Lab**	
Course outcomes: After completing this course a student will have: ✓ Ability of understand finite Differences ✓ Ability of understand Relationship between Δ and E ✓ Ability of understand Interpolation for equal and unequal interval-Newton's forward and backward formula, ✓ Ability of understand Lagrange's interpolation formula, ✓ Ability of understand Newton's divided differences formula, ✓ Ability of understand Central difference formula, ✓ Ability of understand Newton- Gauss forward and backward formula, ✓ Ability of understand Stirling &Bessel's formula ✓ Ability of understand Trapezoidal rule, Simpson's rule and Weddle's rule and numerical problems based on these rules. ✓ Ability to solve Problem based on application of R as Calculator. ✓ Ability to solve Problem based on application of R in simple data analysis		
Credits:**01**	Core: **Compulsory**	
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**	

	Topic	**No. of Hours**
	Problems based on Relationship between Δ and E. 1. Problems based on Interpolation for equal and unequal interval-Newton's forward and backward formula, 2. Problems based on Lagrange's interpolation formula, 3. Problems based on Newton's divided differences formula, 4. Problems based on Central difference formula, 5. Problems based on Newton- Gauss forward and backward formula,	**60**

	6. Problems based on Stirling &Bessel's formula 7. Problems based on Problems based on Trapezoidal rule, Simpson's rule and Weddle's rule 8. Problem based on application of R as Calculator. 9. Problem based on application of R in simple data analysis	
Suggested Readings:As suggested for Theory papers.		
Suggested Continuous Evaluation Methods(25 marks): Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:		
Practical File/Record		**(10 marks)**
Class Interaction		**(05 marks)**
Report Preparation/Presentation		**(10marks)**
Suggested Practical Examination Evaluation Methods:(75 Marks) Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:		
Practical Exercise (Major) 03x15Marks		**45 Marks**
Viva-voce		**15 Marks**
Practical Record and Attendance		**15 marks**
Further Suggestions: Students may be asked to perform practical problems assigned to them by using MS-Excel/any Statistical software.		

Semester-VI

BACHELOR OF STATISTICS

DISCIPLINE SPECIFIC COURSE (DSC)–Sampling Distributions, Parametric and Non-Parametric tests

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Sampling Distributions, Parametricand Non-Parametric Tests	**4**	**3**		**1**	To study this course, a student must have passed Undergraduate Diploma in Statistics	**Nil**

BACHELOR OF STATISTICS			
Programme/Class: Bachelor of Statistics		**Year: III**	**Semester: VI** **Paper: DSC-6**
Subject: STATISTICS			**Credits:3+1+0**
Course Code:-	**Course Title: Sampling Distributions, Parametric and Non-Parametric Tests**		
Course outcomes: After completing this course a student will have: ✓ Knowledge of the concept of Sampling distributions. ✓ Knowledge of the sampling distribution of the sum and mean. ✓ Ability to understand the t, F and chi-square distribution and to identify the main characteristics of these distributions. ✓ Ability to understand various Non Parametric Methods			
Credits: **03**		Core: **Compulsory**	
Max. Marks: As per Univ. rule		**Min. Passing Marks:As per Univ. rule**	

Unit	Topic	No. of Hours
I	Random sample, parameter and statistic, sampling distribution of a statistic. Sampling distribution of Mean in Normal Population. Exact sampling distribution: definition and derivation of *p.d.f.*of $\chi^2$with n degrees of freedom(d.f) using m.g.f., nature of χ^2 curve	**12**

	for different degrees of freedom, mean, variance, m.g.f., cumulative generating function, mode, additive property and limiting form of χ^2 distribution.	
II	Exact sampling distributions- Student's t and Fisher t-distribution, Derivation of its p.d.f., nature of probability curve with different degrees of freedom, mean, variance, moments and limiting form of t distribution. Snedecore's F-distribution: Derivation of p.d.f., Probability curve with different degrees of freedom, mean variance and mode. Distribution of 1/F (n_1, n_2). Relationship between t, F and χ^2 distributions.	**12**
III	Tests of Significance for Large Sampling of Attributes- Test of Significance for Single Proportion, Test of Significance for Difference of Proportions, Sampling of Variables- Unbiased Estimate for Population mean(μ) and variance(σ^2), Standard Error of Sample Mean, Test of Significance for Single Mean, Test of Significance for Difference of Means, Test of Significance the Difference of Standard Deviations, Test of Independence of Attributes- Contingency Tables, Yate's Correction (for 2x2 contingency Table)-Fisher's Exact test, Brandt and Snedecor Formula for 2Xk contingency Table.	**12**
IV	Test of Significance for Small Samples: Test for Single Variance, χ^2- test of Homogeneity of Correlation Coefficients, Bartlett's Test for Homogeneity of Several Independent Estimates of the Same Population Variance, t-test for Single Mean, t-test for Difference of Means, Paired t-test for Difference of Means, t-teat for Testing the Significance of an Observed Sample Correlation Coefficient. F-test for Equality of Two Population Variances, F-test for testing the Significance of an Observed Multiple Correlation Coefficient, F-test for Testing the Linearity of Regression. Applications of Z-transformation.	**12**
V	Order Statistics: Introduction, Distribution of r th, smallest and largest order Statistics, Applications of Order Statistics,Non-parametric tests: Introduction and Comparison with Parametric Tests, The Single Sample Case- The Chi-Square Goodness-of-Fit Test, The Kolmogorov-Smirnov One-Sample Test, The One Sample Runs Test for Randomness, The Case of One Sample, Two Measures or Paired Replicates- The Sign Test, The Wilcoxon Signed Ranks Test. Two Independent Samples- The Chi-Square Test for Two Independent Samples, The Median Test, The Wilcoxon-Mann-Whitney Test, and The Kolmogorov-	**12**

	Smirnov Two-Sample Test.	

Suggested Readings:

1. Fundamentals of Applied Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I & II: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. New Mathematical Statistics: Bansi Lal and S. Arora.
4. Basic Statistics: B. L. Aggarwal.
5. Programmed Statistics: B. L. Aggarwal.
6. An Introduction to Theory of Statistics: G. Udny, M. G, Kendal

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Quiz/Assignment	**(05marks)**
Class Test-I	**(10marks)**
Class Test-II	**(10marks)**
Course prerequisites: To study this course, a student must have passed Undergraduate Diploma in Statistics	

Programme/Class: **Bachelor of Statistics**	Year: **III**	Semester: **VI**
Subject: **STATISTICS (Practical)**		
Course Code:-	Course Title: **Sampling Distributions, Parametric and Non-Parametric Tests Lab**	
Course outcomes: After completing this course a student will have: 1. Ability to conduct test of significance based on t, F tests and Chi-square test. 2. Ability to deal with problems based on large sample tests. 3. Ability to conduct test of significance based on –parametric tests.		

4. Ability to solve problems based on Chi Square Goodness of fit
5. Ability to solve problems based on Run Test and Sign Test
6. Ability to solve problems based on Kolmogrov Smirnov Test
7. Ability to solve problems based on Wilcoxons Signed rank test
8. Ability to solve problems based on Median Test
9. Ability to solve problems based on Mann Whitney test

Credits:01	**Core: Compulsory**
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

	List of Practical	**No. of Hours**
	1. Problems based on t –test. 2. Problems based on F-test. 3. Problems based on Chi-square test. 4. Problems based on large sample tests. 5. Problems based on Chi Square Goodness of fit 6. Problems based on Run Test and Sign Test 7. Problems based on Kolmogrov Smirnov Test 8. Problems based on Wilcoxons Signed rank test 9. Problems based on Median Test 10. Problems based on Mann Whitney test	**60**

Suggested Readings:As suggested for Theory papers.

