**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

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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)	
		C	Certificate in Elementary Stati	stics		
	т	DSC	Statistical Methods	Theory	3+1+0	
	1		Statistical Methods Lab	Practical	5+1+0	
1	п	DSC	Probability Theory and Theoretical Distributions	Theory	2+1+0	
			Theoretical Distributions Lab	Practical	3+1+0	
			<b>Diploma in Basic Statistics</b>	·		
	III	DSC	Statistical Inference	Theory	4+0+0	
		DSE-1	Indian Official , Psychological and Educational Statistics	Theory	4+0+0	
2		DSC	Sampling Techniques	Theory	3+1+0	
	IV		Sampling Techniques Lab	Practical		
		DSE-2	Applied Statistics	Theory	2 . 1 . 0	
			Applied Statistics Lab	Practical	3+1+0	
	Degree in Bachelor of Science					
	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	2+1+0
3			Numerical Analysis and Computer Methods Lab	Practical	3+1+0	
5		DSC	Sampling techniques, Parametric and Non- Parametric tests	Theory	2.1.0	
	VI		Sampling techniques, Parametric and Non- Parametric tests Lab	Practical	5+1+0	
		DSE-4	Statistical Quality Control	Theory		
			Statistical Quality Control Lab	Practical	3+1+0	

	Bachelor (Research) of Science (Statistics)					
		DSC	DSC Probability Theory Theory			
		DSE-1	Statistical Methods	Theory	3	
		DSE-2	Advanced Analysis	Theory	3	
	VII	DSE-3	Matrix Theory And Non Parametric Methods	Theory	3	
			Practical	Practical	4	
			Dissertation	-	6	
		DSE-4 /GE-1	Biostatistics	-	4	
4		DSC	Advanced Statistical Inference	Theory	3	
		DSE-1	Linear Estimation And Regression Analysis	Theory	3	
		DSE-2	Design Of Experiment	Theory	3	
	VIII	DSE-3	Stochastic Processes	Theory	3	
			Practical	Practical	4	
			Dissertation	-	6	
		DSE-4	Economic Statistics And		4	
		/GE-1	Demography	-	4	
Master of Science (Statistics)					-	
		DSC	Multivariate Analysis	Theory	3	
	IX	DSE-1	Reliability Theory	Theory	3	
		DSE-2	Bayesian Inference	Theory	3	
		DSE-3	Time Series Analysis	Theory	3	
			Practical	Practical	4	
			Dissertation	-	6	
5		DSE-4 /GE-1	Bioinformatics	-	4	
C		DSC	Advanced Sampling Theory	Theory	3	
	Х	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 1 <sup>st</sup> -6 <sup>th</sup> Semester				
Sl. No.	Papers Name			
1.	Statistical Methods			
2.	Probability Theory and Theoretical Distributions			
3.	Statistical Inference			
4.	Sampling Techniques			
5.	Linear Estimation, ANOVA and Design of Experiment			
6.	6. Sampling techniques, Parametric and Non-Parametric tests			
List of Discipline Specific Electives (DSE) Papers for 1 <sup>st</sup> -6 <sup>th</sup> Semester				
1.	Indian Official, 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 7 <sup>th</sup> -10 <sup>th</sup> Semester					
Sl. No.	Papers Name				
1.	Probability Theory				
2.	Advanced Statistical Inference				
3.	Multivariate Analysis				
4.	Advanced Sampling Theory				
List of Dis	scipline Specific Electives (DSE) Papers for 7 <sup>th</sup> -10 <sup>th</sup> 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 7 <sup>th</sup> -10 <sup>th</sup> Semester				
1. Biostatistics				
2.	Economic Statistics And Demography			
3.	Bioinformatics			
4.	Actuarial Statistics			

# Abbreviations-

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

Programm	e Specific Outcomes (PSOs)					
After this p	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 learn advanced 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, research and industry as well as to obtain master degree in Statistics.					

PSO 9-10	The Master of Science in Statistics Programme 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 Statistics at the university and college level is to prepare our students for all those fields where advanced Statistical and Analytical skill is required for 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 evaluation, assignment/home assignment and attendance) of total 10 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. Maximum 5 marks of attendance can be given to the students. In each semester practical examination of 40 marks has to be conducted by two examiners (External and internal) having duration of 2 hours for I to IV Semester and 3 hours for V and VI 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)- Statistical Methods**

# No. of Hours-60

# **CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF** THE COURSE

Course	Credits	Credit distribution of the Course			Eligibility	Pre-requisite
THE		Lecture	Tutorial	Practical/Practice	Cinteria	(if any)
DSC: Statistical Methods	4	3		1	Passed Class 12 <sup>th</sup> with Mathematics	Nil

UNDERGRADUATE CERTIFICATE IN STATISTICS						
Programme/Class: Cert	Semester: I Paper: DSC-1					
Subject: STATISTICS			Credits:3+1+0			
Course Code:-	Course Title: Statistical Methods					
<ul> <li>Course outcomes:</li> <li>After completing this cou</li> <li>✓ Knowledge of Statisti</li> <li>✓ Ability to understand different types of data</li> <li>✓ Knowledge of method (such as box plots, his</li> <li>✓ Ability to describe of dispersion.</li> <li>✓ Ability to understand</li> </ul>	rse a student will have: cs, its scope and importance in various d concepts of sample vs. populatio ds for summarizing data sets, includin tograms and stem plots). Interpret hist tata with measures of central tender measures of skewness and kurtosis	fields. n and differ ng common g ograms and b acy and mea and their uti	ence between graphical tools ox plots. sures of			