Suggested Continuous Evaluation Methods:(25Marks)

Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:

Practical File/Record	**(10 marks)**
Class Interaction	**(05 marks)**
Report Preparation/Presentation	**(10 marks)**

Suggested Practical Examination Evaluation Methods:(75 Marks)

Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:

Practical Exercise(Major) 03x15Marks	**45Marks**
Practical Exercise(Minor) 03x15Marks	**45Marks**
Viva-voce	**15 Marks**
Practical Record and Attendance	**15 marks**

Further Suggestions:

Semester-VI

BACHELOR OF STATISTICS

DISCIPLINE SPECIFIC ELECTIVES (DSE-4)–Statistical Quality Control

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Statistical Quality Control	**4**	**3**		**1**	To study this course, a student must have passed Undergraduate Diploma in Statistics	**Nil**

BACHELOR OF STATISTICS		
Programme/Class: Bachelor of Statistics	**Year: III**	**Semester: VI** **Paper: DSE-4**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-DSE-4	**Course Title: Statistical Quality Control**	
Course outcomes: After completing this course a student will have: ✓ Ability to understand the Control Charts for variables ✓ Ability to understand the Control chart for attributes ✓ Ability to understand the Single and double sampling plans ✓ Ability to understand the Producer's and Consumer's risk ✓ Ability to understand the OC, ASN, AOQL and LTPD of Sampling Plans		
Credits: **03**	Core: **Compulsory**	
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**	

Unit	Topic	No. of Hours

I	Introduction to Statistical Quality Control, Elements of Quality Control and its uses, Process Control and Product Control, 3-σ Control limits.	**15**
II	Control Charts for variables: Control Charts for Mean: (X,R) & (X,σ) Charts-Setting the Control Limits both when standards are given and when standards are not given, Checking the Control of process, Control Charts for Range and Standard Deviation: R & σ-Chart-Setting the Control Limits both when Standards are given and when standards are not given, Checking the Control of process.	**15**
III	Control chart for attributes: p (Fraction Defective), d (Number of Defective) & c (Number of Defects) Chart-Setting the Control Limits both when Standards are given and when Standards are not given, Checking the Control of process.	**15**
IV	Sampling Inspection by Attributes-Single and double sampling plans, Producer's and Consumer's risk, OC, ASN, AOQL and LTPD of Sampling Plans. Sequential Sampling Plans	**15**

Suggested Readings:

1. Computer Fundamentals: P. K. Sinha
2. Let Us C: Yashwant Kanitkar.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Quiz/Assignment	**(05marks)**
Class Test-I	**(10marks)**
Class Test-II	**(10marks)**
Course prerequisites: To study this course, a student must have passed Undergraduate Diploma in Statistics	

Programme/Class: **Bachelor of Statistics**	Year: **III**	Semester: **VI**
Subject: **STATISTICS (Practical)**		
Course Code:**-DSE-4**	Course Title: **Statistical Quality Control Lab**	

Course outcomes:

After completing this course a student will have:

1. Ability to solve Problem based on Control Charts for variables
2. Ability to solve Problem based on Control chart for attributes

Credits:**01**	Core: **Compulsory**
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

	Topic	**No. of Hours**
	1. Problem based on Control Charts for variables 2. Problem based on Control chart for attributes	**60**

Suggested Readings:As suggested for Theory papers.

Suggested Continuous Evaluation Methods(25 marks):

Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:

Practical File/Record	**(10 marks)**
Class Interaction	**(05 marks)**
Report Preparation/Presentation	**(10marks)**

Suggested Practical Examination Evaluation Methods:(75 Marks)

Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:

Practical Exercise (Major) 03x15Marks	**45 Marks**
Viva-voce	**15 Marks**
Practical Record and Attendance	**15 marks**

Further Suggestions:

Semester-VII

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC COURSE (DSC-7)–Advanced Probability Theory

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Advanced Probability Theory	**4**	**3**		**1**	To study this course, a student must have passedB.Sc. with Statistics as a major Subject	**Nil**

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)		
Programme/Class: Bachelor (Research) of Science (Statistics)	**Year: IV**	**Semester: VII** **Paper: DSC-7**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-	**Course Title: Advanced Probability Theory**	
Course outcomes: After completing this course a student will have: ✓ Ability to understand the probability theory.		

✓ Ability to understand the Characteristic functionanditselementaryproperties. ✓ Ability to understand the Convergence of sequence of random variables. ✓ Ability to understand the different probability function.	
Credits: 5	**Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Sets, Fields —Fields and Measurable functions, Definition of Measure and probability, Notion of Random Variable, Definition of Integral and expectation of Random variable, Distribution function of a Random variable and Decomposition Theorem	18-20
II	Characteristic functionanditselementaryproperties.Uniqueness,lnversionandcontinuitytheorems,*C*.F. Kolmogorov's inequality. Chebyshev's Inequality. Law of large numbers, Central limittheorem.	15-20
III	Convergence of sequence of random variables. Convergence in Probability, in mean squareand almost sure. The weak law of large numbers, The strong law of large numbers	12-18
IV	Bernoulli's, Kintchin's theorems, Central limit theorem Lindberg – Levyand Liapounov'sform,Borel-CantelliLemma,Borelzero-onelaw.	13-18

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Roliatgi VK & Saleh AK Md. E. 2005. An introduction to Probability andStatistics. 2nd Ed.John Wiley.
6. FellerW.1972.AnIntroductiontoProbabilityTheory&Applications (Vol1andII). John Wiley.
7. Marek F. 1963. Probability Theory and Mathematical Statistics. John Wiley.
8. BhattBR.1999.ModerenProbabilityTheory.3rdEd.NewAgeInternational Pub.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have Bachelor of Science (Statistics as one of the major Subject).

Semester-VII

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-5)–Statistical Methods

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Statistical Methods	**4**	**3**		**1**	To study this course, a student must have passedB. Sc. with Statistics as a major Subjects	**Nil**

BACHELOR (RESEARCH) OF SCIENCE		
Programme/Class: Bachelor (Research) of Science	**Year: IV**	**Semester: VII Paper: DSE-5**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-DSE-5	**Course Title: Statistical Methods**	

Course outcomes:

After completing this course a student will have:

- ✓ Knowledge of discrete distributions. Discuss appropriate distribution negative binomial, Geometric, etc.

with their properties and application of discrete distribution models to solve problems.

- ✓ Knowledge of continuous distributions. Discuss the appropriate distribution (i.e. Lognormal,Logistic,Pareto etc.) with their properties and application of continuous distribution models to solve problems.
- ✓ Ability to understand the Samplingdistributions.
- ✓ Ability to understand theDistributionofquadraticforms.

Credits: **05**	Core: **Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Negative Binomial, Geometric and Hyper Geometric, Uniform, Multinomial - properties of these distributions and real life examples	10-15
II	Cauchy, Gamma, Beta of two kinds,Weibull,Lognormal,Logistic,Pareto,InverseGaussian,Exponentialdistributions Extreme value distributions· Truncateddistribution.Compound distributions. Properties of these distributions. Probability distributions of functions of randomvariables.	15-20
III	Samplingdistributionsofsamplemeanandsample variance from Normal Population, Non- central Chi-Square. t and F distributions, their properties and interrelationship.	13-18
IV	Distributionofquadraticforms,samplingdistributionofcorrelationcoefficient, regression coefficient, correlation ratio, Intra class correlation coefficient.	15-18

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. RaoCR.1965.LinearStatisticalInferenceanditsapplication.JohnWiley
6. DudewiczEJ&AMishraSN.1988.ModernMathematicalStatistics.JohnWiley. Murek F. 1963. Piobability Theory and Mathematical Statistics. John Wiley.
7. HuberP.J.1981.RobustStatistics.John Wiley.
8. Johnson NI., Kotz S & Balakrishnan N. 2000. DiscreteUnivariateDistributions. JohnWilcy.
9. Johnson NI., Kotz S & Balakrishnan N. 2000. Continuous Univariate Distributions. JohnWiley.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics

- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have Bachelor of Science (Statistics as one of the major Subject).

Semester-VII

BACHELOR (RESEARCH) OF SCIENCE(STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-6)–Advanced Analysis

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Advanced Analysis	**4**	**3**		**1**	To study this course, a student must have passedB. Sc. with Statistics as a major Subjects	**Nil**

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)		
Programme/Class: Bachelor (Research) of Science	**Year: IV**	**Semester: VII Paper: DSE-6**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-DSE-6	**Course Title: Advanced Analysis**	

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the Functions of several variables.
- ✓ Ability to understand the Partial derivatives.
- ✓ Ability to understand the Linear transformations.
- ✓ Ability to understand the Conformal representation.

Credits: **05**	Core: **Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Functions of several variables, Concept of functions of two variables, Single valued and multiple valued functions, Simultaneous limits and iterated limits in functions of two variables,.	13-18
II	Partial derivatives, interchange of order of differentiation, Composite functions,Linearcontinuityoffunctionoftwo variables, Partial Derivatives, definition, existence and continuity, interchange of order of differentiation.	15-20
III	Linear transformations, vector valued function, Differentiation of vector valued function.	13-18
IV	Conformal representation, Analytic continuation. The maximum modulus theorem, Schwartz's theorem. Hadmard's three circle theorem, Integral functions, Fourier series and transforms.	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Bartle RG. 1976. Elements ofreal Analysis. John Wiley
6. ChatterjeeSK.1970.MathematicalAnalysis.Oxford&IBH.
7. Priestley HA. 1985. Complex Analysis. Clarenton Press
8. RudinW.1985.PrinciplesofMathematicalAnalysis.McGrawHill.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html

- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have Bachelor of Science (Statistics as one of the major Subject).

Semester-VII

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-7)–Matrix Theory and Non Parametric Inference

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Matrix Theory and Non Parametric Inference	**4**	**3**		**1**	To study this course, a student must have passedB. Sc. with Statistics as a major Subjects	**Nil**

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)		
Programme/Class: Bachelor (Research) of Science	**Year: IV**	**Semester: VII Paper: DSE-7**
Subject: STATISTICS		**Credits:3+1+0**

Course Code:-DSE-7	Course Title: Matrix Theory and Non Parametric Inference

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the Inverse of a matrix.
- ✓ Ability to understand the Non-parametric methods.
- ✓ Ability to understand the Linear rank statistic and general two way sample problem.
- ✓ Ability to understand the Multivariate non parametric test.

Credits: **05**	Core: **Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Inverseofamatrix,Characteristicrootsandvectors,vector spaces,orthonormalbasis of sub-spaces. generalized Inverse, solutions of non Homogenous equations, quadratic forms (real field).	12-18
II	Non-parametricmethods,Signtest,Runtest,Mann-WhitneyU-statistics, KruskalWallistest,testforRandomness,Testfor normality	15-20
III	Linear rank statistic and general two way sample problem, Linear rank tests for location and scale problems, rank test for one way and two way classified data	13-18
IV	Multivariate non parametric test for one sample location problems, Asymptotic relative efficiency, examples of ARE tests.	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. SearleSr.1982.MatrixAlgebra.MatrixAlgebrausefulforStatistics.JohnWiley.
6. Hohn FE. 973. Elementry Matrix Algebra. Macmillan.
7. VatssaBS.l994.TheoryofMatrices.2ndEd.WileyEastern
8. NarayanShanti. 1994. A Text book of Matrices. 9th Ed.
9. S.Chand&Company
10. Gibbons.NonParametricStatistical Inference.
11. SiegelS,JohanN&CasellanJr.1956.NonParametricTestforBehavioralSciences. John Wiley.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics

- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have Bachelor of Science (Statistics as one of the major Subject).

Semester-VII

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-10/GE-1)–Bio-statistics

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Bio-statistics	**4**	**3**		**1**	To study this course, a student must have passedB. Sc. with Statistics as a major Subjects	**Nil**

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)		
Programme/Class: Bachelor (Research) of Science	**Year: IV**	**Semester: VII Paper: DSE-10 /GE-1**

Subject: STATISTICS	**Credits:3+1+0**
Course Code:- DSE-10/GE-1	**Course Title: Bio-statistics**

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the Survival Analysis
- ✓ Ability to understand the Censoring Schemes
- ✓ Ability to understand the Competing Risk Theory
- ✓ Ability to understand the Stochastic Epidemic Models
- ✓ Ability to understand the Statistical Genetics

Credits: **05**	Core: **Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Survival Analysis: Functions of survival times, survival distributions and their applications- exponential, gamma, Weibull, Rayleigh, lognormal, death density function for a distribution having bath-tub shaped hazard function. Censoring Schemes: Type I, Type II and progressive or random censoring with biological examples. Estimation of mean survival time and variance of the estimator for Type I and Type II censored data with numerical examples. Non-parametric methods: Actuarial and Kaplan-Meier methods for estimating survival function and variance of the Estimator.	12-18
II	Competing Risk Theory: Indices for measurement of probability of death under competingrisks and their inter-relations. Estimation of probabilities of death using maximum likelihood principle and modified minimum Chi-square methods. Theory of independent and dependent risks. Bivariate normal dependent risk model.	15-20
III	StochasticEpidemicModels:Simpleepidemicmodels,generalepidemicmodeldefinition and concept (without derivation). Duration of an epidemic.	13-18
IV	Statistical Genetics: Introduction, concepts-Genotype, Phenotype, Dominance, Recessiveness, Linkage and Recombination, Coupling and Repulsion. Mendelian laws of Heredity, Randommating, Gametic Array .relation between genotypicarrayandgametic array under random mating. Distribution of genotypes under random mating. Clinical Trials: Planning and design of clinical trials, Phase I, II and III trials. Single Blinding.	15-20

Suggested Readings:

1. Lee, E.T. and Wang, J.W. (2003): Statistical Methods for Survival data Analysis, 3rdEdition, John Wiley and Sons.
2. Biswas,S.(2007):AppliedStochasticProcesses:ABiostatisticalandPopulation Oriented Approach, Reprinted 2ndCentral Edition, New Central Book Agency.

3. Kleinbaum,D.G.(1996):SurvivalAnalysis,Springer.
4. Chiang,C.L.(1968):IntroductiontoStochasticProcessesinBioStatistics,John Wiley and Sons.
5. Indrayan,A.(2008):MedicalBiostatistics,2nd EditionChapmanandHall/CRC

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have Bachelor of Science (Statistics as one of the major Subject).

Programme/Class: **Bachelor (Research) of Science**		Year:**IV**	Semester:**VII**
Subject: **STATISTICS (Practical)**			
Course Code:-		Course Title: **Practical**	
Course outcomes: After completing this course a student will have: ❖ Find the rank of matrix. ❖ Find the inverse of the matrix. ❖ Find the eigen values and eigen vectors of the matrix. ❖ Find the generalised inverse of the matrix. ❖ Find the moore penrose inverse of the matrix. ❖ Perform kruskal wallis test. ❖ Perform Friedman test. ❖ Fitting of various theoretical distributions.			
Credits:**01**		Core: **Compulsory**	
Max. Marks: As per Univ. rule		**Min. Passing Marks:As per Univ. rule**	
	Topic		**No. of Hours**
	**** Practical papers based on the above Theory papers for Post Graduate course.** ❖ Find the rank of matrix. ❖ Find the inverse of the matrix. ❖ Find the eigen values and eigen vectors of the matrix. ❖ Find the generalised inverse of the matrix. ❖ Find the moore penrose inverse of the matrix. ❖ Perform kruskal wallis test. ❖ Perform Friedman test. ❖ Fitting of various theoretical distributions.		**60**
Suggested Readings:As suggested for paper I & II			

Suggested Continuous Evaluation Methods(25 marks): Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:	
Practical File/Record	**(10 marks)**
Class Interaction	**(05 marks)**
Report Preparation/Presentation	**(10marks)**
Suggested Practical Examination Evaluation Methods:(75 Marks) Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:	
Practical Exercise (Major) 03x15Marks	**45 Marks**
Viva-voce	**15 Marks**
Practical Record and Attendance	**15 marks**
Further Suggestions:	

Semester-VIII

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC COURSE (DSC-8)–Advanced Statistical Inference

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Advanced Statistical Inference	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to	**Nil**

					VII semester.	