- significance.
- ✓ Ability to understand Correlation and Regression

Credits: 03

Core: Compulsory

Max. M	arks: As per Univ. rule	Min. Passing Marks: As p	er Univ. rule
Unit	Торіс		No. of Hours
I	Definition and Scope of Statistics, Sta Quantitative. Scales of measurement: and Ratio. Organization of data, Collec and Graphical representation of Da Definition, Consistency and independent reference to attributes.	atistical data: Qualitative & Nominal, Ordinal, Interval ction of data, Diagrammatic ata. Theory of Attributes- dence of data with special	16
П	Measures of Location (Mathematic Median, Mode, Quartiles, Deciles an dispersion, Range, Quartile Deviation, Standard Deviation, Root Mean Squar Variation, Moments, Factorial moment Sheppard's corrections and Charlier's of	cal and Positional)-Mean, ad Percentiles Measures of Mean Deviation, Variance, re Deviation, Coefficient of ats, Skewness and Kurtosis. Check.	16
III	Meaning of Correlation, Scatter Coefficient of Correlation. Assum Pearson's Correlation Coefficient. Co Bivariate Frequency Distribution. R regression, Properties of Regression C least squares and curve fitting.	diagram, Karl Pearson's nptions Underlying Karl orrelation coefficient for a Rank Correlation. Linear oefficients. $R^2$ , <i>Principle</i> of	16
IV	Multiple and Partial Correlation (Limit	ed 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

## Suggested Online Links/Readings:

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

• 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	(05 marks)	
Class Test-I	(10 marks)	
Class Test-II	(10 marks)	
<b>Course prerequisites:</b> To study this course, a student must have Mathematics of 12 <sup>th</sup> standard.		

Programme/Class: Certificate	Year: I	Semester: I			
Subject: STATISTICS (Practical)					
Course Code:-	Course Title: Statistica	l Methods Lab			
Course outcomes:	Course outcomes:				
After completing this course a student will have:					
$\checkmark$ Ability to represent/summarize the data/inf	ormation using appropriate	Graphical			
methods including common graphical tools (s	such as box plots, histogram	ns and stem			
plots) and also to draw inferences from these gr	aphs	C . 1			
<ul> <li>Acquire the knowledge to identify the situation</li> </ul>	to apply appropriate measur	e of central			
tendency as per the nature and need of the	data and draw meaningful	conclusions			
regarding behavior of the data. $\checkmark$ Acquire the knowledge to identify the situ	tion to apply appropriate	maggura of			
dispersion as per the nature and need of the	data and draw meaningful	conclusions			
regarding beterogeneity of the data	data and draw meaningful	conclusions			
✓ Ability to measure skewness and kurtosis of dat	a and define their significance	e			
✓ Ability to deal with problems of Correlation and	Regression.				
Credits:01 Core: Compulsory					
Max. Marks: As per Univ. rule	Min. Passing Marks: As p	er Univ. rule			
List of Practic	al	No. of Hours			
1. Problems based on graphical re	presentation of data by				
Histogram, Frequency polygons,	frequency curves and				
Ogives, Stem and Leaf Plot, Box Plo	ot.				
2. Problems based on calculation of	of Measures of Central	60			
Tendency.					
<b>3.</b> Problems based on calculation of M	3. Problems based on calculation of Measures of Dispersion.				
4. Problems based on Correlation and Regression					
Suggested Readings: As suggested for paper I					
Suggested Continuous Evaluation Methods:(10N		A			
Continuous Internal Evaluation shall be based of	Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and				
Overall performance. The marks shall be as follows	•				

Practical File/Record	(05 marks)			
Class Interaction	(03 marks)			
Report Preparation/Presentation	(02 marks)			
Suggested Practical Examination Evaluation Methods: (40 Marks)				
Practical Examination Evaluation shall be based on Viva-voce and Practical	Exercises. The			
marks shall be as follows:				
Practical Exercise(Major) 01x15 Marks	15 Marks			
Practical Exercise(Minor) 01x10 Marks	10 Marks			
Viva-voce	15 Marks			
There shall be 04-05 Practical Exercises in Examination comprising 01 as Major				
(Compulsory) and 03-04 as Minor (Students have to attend any 01).				
Course prerequisites: To study this course, a student must have Mathematics of	12 <sup>th</sup> standard.			

# 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			Credit distribution of the Course		Eligibility criteria	Pre- requisite
		Lecture	Tutorial	Practical/Practice		of the course (if any)		
DSC: Probability Theory and Theoretical Distributions	4	3		1	Passed Class 12 <sup>th</sup> with Mathematics	Nil		

	UNDERGRADUATE	CERTIFICATE IN STATI	ISTICS		
Program	nme/Class: Certificate	Ye	ear: I	Semester: II Paper: DSC-2	
Subject: STATISTICS				Credits:3+1+0	
Course	Code:- Course Title: Pro	bability Theory and The	oretica	l Distributions	
After co $\checkmark$ K P $\downarrow$ K u d $\checkmark$ K $\checkmark$ A $\checkmark$ A $\land$	mpleting this course a student will nowledge of discrete distribution oisson, etc. with their properties a roblems. nowledge of continuous distri niform, exponential, normal, etc. istribution models to solve problet nowledge of the formal definition bility to identify the application of bility to understand the concept robability. Ability to understand the terms elevance. Ability to identify the appropriate olving a problem. Ability to apply basic probability p Ability to understand the concept oncept of probability distribution. <b>03</b> <b>arks: As per Univ. rule</b>	have: Discuss appropriate distribution of discrete distributions. Discuss the approximate with their properties and a ns. of order statistics. f theory of order statistics in of probability along with b mutually exclusive and method (i.e. union, intersect frinciples to solve real life pro- of random variable (discrete and a not of the context	oution ne stribution opriate application real life asic law independ independ independ cion, con- oblems. and cont	egative binomial, n models to solve distribution (i.e. on of continuous problems. s and axioms of dence and their ditional, etc.) for inuous), er Univ. rule	
Unit	T	pic		No. of Hours	
I	Introduction: Brief History, Bas (or Classical or 'a Priori') Pro Probability. Statistical (or Em Empirical Probability. Subjectiv Preliminary Notations of sets- I Algebra of sets. Axiomatic a experiment, Sample Space an assignment of probabilities, N Axiomatic Probability, Algebra	c Terminology, and Mather bability-limitation of Mather birical) Probability, Limitat e Probability. Mathematical lements of sets, Operation of pproach to probability- R l Elementary events, Acco atural assignment of probal of Events.	matical matical tion of l tools: on sets, candom eptable bilities,	12	
	experiment, Sample Space and Elementary events, Acceptable assignment of probabilities, Natural assignment of probabilities, Axiomatic Probability, Algebra of Events.IISome Theorems on Probability-Addition theorem of Probability, Extension of Addition theorem of Probability to n Events, Boole's				

m	<ul> <li>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.</li> <li>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.</li> </ul>	10
	expectation of sum of random variables. Expectation-theorem on expectation of sum of random variables and product of independent random variables, Conditional Expectation.	
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

## Suggested Online Links/Readings:

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

## **Suggested Continuous Evaluation Methods:**

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

Quiz/Assignment	(05 marks)		
Class Test-I	(10 marks)		
Class Test-II	(10 marks)		
<b>Course prerequisites:</b> 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 Tit	le: Theoretical Distribu	tions Lab
Course outcomes:			
After completing this course a student wi	ll have:		
1. Ability to fit Binomial, Poisson ar	nd Normal dis	stribution for given data.	
2. Acquire the knowledge to comput	e conditional	probabilities based on Bay	e's Theorem.
Credits:01	C	ore: Compulsory	
Max. Marks: As per Univ. ruleMin. Passing Marks: As per Univ. rule			er Univ. rule
List of Practical		No. of Hours	
<b>1.</b> Fit Binomial, Poisson and Normal distribution for given data.			
2. Computation of conditional probabilities based on Bayes		60	
theorem			
Suggested Continuous Evaluation Methods:(10Marks)			
Continuous Internal Evaluation shall be	based on Pa	ractical File/Record, Class	s Activities and
Overall performance. The marks shall be	as follows:		
Practical File/Record (05 marks			(05 marks)
Class Interaction (03 J			(03 marks)
Report Preparation/Presentation			(02 marks)

## Suggested Practical Examination Evaluation Methods: (40 Marks)

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

Practical Exercise (Major) 01x15 Marks	15 Marks
Practical Exercise (Minor) 01x10 Marks	10 Marks
Viva-voce	15 Marks
There shall be 04-05 Practical Exercises in Examination comprising 01	as Major
(Compulsory) and 03-04 as Minor (Students have to attend any 01).	
Commentaria interesting the state of the second state of the secon	

**Course prerequisites:** To study this course, a student must have Opted Sem-II Theory DSC-2 **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
Inc		Lecture	Tutorial	Practical/Practice	cincina	(if any)
DSC: Statistical Inference	4	4	-	-	To study this course, a student must have passed Certificate Course in Elementary Statistics.	Nil

Progran	nme/Class: Diploi	na		Year: II	Semester: III Paper: DSC-3
Subject: STATISTICS					Credits:4+0+0
Course (					
fter com fter com ✓ Kn alte p v ✓ Ab ✓ Ab larg ✓ Ab &s: ✓ Kn cha ✓ Ab Credits:	autcomes: appleting this course owledge of the te ernative hypothese alue etc. ility to understand ility to understand ge sample tests (in ility to understand tandard deviation. owledge of the c aracteristics of a go ility to understand 03	e a student will have: rms like null and alte s, significant and insig the concept of MP, Uf d under what situation case of one sample an l the difference betwe oncept of Point and ood estimator. and practice various n	ernative hypotheses gnificant, level of s MP and UMPU tes ns one would cond d two sample tests en parameter & st Interval Estimatio nethods of estimati	s, two-tailed ignificance ts duct the sm ). atistic and s n and discu ons of parar <b>ory</b>	and one-tailed and confidence, all sample and atandard error ass neters.
Max. Ma	arks: As per Univ	v. rule	Min. Passing M	arks: As pe	er Univ. rule
Unit		Торіс			No. of Hours
I	Point Estimation Characteristics/P Consistency, Ef Variance Unbiass Theorem( Neyme Fisher-Neyman inequality and Posterior Distribut	on: Introduction, I roperties of E ficiency- Most Effi- ed (MVU) Estimators an), Invariance prope Criterion for Suffici MVB estimators. Ba utions, Different types	Estimators and stimators: Unb cient Estimator, s, Sufficiency- Fac erty of Sufficient ent Estimator. Cr tye's Estimators, of Priors	Estimate. biasedness, Minimum ctorization Estimator, ramer-Rao Prior and	20
II	Method of Estim Likelihood Esti Estimators, Met Squares	nation: Method of Mon imation, Properties hod of Minimum V	ments, Method of of Maximum I Variance, Method	Maximum Likelihood of Least	12
ш	Testing of H Composite, Test Alternative Hypo of Significance,	ypothesis: Statistica t of a Statistical Hy othesis, Critical Region Power of the Test, S	l Hypothesis-Sin ypothesis, Null H n, Two Type of Err Steps in Solving 7	nple and Typothesis, Fors, Level Testing of	20