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)		
Programme/Class: Bachelor (Research) of Science	**Year: IV**	**Semester: VIII** **Paper: DSC-8**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:- DSC-8	**Course Title: Advanced Statistical Inference**	

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the Elements of Decision Theory
- ✓ Ability to understand the Method of Estimation
- ✓ Ability to understand the Testing of Hypothesis
- ✓ Ability to understand the Sequential Analysis

Credits: 5	**Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	**Elements of Decision Theory**: Admissibility, Properties of good estimators, Unbiasedness, Efficiency, Sufficiency and completeness, Cramer —Rao inequality and its generalization, Bhattacharya's Bounds, Characteristics of distribution admitting sufficient statistic, Rao-Blackwell Theorem and Lehmann - Scheffe theorem.	16-20
II	**Method of Estimation**, Method of Maximum Likelihood, Method of Moments, Method of Chi-Square, Properties of M.L.E, existence of best asymptotic normal estimate under regularity conditions,. Interval Estimation: Confidence Regions, Shortest Confidence Interval	12-18
III	**Testing of Hypothesis**- Neyman Pearson Lemma and its generalization, UMP Tests, Unbiased Tests, UMPU Tests, Tests with Neyman structure and UMP similar tests, Likelihood Ratio tests and their large sample properties along with simple applications.	14-18
IV	**Sequential Analysis-** Need of Sequential Probability Ratio tests and it's properties, Wald's fundamental identity, OC and ASN function, Optimality of SPRT, Applications to Normal, Binomial and Poisson Distributions, Sequential estimation- Basic idea, Stein's two stage	14-20

	procedure.	

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Rohatgi VK. 1984. Statistical Inference. John Wiley
6. Rohatgi VK & Sala AK. Md. E. 2005. An Introduction to Probability and Statistics. 2I'd Ed. John Wiley
7. Joshi DD. 1990. Linear Estimation and Design of Experiment. First reprint. Wiley Eastern
8. Rao CR. 1973. Linear Statistical Inference and Its Applications. 2nd Ed. Wiley Eastern
9. E. L Lehman. 1990.Testing of Hypothesis. John Wiley
10. Wald A. 2004. Sequential Analysis. Dover Publ.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to VII semester.

Semester-VIII

BACHELOR (RESEARCH) OF SCIENCE(STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-11)–Linear Estimation and Regression Analysis

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Linear Estimation andRegression Analysis	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to VII semester.	**Nil**

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)			
Programme/Class: Bachelor (Research) of Science		**Year: IV**	**Semester: VIII** **Paper: DSE-11**
Subject: STATISTICS			**Credits:3+1+0**
Course Code:-DSE-11	**Course Title: Linear Estimation andRegression Analysis**		
Course outcomes: After completing this course a student will have: ✓ Ability to understand the Simple and multiple Linear regression ✓ Ability to understand the Assumptions of regression ✓ Ability to understand the Concepts of Least median of squares and its applications ✓ Ability to understand the Weighted Least squares method			
Credits: **05**		Core: **Compulsory**	
Max. Marks: 25+75		Minimum Passing Marks: ….	

Unit	**Topic**	**No. of Hours**
I	Simple and multiple Linear regression, Least squares fit- Properties and example, Polynomial Regression, Use of orthogonal polynomials	16-20

II	Assumptionsofregression,diagnosticsandtransformations,Examinationofresiduals, - Studentized residuals, applications of residuals in detecting outliers, identification of influential observations, Lack of fit, pure error, Testing homoscedasticityandnormalityoferrors,DurbinWatsontest,UseofR^2in examining goodness of fit, other measures of goodness of fit. Cook statistic, M- estimation.	12-18
III	ConceptsofLeastmedianofsquaresanditsapplications,ConceptofMulticollinearity, Analysis of Multiple Regression Models, estimation and testing of regressionparameters,subhypothesistesting,restrictedestimation.	14-18
IV	Weighted Least squares method: Properties and it's examples, Box-Cox family of transformation, Using of Dummy variables, Selection of variables, Forward Selection, Backwardelimination,StepwiseandStagewise regression. Introduction to non linear models, Non linear estimation: Least squares for non linearmodels.	14-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Rohatgi VK. 1984. Statistical Inference. John Wiley
6. Rohatgi VK & Sala AK. Md. E. 2005. An Introduction to Probability and Statistics. 2I'd Ed. John Wiley
7. Joshi DD. 1990. Linear Estimation and Design of Experiment. First reprint. Wiley Eastern
8. BalsleyDA, Kuh E & WalschRE. 2004. Regression Diagnostics -- IdentifyingInfluentialDataandSourcesOfCollinearity.JohnWiley.
9. ChatterjeeS,HadiA,&PriceB.1999.RegressionAnalysisbyExamples. John Wiley.
10. MontgomeryDC,PeckEA&ViningGG.2003.IntroductiontoLinearRegressionAnalysis.3rdEd.JohnWiley.
11. Draper&Smith.2005.AppliedRegressionAnalysis,JohnWiley

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to VII semester.

Semester-VIII

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-12)–Design of Experiment

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Design of Experiment	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to VII semester.	**Nil**

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)		
Programme/Class: Bachelor (Research) of Science	**Year: IV**	**Semester: VIII** **Paper: DSE-12**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-DSE-12	**Course Title: Design of Experiment**	
Course outcomes: After completing this course a student will have: ✓ Ability to understand the Fundamentals of experimental designs ✓ Ability to understand the block design		

✓ Ability to understand the Factorial Experiments ✓ Ability to understand theMissing Plot technique	
Credits: **05**	Core: **Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Fundamentals of experimental designs, one way and two way classifications ,heterogeneity settings, connectedness, balance, orthogonal structures, contrasts,.	15-20
II	Balanced incomplete block design and Lattice design, Recovery of intra-block information, Latin square, mutually orthogonal latin squares, Youden squares,.	12-18
III	Factorial Experiments- 2^2,2^3 and 3^2 designs, confounding in factorial experiments,	15-20
IV	Missing Plot technique. Plot sampling, Uniformity Trials. Split Plot and Strip plot Design	13-18

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. **Joshi DD. 1990.** Linear Estimation and Design of Experiment. First reprint. Wiley Eastern
6. Ltd. **Cochran WG & Cox GM. 1957.** Experimental Designs. 2nd Ed. John Wiley.
7. **Federer WT. 1985.** Experimental Designs. MacMillan
8. **Nigam AK & Gupta VK. 1979**. Handbook on Analysis of Experiments. IASRI Publ.
9. **Dean AM & Voss D. 1999.** Design and Analysis of Experiments. Springer.
10. **Fisher RA. 1953**. Design and Analysis of Experiments. Oliver & Boyd.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to VII semester.