	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.	
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

## Suggested Online Links/Readings:

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

## **Suggested Continuous Evaluation Methods:**

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

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

# Semester-III

# **Undergraduate Diploma in Statistics**

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

No. of Hours-60

# CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

<b>Course Title</b>	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite
		Lecture	Tutorial	Practical/Practice	enternu	(if any)
DSE: Indian Official, 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: Diplo	ma	Year: II	Semester: III Paper: DSE-1				
Subject: STATISTICS		Credits:4+0+0					
Course Code:-DSE-1 Course Title: Indian Official, Psychological and Educational Statistics							
<b>Course outcomes:</b>							
After completing this cour	se a student will have:						
✓ Gain knowledge ab	out Indian Official Statistics						
✓ Gain knowledge ab	out Educational Statistics						
$\checkmark$ Ability to understand the Scaling individual test item in terms of difficulty.							
✓ Ability to understand	✓ Ability to understand the Z score and Z-scaling.						
✓ Ability to understand	the T- scores, uses of T score and Z sco	ore.					

Credits:	04	Core: Compulsory	
Max. M	arks: As per Univ. rule	Min. Passing Marks: As per	r Univ. rule
Unit	Торіс		No. of Hours
	Indian Official, Psychologic	al& Educational Statistics	
I	Indian Statistical System: Present o India, Methods of collection of office and limitation and the principal p statistics on the topics- population, price, labour and employment, tra banking and finance.	fficial Statistical System in ial Statistics, their reliability ublications containing such agriculture, industry, trade, nsport and communication,	20
II	Importance or statistics in psycholog measurement: nominal ordinal interval between psychological and physic problems and sources of errors in meas Meaning and types of tests in psycholog psychological measurement and testing Varieties of tests. Characteristics of a test construction. Test administration a Item writing and item analysis: Mean Purpose and methods for evaluating test	y and educt1tion. Levels of l and ratio scales. Distinction cal measurements. General urement. ogy and education. History of g. Uses and limitations of test. a good test. General steps of nd scoring. hing and types of test items, st items.	20
Ш	Reliability: definition Methods of d retest or parallel forms, Spill half tech Effect upon reliability of lengthening o coefficient as a measure of true varian way of regression equation and reli reliability. Validity: meaning: Estimation of v validity and test length; comparison be	etermining reliability: Test- nnique, Rational equivalence. r repeating or test. Reliability ce. Estimating true scores by ability coefficient, Index of validity; Types of validity: tween reliability and validity	20

#### **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

## **Suggested Online Links/Readings:**

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

#### **Suggested Continuous Evaluation Methods:**

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

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

## 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	Pre-requisite of the course
		Lecture	Tutorial	Practical/Practice	criteria	(if any)
DSC: Sampling Techniques	4	3		1	To study this course, a student must have	Nil

	passed Certificate	
	Course in	
	Statistics.	

	UNDERGRADUATE DIPLOMA IN STATISTICS						
Programme/Class: Diploma Year: II					Semester: IV Paper: DSC-4		
Subject: S	STATISTICS				Credits:3+1+0		
Course Co	ode:-	Course Title: Sampl	ing Techniques				
Course ou After com ✓ Abilit enum ✓ Know estim ✓ Abilit ✓ Know	<ul> <li>Course outcomes:</li> <li>After completing this course a student will have:</li> <li>✓ Ability to understand the concept of sampling and how it is different from complete enumeration.</li> <li>✓ Knowledge of various probability and non-probability sampling methods along with estimates of population parameters</li> <li>✓ Ability to identify the situations where the various sampling techniques shall be used.</li> </ul>						
Credits: 03 Core: Compulsory							
Max. Marks: As per Univ. rule Min. Passing Marks: As p				er Univ. rule			
Unit Topic				No. of Hours			
		Sampling Te	echniques				
Ι	Introduction, Ty sampling, Para Statistic, Standa sampling units precision and eff	pe of Sampling- Purp meter and Statistic- ard Error, Sampling and frame, sampling ficiency of sampling es	osive sampling, P Sampling Distril vs complete enu and non-samplin stimators.	robability oution of meration, ng errors,	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.				definition oopulation estimates e Random	12		
III	Stratified rando mean and total, optimum, Neyn	m sampling: Technique, variances of these enant allocations and the	ue, estimates of p estimates, proport neir comparison v	opulation ional and vith SRS.	12		

	Practical difficulties in allocation, estimation of gain in precision, post stratification and its performance.	
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

## Suggested Online Links/Readings:

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

## **Suggested Continuous Evaluation Methods:**

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

Quiz/Assignment	
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(05 marks)

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

J	· · · · · · · · · · · · · · · · · · ·	/	
Course Code:-			Course Title: Sampling Techniques Lab
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## **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		er Univ. rule	
List of Pract	ical	No. of Hours	
<b>1.</b> Problems based on drawing a sim	ple random sample with the		
help of table of random numbers.	help of table of random numbers.		
2. Problems based on estimation of population means and			
variance in simple random sampling.		60	
<b>3.</b> Problems based on Stratified rand	lom sampling for population		
means (proportional and optimum	allocation).		
4. Problems based on Systematic rand	dom sampling.		
Suggested Readings: As suggested for paper I	& II		
Suggested Continuous Evaluation Methods: (10Marks)			
Continuous Internal Evaluation shall be based	Continuous Internal Evaluation shall be based on Practical File/Record, Class Activities and		
Overall performance. The marks shall be as follows:			
Practical File/Record		(05 marks)	
Class Interaction		(03 marks)	
Report Preparation/Presentation		(02 marks)	
Suggested Practical Examination Evaluation Methods: (40 Marks)			
Practical Examination Evaluation shall be base	d on Viva-voce and Practical	Exercises. The	
marks shall be as follows:			
Practical Exercise(Major) 01x15 Marks 15 M		15 Marks	
Practical Exercise(Minor) UIX10 Marks		10 Marks	
Viva-voce 15 Marks			
There shall be 04-05 Practical Exercises in	Examination comprising 01	as Major	
(Compulsory) and 03-04 as Minor (Students have to attend any 01).			
<b>Course prerequisites:</b> To study this course, a stu	dent must have opted Sem-IV T	heory DSC-4	
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	Credits	Credit	t distributi	on of the Course	Eligibility criteria	Pre-requisite
Title	Creatis	Lecture	Tutorial	Practical/Practice		(if any)
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: Diplo	ma	Year: II	Semester: IV Paper: DSE-2	
Subject: STATISTICS Credits:3+1+			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.

 $\checkmark$  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  $\checkmark$ numbers.
- $\checkmark$  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		er Univ. rule	
Unit	Торіс		No. of Hours
	Applied S	tatistics	
I	Economic Time Series: Definition, c trends, seasonal, cyclic and irregul illustrations Additive and multiplicativ trend- graphic method, semi-averages fitting by principal of least squares Analysis of seasonal fluctuations, cons using method of simple averages, ration moving average method and link relative	omponent of time series – ar components with their ve models, determination of methods, method of curve , moving average method. struction of seasonal indices to to trend method, ratio to ve method.	15
Π	Index Numbers : Definition, problems of index numbers, calculation of index method, weighted aggregates method relatives, weighted average of price re indices, value index numbers, price a Laspeyre's, Paasche's, Marshall-Edge numbers.	involved in the construction numbers- simple aggregate l, simple average of price latives, link relatives, chain nd quantity index numbers, eworth and Fisher's index	15
III	Time and factor reversal tests of inde index number and its uses. Base shiftin index numbers.	ex number, consumer price ng, splicing and deflation of	15
IV	Vital Statistics: Introduction, measure and ratios of vital events. Measureme (w.r.t. Age and sex), IMR, Stand (mortality) tables: definition of its Measurement of fertility and reproduc Measurement of population growth: Of fertility rates, gross and net reproduct table.	ements of population, rates nt of mortality: CDR, SDR ardized death rates, Life main functions and uses. ction: CBR, GFR and TFR. GRR, NRR-birth, death and tion rates, elements of life	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

## Suggested Online Links/Readings:

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

## **Suggested Continuous Evaluation Methods:**

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

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

 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

- 1. Additive to solve Problem based on Index Number
- 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	
Торіс		No. of Hours	
<ol> <li>Problem based on Time Series</li> <li>Problem based on Index Numbers</li> <li>Problem based on Vital Statistics</li> </ol>		60	
Suggested Readings: As suggested for paper	I & II		
Continuous Internal Evaluation shall be based of Class Activities and Overall performance. The n	n Practical File/Record, narks shall be as follows:	(07	
Practical File/Record (05 mar)		(05 marks)	
Class Interaction (03 marks)		(03 marks)	
Report Preparation/Presentation(02marks)		(02marks)	
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) 01x15 Marks		15 Marks	
Practical Exercise(Minor)01x10 Marks		10 Marks	
Viva-voce		15 Marks	
There shall be 04- 05 Practical Exercises in Examination comprising 01 as Major (Compulsory) and 03-04 as Minor(Students have to attend any 01).			
<b>Course prerequisites:</b> To study this course, a student must have opted Sem-IV Theory DSE-2			
<b>Further Suggestions:</b> 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	Credits Lecture	t distributi	on of the Course	Eligibility	Pre- requisite of	
Title		Lecture	Tutorial	Practical/Practice	criteria	the course (if any)
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				
Programm	Programme/Class: Bachelor of Statistics Year: III Semester: V Paper: DSE-			
Subject: STATISTICS	Subject: STATISTICS Credits:3+1+0			Credits:3+1+0
Course Code:- Course Title: Linear Inference, ANOVA & Design of Experiment				
<ul> <li>After completing this c</li> <li>✓ Ability to under</li> <li>✓ Ability to perform</li> <li>✓ Ability to perform</li> <li>✓ Ability to perform</li> <li>✓ Ability to perform</li> <li>✓ Knowledge of t</li> <li>✓ Ability to perform</li> </ul>	ourse a student will have: stand linear modeling. rm ANOVA for one way and rm post-hoc analysis rm post-hoc analysis he concept of Design of export rm the basic symmetric des observations.	d two classification eriment and its basi igns CRD, RBD an	s. ic principl nd LSD w	es. vith and
Credits: 03 Core: Compulsory				
Max. Marks: As per Univ. ruleMin. Passing Marks: As per Univ. rule				
Unit Topic No. of Hour		No. of Hours		