Semester-VIII

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-13)–Stochastic Process

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Stochastic Process	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to VII semester.	**Nil**

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)		
Programme/Class: Bachelor (Research) of Science	**Year: IV**	**Semester: VIII** **Paper: DSE-13**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-DSE-13	**Course Title: Stochastic Process**	

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the Stochastic processes
- ✓ Ability to understand the Markov Process

Credits: **05**	Core: **Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Probability Distributions: Generating functions, Bivariate probability generating function. Stochastic Process: Introduction, Stationary Process.	15-18
II	Markov Chains: Definition of Markov Chain, transition probability matrix, order of Markov chain, Markov chain as graphs, higher transition probabilities. Generalization of independent Bernoullitrials,classificationofstatesandchains,stabilityofMarkovsystem,graph theoreticapproach.	14-16
II	PoissonProcess: postulates of Poisson process,propertiesofPoisson process,inter-arrival time, pure birth process, Yule Furry process, birth and death process, pure death process.	15-20
V	Queuing System: General concept, steady state distribution,queuingmodel,M/M/1withfinite and infinite system capacity, waiting time distribution (without proof). Gambler's Ruin Problem: Classical ruin problem, expected duration of the game.	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Medhi J. 2001. Stochastic Processes. 2nd Ed. Wiley Eastern.
6. Parzen E. 1962. Stochastic Processes. Holden-Day.
7. Bhatt BR. 2000. Stochastic Models; Analysis and Applications. New Age

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to VII semester.

Semester-VIII

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-16/GE-2)–Economic Statistics and Demography

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Economic Statistics and Demography	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to VII semester.	**Nil**

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)		
Programme/Class: Bachelor (Research) of Science	**Year: IV**	**Semester: VIII Paper: DSE-16/GE-2**
Subject: STATISTICS		**Credits:3+1+0**

Course Code:-DSE-16/GE-2	Course Title: Economic Statistics and Demography

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the Tests of Randomness
- ✓ Ability to understand the Demand Analysis
- ✓ Ability to understand the Demography
- ✓ Ability to understand the Vital rates and Ratios

Credits: **05**	Core: **Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Objects decomposition, Tests of Randomness, Trend Component, Polynomial Logistic, Gompertz, Log Normal trend functions, smoothing of moving average, Spencer's formula and effects, Slutzky-Yule effect, variate difference method, measurement of seasonal and cyclic fluctuations, periodogram and Harmonic analysis, Stationary Time Series: Concepts, Autocorrelation and Correlogram analysis.	15-18
II	Demand Analysis: Distribution of income, income and demand elasticities, Method of estimation of elasticities using family budget data and time series data, Engel's curve and Engel's law.	14-16
III	Demography: Sources of Demographic data, limitations and uses of demographic data, Theory of Demographic transition, stationary and stable population theory, uses of Lothka's stable population theory in the estimation of demographic parameters, method of inter-censal and post-censal estimation.	15-20
IV	Vital rates and Ratios, definition and construction of life tables from Vital Statistics, census returns, uses of life table, logistic and other population growth curves, measure of fertility gross net reproduction rates,	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta

5. Cox DR. 1957. Demography. Cambridge Univ. Press.
6. Rowland Di'. 2004. Demographic Methods and Concepts. Oxford Press.
7. Sigel JS & Swanson DA. 2004. The Methods and Material of Demography. 2"d Ed. Elsevier.
8. Woolson FR. 1987. Statistical Methods for the Analysis of Biomedical Data. John Wiley.
9. Wald H. Demand Analysis
10. Kendall MG. Advanced Theory of Statistics Vol-11

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to VII semester.

Programme/Class: **Bachelor (Research) of Science**	Year:**IV**	Semester:**VIII**
Subject: **STATISTICS (Practical)**		
Course Code:-	Course Title: **Practical**	

Course outcomes:
After completing this course a student will have:

- Find the least square estimator of a multiple regression model.
- Find $R^2$and check significance of the regression model.
- Analysis of BIBD.
- Analysis of 2^2 and 2^3 factorial experiment.
- Analysis of 3^2 factorial experiment.
- Analysis of split plot design.
- Analysis of strip plot design.
- Constructing transition graphs from TPM.
- Finding various probabilities from TPM.
- Queuing problem.

Credits:**01**	Core: **Compulsory**
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**

	Topic	**No. of Hours**
	**** Practical papers based on the above Theory papers for Post Graduate course.** ❖ Find the least square estimator of a multiple regression model. ❖ Find $R^2$and check significance of the regression model.	**60**

	❖ Analysis of BIBD. ❖ Analysis of $2^2$and 2^3factorial experiment. ❖ Analysis of 3^2factorial experiment. ❖ Analysis of split plot design. ❖ Analysis of strip plot design. ❖ Constructing transition graphs from TPM. ❖ Finding various probabilities from TPM. ❖ Queuing problem.	
Suggested Readings:As suggested for Theory papers.		
Suggested Continuous Evaluation Methods(25 marks): Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:		
Practical File/Record		**(10 marks)**
Class Interaction		**(05 marks)**
Report Preparation/Presentation		**(10marks)**
Suggested Practical Examination Evaluation Methods:(75 Marks) Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:		
Practical Exercise (Major) 03x15Marks		**45 Marks**
Viva-voce		**15 Marks**
Practical Record and Attendance		**15 marks**
Further Suggestions:		

Semester-IX

MASTER OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC COURSE (DSC-9)–Multivariate Analysis

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Multivariate Analysis	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to VIII semester.	**Nil**

MASTER OF SCIENCE			
Programme/Class: Master of Science		**Year: V**	**Semester: IX** **Paper: DSC-9**
Subject: STATISTICS			**Credits:3+1+0**
Course Code:-	**Course Title: Multivariate Analysis**		
Course outcomes: After completing this course a student will have: ✓ Ability to understand the Non Singular and Singular Multivariate Normal distributions. ✓ Ability to understand the Hotelling's T2 statistic andit's distribution and applications. ✓ Ability to understand the Principal Components and Canonical Correlations analysis. Ability to understand the Discriminant Analysis, Discriminant function.			
Credits: 5		**Compulsory**	
Max. Marks: 25+75		Minimum Passing Marks: ….	
Unit	**Topic**		**No. of Hours**

I	Non Singular and Singular Multivariate Normal distributions, Marginal and Conditional distributions, Characteristic Function and Moment Generating Functions, Maximum Likelihood Estimation of Mean and Co-Variance matrix,	15-20
II	Hotelling's T2 statistic as a function of the Likelihood Ratio criterion, It's distribution and applications, Mahalanobis D2 statistic and it's distribution	13-18
III	Principal Components and Canonical CorrelationsAnalisis, Factor Analysis, Cluster Analysis	14-20
IV	Discriminant Analysis, Discriminant function (for two variables), Path Analysis, MANOVA	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Anderson,TW.1958.AnintroductiontoMultivariateStatisticalAnalysis. John Wiley.
6. DillonWR&GoldsteinM.1984.MultivariateAnalysis-Methodsand Applications.John Wiley.
7. MorrisonDF.1976.MultivariateStatisticalMethods.McGrawHill.
8. GillNC.MultivariateStatisticalInference

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to VIII semester.

Semester-IX

MASTER OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-17)–Reliability Theory

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Reliability Theory	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to VIII semester.	**Nil**

MASTER OF SCIENCE			
Programme/Class: Master of Science		**Year: V**	**Semester: IX** **Paper: DSE-17**
Subject: STATISTICS			**Credits:3+1+0**
Course Code:-	**Course Title: Reliability Theory**		
Course outcomes: After completing this course a student will have: ✓ Ability to understand the reliability theory. ✓ Ability to understand the system reliability.			
Credits: 5		**Compulsory**	
Max. Marks: 25+75		Minimum Passing Marks: ….	
Unit	**Topic**		**No. of Hours**

I	**RELIABILITY THEORY:** Definition of Reliability, Maintainability and Availability ,Basic functions of Reliability and their relationships- Reliability Function, Cumulative failure distribution function, failure density function, hazard rate, Relationship between functions R(t),F(t), f(t) and λ(t), Mean time to system failure and mean time between failure, Bath Tub Curve, Estimation of Reliability from failure data	15-20
II	System Reliability- Definition of a simple system, Reliability Evaluation of a system, Reliability of a Series system, Reliability of a Parallel System, Reliability of a mixed system	13-18
III	Definition of Redundancy, Fully Redundant system and partially Redundant system, Active Redundancy and standby Redundancy,Reliability of k out of n system, Reliability of Standby systems, Standby system with perfect switching, Standby system with imperfect switching	14-20
IV	Definition of a complex system, Decomposition Method, Minimal path set and cut set method, cut set method, Tie set method,Life distributions, exponential, Gamma, Weibull and Log Normal models, Linearly increasing Hazard model	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Ravichandran N 1990. Stochastic Methods in Reliability Theory. New Age.
6. Sinha SK. 1986. Reliability and Life Testing. Wiley Eastern Ltd.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to VIII semester.

Semester-IX

MASTER OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-18)–Bayesian Inference

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Bayesian Inference	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to VIII semester.	**Nil**

MASTER OF SCIENCE		
Programme/Class: Master of Science	**Year: V**	**Semester: IX** **Paper: DSE-18**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-	**Course Title: Bayesian Inference**	
Course outcomes: After completing this course a student will have: ✓ Treat "evidence'' as value of observations and prescribe methods to deal rationally with it.		

✓ Equip students with skills to carry out and interpret posterior and preposterior data based modeling and analyses. ✓ Compute probability that the theory in question could produce the observed data. ✓ Examine some simple Bayesian models and linear regression in a Bayesian framework.		
Credits: 5		**Compulsory**
Max. Marks: 25+75		Minimum Passing Marks: ….
Unit	**Topic**	**No. of Hours**
I	Review of Basic Probability Concepts. Comparing Likelihood and Bayesian Approaches, Concept of Inverse Probability and Bayes Theorem. Classes of Prior Distributions. Conjugate Families for One Parameter Exponential Family Models, Models admitting sufficient statistics of fixed dimension.	15-20
II	Generalized Maximum Likelihood Estimate. Type of Loss Functions. Bayes estimation under various loss functions. Posterior Risk. Bayesian interval estimation: Credible intervals, HPD intervals, Comparison with classical confidence intervals. Situation specific case studies to conduct posterior analysis.	13-18
III	Prior and posterior odds. Bayes factor. Lindley's Paradox. Various types of testing hypothesis problems.	15-18
IV	Predictive density function, Regression Models	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. **Sinha Sk 1998**. Bayesian Estimation. New Age International.
6. **Winkler.** Introduction To Bayesian Inference
7. **Lee, P.** M. (1997). Bayesian Statistics: An Introduction, Arnold Press.
8. **Robert, C.**P. (2001) . The bayesian Choice: A Decision Theoretic Motivation, 2nd ed Springer Verlag.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics

- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to VIII semester.

Semester-IX

MASTER OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-19)–Time Series Analysis

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Time Series Analysis	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to VIII semester.	**Nil**

MASTER OF SCIENCE		
Programme/Class: Master of Science	**Year: V**	**Semester: IX Paper: DSE-19**
Subject: STATISTICS		**Credits:3+1+0**

Course Code:-	Course Title: Time Series Analysis

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the LinearStationarymodels.
- ✓ Ability to understand the MovingAverageandmixedprocesses.
- ✓ Ability to understand the Forecasting.
- ✓ Ability to understand the Model identificationtechniques.

Credits: 5	Compulsory
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Definition of Time series and its components, Measurement of Irregular component- Variate difference method, Harmonic Analysis, Autocorrelation and partial autocorrelation functions, Periodogram and Correlogram Analysis.	15-20
II	LinearStationarymodels:Autoregressive,MovingAverageandmixedprocesses,LinearnonStationarymodels,Autoregressiveintegratedmovingaverageprocesses	13-18
III	Forecasting: Minimum mean square forecast and their properties, calculating and updating forecast.	15-18
IV	Modelidentification:techniquesandobjectives,initialestimates,Model estimation: Likelihood function, sum of squares function, Leastsquare estimates, Seasonalmodels,InterventionanalysismodelsandOutlierdetection	15-20

Suggested Readings:

1. Fundamentals of Applied Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. BarnettV&Lewis'1'.1984.OutliersinStatisticalData.JohnWiley.
6. Box GEP, Jenkins GM & ReinselGC. 2007. Time Series Analysis: ForecastingandControl.3"1Ed.PearsonEdu
7. Douglas Montgomery. 2003. Introduction to Time Series Analysis and Forecasting. Wiley
8. RobertHShumway.2000.TimeSeriesAnalysisandit'sApplications.Springer

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to VIII th semester.

Semester-IX

MASTER OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-21/GE-3)–Bio Informatics

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Bio Informatics	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to VIII semester.	**Nil**

MASTER OF SCIENCE		
Programme/Class: Master of Science	**Year: V**	**Semester: IX Paper: DSE-**

		21/ GE-3
Subject: STATISTICS		**Credits:3+1+0**
Course Code:- DSE-21/GE-3	**Course Title: Bio Informatics**	

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the Basic Biology.
- ✓ Ability to understand the Computing techniques.
- ✓ Ability to understand the Tools for Bioinformatics.
- ✓ Ability to understand the Multiple alignment and data base search using motif models.

Credits: 5	**Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	**Basic Biology:** Cell, genes , gene structure, gene expression and regulation, Molecular tools, nucleotides, nucleic acid, markers , proteins and enzymes, bioenergetics, single nucleotidepolymorphism,expressedsequencetag,StructuralandfunctionalGenomics, Organization and structure of genomes, assembling of physical maps, strategies and techniquesforgenomesequencingandanalysis	15-20
II	**Computing techniques:** OS and programming languages, - Linux, pert, biioperl, cgi,MySQL,phpMyAdmin:CodingforbrowsingBiologicaltablesontheweb, parsingandannotationofgenomicsequences,Databasedesigning,Computer Networks: Internet, World wide Web, Web,browsersEMBnet, NCBI, Database on publicdomainpertainingtoNucleicacidsequences,proteinsequences,SNPsetc, ,Searchingsequencedatabases,Structuraldatabases.	12-18
III	**Tools for Bioinformatics:** DNA Sequence Analysis- Features of DNA Sequence Analysis,ApproachestoESTanalysis,Pairwisealignment techniques, Comparing two sequences, PAM and BLOSUM, Global Alignment(The Needleman and Wunsch algorithms)Local alignment(The Smith-Waterman Algorithm),DynamicProgramming, Pairwise database searching, Sequence Analysis- BLAST and otherrelatedtools	15-20
IV	Multiplealignmentanddatabasesearchusingmotifmodels, ClustalW,Phylogeny,DatabasesonSNPs,EMalgorithmsandothermethodsto discover common motifs in biosequences, Gene production based on Neural Networks, Genetic Algorithms, Hidden Markov models, Computational analysis of protein sequences,structureandfunction,DesignandAnalysisofmicroarrayexperiments.	13-18

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. BaldiP&BrunakS.2001.Bioinformatics:TheMachineLearningApproach.
6. 201Ed.(AdaptiveComputationandMachineLearning).MITPress.
7. Baxevanis AD & Francis BF. (Eds.). 2004.
8. Bioinformatics:APracticalGuidetotheAnalysisofGenesandProteins.JohnWiley.
9. BergeronBP.2002.BioInformaticsComputing.PrenticeHall.
10. EwensWJ&GrantGR.2001.StatisticalMethodsinBioinformatics:An Introduction(StatisticsforBiology and Health). Springer.
11. JonesNC&PevznerPA.2004.AnIntroductiontoBioinformaticsAlgorithms. MIT Press.
12. Krane DE & Raymer ML. 2002. Fundamental Concepts of Bioinformatics. Benjamin /Cummings. Tisdall JD. 2003. Beginning Perl for Bioinformatics. O'Reilly & Associates.
13. Wunschiers R. 2004. Computational Biology Unix/Linux, Data Processing and Programming. Springer.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to VIII semester.