Ι	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

## Suggested Online Links/Readings:

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

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

## **Suggested Continuous Evaluation Methods:**

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

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

Program	nme/Class: Bachelor of Statistics	Year: III	Semester: V		
Subject	: STATISTICS (Practical)				
Course	&DOE Lab				
Course of	outcomes:				
After cor	npleting this course a student will have:				
🖌 Abil	lity to conduct test of significance based o	n One Way ANOVA			
🖌 Abil	lity to conduct test of significance based o	n Two Way ANOVA			
✓ Abil	lity to analyze data in a CRD				
✓ Abi	lity to analyze data in a RBD				
✓ Abi	lity to analyze data in a LSD				
✓ Ability to perform missing plot analysis					
Credits:					
Max. Ma	arks: As per Univ. rule	Min. Passing Marks: As p	er Univ. rule		
	List of Practic	cal	No. of Hours		
	1. Problems based on One way ANOVA	<u>.</u>			
	2. Problems based on Two way ANOVA	Δ			
	3. Problems based on CRD				
	4. Problems based on RBD		60		
	5. Problems based on LSD				
	6. Problems based on MISSING PLOTS	5			
Suggeste	d Readings: As suggested for paper I &	k II			
Suggeste	ed Continuous Evaluation Methods: (10)	Marks)			
Continuo	us Internal Evaluation shall be based o	n Practical File/Record, Clas	s Activities and		
Overall p	performance. The marks shall be as follow	s:			
Practica	ll File/Record		(05 marks)		
Class Interaction (					
<b>Report</b>	Report Preparation/Presentation				
Suggested Practical Examination Evaluation Methods: (40 Marks)					

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

Practical Exercise(Major) 01x15 Marks	15 Marks
Practical Exercise(Minor) 01x10 Marks	10 Marks
Viva-voce	15 Marks
There shall be 04-05 Practical Exercises in Examination comprising 01 as Maj	or (Compulsory)

and 03-04 as Minor (Students have to attend any 01). **Course prerequisites:** To study this course, a student must have opted Sem- V Theory DSC-5

**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 Analysis and Computer Methods

No. of Hours-60

# CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

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

		BACHELOR O	F STATISTICS		
Programme/Class: Bachelor of Statistics Year: III					Semester: V Paper: DSC-5
Subject: STATISTICS				Credits:3+1+0	
Course (	Code:-	Computer	Methods		
<ul> <li>Course outcomes:</li> <li>After completing this course a student will have:</li> <li>✓ Ability of understand finite Differences</li> <li>✓ Ability of understand Relationship between Δ and E</li> <li>✓ Ability of understand Interpolation for equal and unequal interval-Newton's forward and backward formula,</li> <li>✓ Ability of understand Lagrange's interpolation formula,</li> <li>✓ Ability of understand Newton's divided differences formula,</li> <li>✓ Ability of understand Central difference formula,</li> <li>✓ Ability of understand Newton- Gauss forward and backward formula,</li> <li>✓ Ability of understand Stirling &amp;Bessel's formula</li> <li>✓ Ability of understand Trapezoidal rule, Simpson's rule and Weddle's rule and numerical problems based on these rules.</li> <li>✓ Ability to understand the Basics of computer</li> <li>✓ Ability to understand the Basics of Excel and R Language.</li> </ul>					
Max. Marks: As per Univ. rule Min. Passing Marks: As p				rks: As pe	er Univ. rule
Unit		Торіс			
Ι	Finite differences: Definition of $\Delta$ and E operations, Relationship between $\Delta$ and E, Properties of operator's $\Delta$ and E with their associated mathematical problems.			tionship ith their	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,				10
	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.				
	Flow Charts and Algorithm: Concepts of chart, algorithm and				
	programming. Flow charts and algorithms for the following:	10			
V	Mean, Standard Deviation, Coefficient of Correlation, Straight line	10			
	fitting. Trapezoidal rule, Simpson's 1/3 and 3/8 <sup>th</sup> rules.				
VI	Basics of Excel and R Software: use of Excel and R as a calculator	10			

- 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

#### Suggested Online Links/Readings:

- <u>http://heecontent.upsdc.gov.in/SearchContent.aspx</u>
- <u>https://swayam.gov.in/explorer?searchText=statistics</u>
- <u>https://nptel.ac.in/course.html</u>
- <u>https://www.edx.org/search?q=statistics</u>
- 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	(05 marks)
Class Test-I	(10 marks)
Class Test-II	(10 marks)
Course prerequisites: To study this course, a student must have pa	ssed Undergraduate Diploma
in Statistics	

Programme/Class: **Bachelor of Statistics** Year: III Semester: V Subject: STATISTICS (Practical) Course Title: Numerical Analysis and Course Code:-DSE-3 **Computer Methods Lab** Course outcomes: After completing this course a student will have: ✓ Ability of understand finite Differences  $\checkmark$  Ability of understand Relationship between  $\triangle$  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.  $\checkmark$  Ability to solve Problem based on application of R in simple data analysis Core: Compulsory Credits:01 Max. Marks: As per Univ. rule Min. Passing Marks: As per Univ. rule Topic No. of Hours Problems based on Relationship between  $\Delta$  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 60 formula. 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 paper I & II **Suggested Continuous Evaluation Methods (10 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	(05 marks)				
Class Interaction	(03 marks)				
Report Preparation/Presentation (02 mark					
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) 01x15 Marks 15 Marks					
Practical Exercise(Minor)01x10 Marks	10 Marks				