Programme/Class: **Master of Science**	Year:**V**	Semester:**IX**
Subject: **STATISTICS (Practical)**		
Course Code:-	Course Title: **Practical**	

Course outcomes:

After completing this course a student will have:

- Perform PCA.
- Perform factor analysis.
- Perform discriminant analysis.
- Perform T^2 test and MANOVA.
- Perform MANOVA.
- Perform Canonical correlation analysis.
- Find the different Reliability functions of failure data.
- Finding the Reliability of series and parallel systems.
- Finding the Reliability of complex system.

❖ Corellogram analysis. ❖ Periodogram analysis.		
Credits:**01**	Core: **Compulsory**	
Max. Marks: As per Univ. rule	**Min. Passing Marks:As per Univ. rule**	
	Topic	**No. of Hours**
	**** Practical papers based on the above Theory papers for Post Graduate course.** ❖ Perform PCA. ❖ Perform factor analysis. ❖ Perform discriminant analysis. ❖ Perform T^2 test and MANOVA. ❖ Perform MANOVA. ❖ Perform Canonical correlation analysis. ❖ Find the different Reliability functions of failure data. ❖ Finding the Reliability of series and parallel systems. ❖ Finding the Reliability of complex system. ❖ Corellogram analysis. ❖ Periodogram analysis.	**60**
Suggested Readings:As suggested for Theory papers.		
Suggested Continuous Evaluation Methods(25 marks): Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:		
Practical File/Record		**(10 marks)**
Class Interaction		**(05 marks)**
Report Preparation/Presentation		**(10marks)**
Suggested Practical Examination Evaluation Methods:(75 Marks) Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:		
Practical Exercise (Major) 03x15Marks		**45 Marks**
Viva-voce		**15 Marks**
Practical Record and Attendance		**15 marks**
Further Suggestions:		

Semester-X

MASTER OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC COURSE (DSC-10)–Advanced Sampling Theory

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Advanced Sampling Theory	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to IX semester.	**Nil**

MASTER OF SCIENCE		
Programme/Class: Master of Science	**Year: V**	**Semester: X** **Paper: DSC-10**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-	**Course Title: Advanced Sampling Theory**	
Course outcomes: After completing this course a student will have: ✓ Ability to understand the sampling methods. ✓ Ability to understand the Probability sampling. ✓ Ability to understand the Stratified sampling and proportional and optimum allocation. ✓ Ability to understand the Ratio and regression method of estimation.		
Credits: 5	**Compulsory**	

Max. Marks: 25+75	Minimum Passing Marks: ….	
Unit	**Topic**	**No. of Hours**
I	Fundamentals of survey sampling, Probability sampling, purposive sampling. Advantages of sample survey over complete survey. Simple random sampling, with and without replacement.	15-20
II	Stratified sampling, proportional and optimum allocation. Systematic sampling, comparison with simple random sampling, linear trend, periodicity, circular systematic sampling.	13-18
III	Ratio and regression method of estimation. sampling with replacement and unequal probabilities, Estimation of mean and it's variance, Cluster Sampling: Estimates of mean and Variance for equal and unequal clusters, Efficiency in terms of Intra class correlation, Optimum unit of sampling.	14-20
IV	Double sampling, Multistage sampling with special reference to two stage design, Non Sampling errors, problems of Non Response, errors of measurement, Interpenetrating sub-sampling, Sampling with varying probabilities with and without replacement, PPS sampling, Cumulative method and Lahiri's method of selection, Horvitz-Thompson estimator, Ordered and unordered estimators, Sampling strategies due to Midzuno-Sen, Sampford and Rao-Hartley-Cochran, inclusion probability proportional to size sampling, PPS systematic sampling,Multistage sampling with unequal probabilities.	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Cochran WG. 1977. Sampling Techniques. John Wiley.
5. Murthy MN. 1977. Sampling Theory And Methods. 2nd Ed. Statistical Publ. Soc., Calcutta.
6. Mukhopadhyay P. 1998. Theory and Methods of Survey Sampling. Prentice Hall of India Pvt. Ltd., New Delhi.
7. Des Raj & Chandhok P. 1988. Sample Survey Theory. Narosa Publ. House.
8. Sukhatme PV, Sukhatme BV, Sukhatme S & Asok C. 1984. Sampling Theory of Surveys with Applications. Sampling Theory of Surveys with Applications. Iowa State University Press and Indian Society of Agricultural Statistics, New Delhi.

9. Thompson SK. 2000. Sampling. John Wiley.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to IX semester.

Semester-X

MASTER OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-23)–Statistical Computing

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Statistical Computing	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to IX semester.	**Nil**

MASTER OF SCIENCE			
Programme/Class: Master of Science		**Year: V**	**Semester: X** **Paper: DSE-23**
Subject: STATISTICS			**Credits:3+1+0**
Course Code:-	**Course Title: Statistical Computing**		

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the Introduction to Statistical packages and computing.
- ✓ Ability to understand theMatrix computations in linear models.
- ✓ Ability to understand theSpatial Statistics.
- ✓ Ability to understand the Regression Analysis.

Credits: 5	**Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Introduction to Statistical packages and computing, data types and structures, pattern recognition, classification, association rules, graphical methods, Data analysis principles and practice.	15-20
II	Matrix computations in linear models, Analysis of discrete data, Numerical linear algebra, Numerical optimization, graphical techniques, numerical approximations, numerical integration and Monte Carlo Methods.	15-18
III	Spatial Statistics, spatial sampling, hierarchical modeling. Analysis of cohort studies, case controlled studies and randomized clinical trials, techniques in the survival data and longitudinal studies, Approaches to handle missing data and meta analysis.	15-20
IV	Random number generators, Regression Analysis (both linear and non linear), ANOVA and ANCOVA, EML Algorithm, Gibbs Sampling, Some advanced statistical computing	15-18

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta

5. Agresti A. 2002. Categorical Data Analysis. 2nd Ed. John Wiley.
6. 'Misted RA. 1998. Elements of Statistical Computing. Chapman & Hall.
7. Ross S. 2000. Introduction to Probability Models. Academic Press.
8. Rajaraman V. 1993. Computer Oriented Numerical Methods. Prentice-Hall.
9. Ilan J & Kamber M. 2000. Data Mining: Concepts and Techniques. Morgan. Packages: SPSS/R/Statistica/SYSTAT

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to IX th semester.

Semester-X

MASTER OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-24)–Econometrics

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Econometrics	**4**	**3**		**1**	To study this course, a student must have passed all	**Nil**

					Theory papers up to IX semester.	

MASTER OF SCIENCE			
Programme/Class: Master of Science		**Year: V**	**Semester: X** **Paper: DSE-24**
Subject: STATISTICS			**Credits:3+1+0**
Course Code:-	**Course Title: Econometrics**		
Course outcomes: After completing this course a student will have: ✓ Ability to understand the econometrics. ✓ Ability to understand themodels and identification. ✓ Ability to understand the Simultaneous equations. ✓ Ability to understand the Identification Problems.			
Credits: 5		**Compulsory**	
Max. Marks: 25+75		Minimum Passing Marks: ….	