Viva-voce15 MarksThere shall be 04- 05 Practical Exercises in Examination comprising 01 as Major<br/>(Compulsory) and 03-04 as Minor (Students have to attend any 01).01

Course prerequisites: To study this course, a student must have opted Sem- V Theory DSE-3

# 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	t distributi	on of the Course		Pre- requisite
Course Title	Credits	Lecture	Tutorial	Practical/Practice	Eligibility criteria	of the course (if any)

DSC: Sampling Distributions, Parametric and Non-	4	3	1	To study this course, a student must have passed Undergraduate	Nil
Parametric Tests				Diploma in Statistics	

BACHELOR OF STATISTICS							
Programm	Programme/Class: Bachelor of Statistics Year: III						
Subject: S	Credits:3+1+0						
Course Code:- Course Title: Samp Parametric Tests			ing Distributions	, Parametri	c and Non-		
Course out After comp ✓ Know ✓ Know ✓ Ability charact ✓ Ability t	<ul> <li>Course outcomes:</li> <li>After completing this course a student will have:</li> <li>✓ Knowledge of the concept of Sampling distributions.</li> <li>✓ Knowledge of the sampling distribution of the sum and mean.</li> <li>✓ Ability to understand the t, F and chi-square distribution and to identify the macharacteristics of these distributions.</li> <li>✓ Ability to understand various Non Peremetric Mathada</li> </ul>						
Credits: 03							
Max. Mar	Iarks: As po	er Univ. rule					
Unit		Торіс			No. of Hours		
I	Random sample a statistic. Samp Exact sampling $\chi^2$ with n degrees for different of cumulative gen limiting form of	ibution of opulation. of <i>p.d.f.</i> of f $\chi^2$ curve e, m.g.f., perty and	12				
п	Exact sampling distribution, De with different de limiting form Derivation of p freedom, mean	Fisher t- lity curve ments and stribution: legrees of $F(n_1, n_2)$ .	12				

	Relationship between t, F and $\chi^2$ distributions.	
ш	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( $\mu$ ) and variance( $\sigma^2$ ), 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, $\chi^2$ - 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- Smirnov Two-Sample Test.	12

- 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

## Suggested Online Links/Readings:

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

## **Suggested Continuous Evaluation Methods:**

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

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

Programme/Class: Bachelor of Stati	istics	Year: III	Semester: VI						
Subject: STATISTICS (Practical)									
Course Code:	Course Title	: Sampling Distributio	ns, Parametric						
Course Code	and Non-Par	ametric Tests Lab							
Course outcomes:									
After completing this course a student	After completing this course a student will have:								
1. Ability to conduct test of signification	nce based on t, I	F tests and Chi-square test							
2. Ability to deal with problems base	ed on large samp	le tests.							
3. Ability to conduct test of signification	ince based on -p	arametric tests.							
4. Ability to solve problems based o	4. Ability to solve problems based on Chi Square Goodness of fit								
5. Ability to solve problems based o	n Run Test and S	Sign Test							
6. Ability to solve problems based of	n Kolmogrov Sr	nirnov Test							
7. Ability to solve problems based of	n Wilcoxons Sig	ned rank test							
8. Ability to solve problems based of	n Median Test								
9. Ability to solve problems based of	n Mann Whitney	/ test							
Credits:01	C	ore: Compulsory							
Max. Marks: As per Univ. rule	Ν	Iin. Passing Marks: As p	er Univ. rule						
L	No. of Hours								
1. Problems based on t –test.									
2. Problems based on F-	60								
3. Problems based on C	hi-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							
Suggeste	ed Readings: As suggested for paper I & II							
Suggeste	ed Continuous Evaluation Methods: (10 Marks)							
Continuo	ous Internal Evaluation shall be based on Practical File/Record, Class	s Activities and						
Overall performance. The marks shall be as follows:								
Practical File/Record (05 marks)								
Class In	iteraction	(03 marks)						
Report Preparation/Presentation (02 mark								
Suggeste	ed Practical Examination Evaluation Methods: (40 Marks)							
Practical	Examination Evaluation shall be based on Viva-voce and Practical	Exercises. The						
marks sh	all be as follows:							
Practica	l Exercise(Major) 01x15 Marks	15 Marks						
Practica	l Exercise(Minor) 01x10 Marks	10 Marks						
Viva-voo	ce	15 Marks						
There shall be 04-05 Practical Exercises in Examination comprising 01 as Major								
(Compulsory) and 03-04 as Minor (Students have to attend any 01).								
<b>Course prerequisites:</b> To study this course, a student must have opted Sem-VI theory DSC-6								
Further Suggestions:								