Unit	**Topic**	**No. of Hours**
I	Models and identification, meaning of Econometrics, formulation of economic phenomenon with specification analysis, Endogenous and Exogenous Variables.	15-20
II	Simultaneous equations, meaning of structure and model problems involved in construction of economic models, concept of Multicollinearity.	15-20
III	Identification Problems, rank and order condition of Identify ability, identification under bilinear restrictions, identify ability everywhere in the parametric space, WALA'S criterion of identification.	15-18
IV	Estimation: method of estimation, two stage and three stage least squares, K- class estimates withproperties(Bias and Moment matrix), Maximum Likelihood estimators, full information and limited information maximum likelihood estimators ,Monte Carlo Studies.	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Koop G. 2007. Introduction to Econometrics. John Wiley.
6. Maddala GS. 2001. Introduction to Econometrics. 3rd Ed. John Wiley.
7. Pindyck RS & Rubinfeld DL. 1998. Econometric Models and Economic Forecasts. 4`11 Ed. McGraw Hill.
8. Verbeek M. 2008. A Guide to modern Econometrics. 3rd Ed. John Wiley.
9. G. M. K Madnani. 2008. Introduction to Econometrics.8th Ed. Oxford and IBH

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to IX semester.

Semester-X

MASTER OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-25)–Operation Research

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Operation Research	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to IX semester.	**Nil**

MASTER OF SCIENCE		
Programme/Class: Master of Science	**Year: V**	**Semester: X** **Paper: DSE-25**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-	**Course Title: Operation Research**	

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the operation research.
- ✓ Ability to understand theapplicationoperation research.
- ✓ Ability to understand theinventorycontrol.
- ✓ Ability to understand thequelling theory.

Credits: 5	**Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Introduction, definition and scope of O.R., different types of Models, Simulation techniques and Monte-Carlo Methods, Linear programming: Mathematical formulation and Simplex Method of solutions.	15-20
II	Application to the allocation of resources and industry, Transportation and Assignment Techniques.	15-20

III	Inventory Control: Economic Lot Size formula of Harris in case of known Demand and its extension allowing shortages, the case of random demand, Discrete and continuous cases, Newspaper boy problems, Replacement of items that depreciate , that fail according to a probability law, Stuffing Problems.	15-18
IV	Quelling theory: The case of Poisson and exponential input, Erlangian general and regular service items, Queuing formulas and their use in determining the optimum service rate and number of channels, Machine repair problems.	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Rustagi JS. 1994. Optimization Techniques in Statistics. Academic Press.
6. Taha HA. 2007. Operations Research: Introduction with CD. 811' Ed. Pearson Edu.

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx
- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to IX semester.

Semester-X

MASTER OF SCIENCE (STATISTICS)

DISCIPLINE SPECIFIC ELECTIVES (DSE-28/GE-4)–Actuarial Statistics

Total Number of Hours = 70-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: Actuarial Statistics	**4**	**3**		**1**	To study this course, a student must have passed all Theory papers up to IX semester.	**Nil**

MASTER OF SCIENCE		
Programme/Class: Master of Science	**Year: V**	**Semester: X Paper: DSE-28/ GE-4**
Subject: STATISTICS		**Credits:3+1+0**
Course Code:-	**Course Title: Actuarial Statistics**	

Course outcomes:

After completing this course a student will have:

- ✓ Ability to understand the Life tables and it's relation with survival function.
- ✓ Ability to understand themultiple life functions.
- ✓ Ability to understand the Insurance payable at the moment of death and at the end of the year of death-level benefits insurance.
- ✓ Ability to understand theNet premiums.

Credits: 5	**Compulsory**
Max. Marks: 25+75	Minimum Passing Marks: ….

Unit	Topic	No. of Hours
I	Insurance and utility theory, models for individual claims and their sums, survival function, curtate future lifetime, force of mortality Life tables and it's relation with survival function, examples,	15-20

	assumptions for fractional ages, some analytical laws of morality, select and ultimate tables.	
II	Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple numerical evaluation, central rate of multiple decrement Distribution of aggregate claims, compound Poisson Distribution and it's applications, Principles of compound interest, Nominal and effective rates of interest and discount, compound interest, accumulation factor, continuous compounding	15-20
III	Insurance payable at the moment of death and at the end of the year of death-level benefit insurance, endowment insurance, deferred insurance and varying benefit insurance, recursions, commutation functions, Life annuities, single payment, continuous life annuities, discrete life annuities, life annuities with monthly payment, commutation functions, varying annuities, recursions , complete annuities-intermediate and apportionable annuities-due.	15-18
IV	Net premiums: Continuous and discrete premiums, true monthly payment premiums, accumulation type benefits, Net premium reserves, Continuous and discrete net premium reserve, reserves on a semi continuous basis, reserves based on true monthly premium, reserves on an apportionable or discounted continuous basis, reserves at fractional durations, allocation of loss to policy years, recursive formulas and differential equations for reserves, commutation functions.	15-20

Suggested Readings:

1. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
2. Fundamentals of Statistics Vol- I: A. M. Goon, M. K. Gupta and B. Dasgupta.
3. Fundamentals of Statistics Vol-II: A. M. Goon, M. K. Gupta and B. Dasgupta
4. An Outline of Statistical Theory Vol-I & II, A. M. Goon, M. K. Gupta and B. Dasgupta
5. Joshi DD. 1990. Linear Estimation and Design of Experiment. First reprint. Wiley Eastern

SuggestedOnlineLinks/Readings:

- http://heecontent.upsdc.gov.in/SearchContent.aspx

- https://swayam.gov.in/explorer?searchText=statistics
- https://nptel.ac.in/course.html
- https://www.edx.org/search?q=statistics
- https://www.coursera.org/search?query=statistics&

Course Prerequisites: To study this course, a student must have passed all Theory papers up to IX semester.

<table>
<tr><td colspan="2">Programme/Class: Master of Science</td><td>Year:V</td><td>Semester:X</td></tr>
<tr><td colspan="4">Subject: STATISTICS (Practical)</td></tr>
<tr><td colspan="2">Course Code:-</td><td colspan="2">Course Title: Practical</td></tr>
<tr><td colspan="4">Course outcomes:
After completing this course a student will have:
❖ Find the estimate of mean and variance for Cluster sampling.
❖ Find the estimate of mean and variance for two stage sampling.
❖ Find the estimate of mean and variance for double sampling.
❖ Cumulative and Lahiri method of selecting varying probability sampling.
❖ Find the estimate of mean and variance for various varying probability sampling schemes.
❖ 2 SLS method.
❖ 3SLS method.
❖ Graphical method for LPP problems.
❖ Simplex method for LPP problems.
❖ Transportation problem.
❖ Assignment problem.</td></tr>
<tr><td colspan="2">Credits:01</td><td colspan="2">Core: Compulsory</td></tr>
<tr><td colspan="2">Max. Marks: As per Univ. rule</td><td colspan="2">Min. Passing Marks:As per Univ. rule</td></tr>
<tr><td></td><td>Topic</td><td colspan="2">No. of Hours</td></tr>
<tr><td></td><td>** Practical papers based on the above Theory papers for Post Graduate course.
❖ Find the estimate of mean and variance for Cluster sampling.
❖ Find the estimate of mean and variance for two stage sampling.
❖ Find the estimate of mean and variance for double sampling.
❖ Cumulative and Lahiri method of selecting varying probability sampling.
❖ Find the estimate of mean and variance for various varying probability sampling schemes.
❖ 2 SLS method.
❖ 3SLS method.
❖ Graphical method for LPP problems.
❖ Simplex method for LPP problems.
❖ Transportation problem.
❖ Assignment problem.</td><td colspan="2">60</td></tr>
</table>

Suggested Readings:As suggested for Theory papers.	
Suggested Continuous Evaluation Methods(25 marks): Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and Overall performance. The marks shall be as follows:	
Practical File/Record	**(10 marks)**
Class Interaction	**(05 marks)**
Report Preparation/Presentation	**(10 marks)**
Suggested Practical Examination Evaluation Methods:(40Marks) Practical Examination Evaluation shall be based on Viva-voce and Practical Exercises. The marks shall be as follows:	
Practical Exercise (Major) 03x15Marks	**45 Marks**
Viva-voce	**15 Marks**
Practical Record and Attendance	**15 marks**
Further Suggestions:	