## Semester-VI

# **BACHELOR OF STATISTICS**

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

No. of Hours-60

Course Title	Credits	Credit	Credit distribution of the Course			Pre-requisite
	cicuits	Lecture	Tutorial	Practical/Practice	criteria	(if any)
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						
Subject: S		Credits:3+1+0					
Course Co							
Course ou After comp ✓ Ability t ✓ Ability t ✓ Ability t ✓ Ability t ✓ Ability t ✓ Ability t ✓ Ability t	g Plans ory arks: As p	er Univ. rule					
Unit Topic					No. of Hours		
Ι	I Introduction to Statistical Quality Control, Elements of Quality Control and its uses, Process Control and Product Control, 3-σ Control limits.				15		
Π	Control Charts (X, $\sigma$ ) Charts-Se given and when process, Contro $\sigma$ -Chart-Setting	for variables: Control tting the Control Lim standards are not give l Charts for Range an the Control Limits	Charts for Mean: its both when stan en, Checking the C d Standard Deviat both when Stand	(X,R) & dards are control of ion: R & lards are	15		

	given and when standards are not given, Checking the Control of process.	
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

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

## **Suggested Online Links/Readings:**

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

## **Suggested Continuous Evaluation Methods:**

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

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

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

# **Course outcomes:**

After completing this course a student will have:

- Ability to solve Problem based on Control Charts for variables
   Ability to solve Problem based on Control chart for attributes

	Credits:01	Core: Comp	ulsory		
Max. Marks: As per Univ. rule Min. Pa		Min. Passing Marks: A	. Passing Marks: As per Univ. rule		
	No. of Hours				
	<ol> <li>Problem based on Control Cha</li> <li>Problem based on Control char</li> </ol>	rts for variables t for attributes	60		
Suggested	Readings: As suggested for paper I	& II			
Suggested	Continuous Evaluation Methods (10	) marks):			
Continuous Class Activ	s Internal Evaluation shall be based on vities and Overall performance. The matrix	Practical File/Record, arks shall be as follows:			
Practical File/Record (05 mark					
Class Inter	(03 marks)				
Report Pro	(02 marks)				
Suggested	Practical Examination Evaluation N	Aethods: (40Marks)			
Practical E marks shall	xamination Evaluation shall be based l be as follows:	l on Viva-voce and Practi	cal Exercises. The		
Practical H	Exercise (Major) 01x15 Marks		15 Marks		
Practical H	Exercise(Minor)01x10 Marks		10 Marks		
Viva-voce	15 Marks				
There shall be 04- 05 Practical Exercises in Examination comprising 01 as Major (Compulsory) and 03-04 as Minor (Students have to attend any 01).					
<b>Course prerequisites:</b> To study this course, a student must have opted Sem-VI theory DSE-4.					
<b>Further Su</b>	iggestions:				

# Semester-VII

# **BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)**

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

# **Total Number of Hours = 70-75**

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

<b>BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)</b>						
Programme/Class: Ba	Semester: VII Paper: DSC-7					
Subject: STATISTICS	5		Credits:3+1+0			
Course Code:- Course Title: Advanced Probability Theory						
Course outcomes:						
After completing this c	ourse a student will have:					
$\checkmark$ Ability to understand	d the probability theory.					
$\checkmark$ Ability to understand	$\checkmark$ Ability to understand the Characteristic function and its elementary properties.					
✓ Ability to understand the Convergence of sequence of random variables.						
$\checkmark$ Ability to understand	d the different probability function.					

	Credits: 5	Compulsory	
	Max. Marks: 25+75	Minimum Passing Mar	ks:
Unit	Торіс		No. of Hours
I	Sets, Fields —Fields and Measurable function probability, Notion of Random Variable expectation of Random variable, Distribution variable and Decomposition Theorem	ions, Definition of Measure and e, Definition of Integral and pution function of a Random	18-20
II	Characteristic function and its elementary part and continuity theorems, <i>C</i> .F. Kolmogo Inequality. Law of large numbers, Central li	roperties. Uniqueness, Inversion rov's inequality. Chebyshev's mit theorem.	15-20
ш	Convergence of sequence of random variable in mean square and almost sure. The weak la law of large numbers	les. Convergence in Probability, aw of large numbers, The strong	12-18
IV	Bernoulli's, Kintchin's theorems, Central la and Liapounov's form, Borel-Cantelli Lemi	imit theorem Lindberg – Levy ma, Borel zero-one law.	13-18

- 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 and Statistics. 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.3<sup>rd</sup>Ed.NewAgeInternational Pub.

## Suggested Online Links/Readings:

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

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

<b>BACHELOR (RESEARCH) OF SCIENCE</b>							
Programme/Class: Bachelor (Research) of Science Year: IV							
	Credits:3+1+0						
$\checkmark$ Knowledge of discrete distributions. Discuss appropriate distribution negative binomial,							
ete distribu	ation models to						
	Year: IV						

✓ 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 Sampling distributions.

✓ Ability to understand the Distribution of quadratic forms.

Credits: 05	Credits: 05 Core: Compulsory		
Max. Marks: 25+75 Minimum Passing Marks:			
Unit	Торіс		No. of Hours
Ι	Negative Binomial, Geometric Uniform, Multinomial - properties real life examples	10-15	
II	Cauchy, Gamma, Beta of two kinds, W Pareto, InverseGaussian, Eexponential di Extreme value distributions. Truncat distributions. Properties of these distributions. Probabi of random variables.	15-20	
III	Sampling distributions of sample mean Normal Population, Non- central Chi-S their properties and interrelationship.	and sample variance from quare. t and F distributions,	13-18
IV	Distribution of quadratic forms, samplin coefficient, regression coefficient, co correlation coefficient.	ng distribution of correlation rrelation ratio, Intra class	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. Discrete Univariate Distributions. JohnWilcy.
- 9. Johnson NI., Kotz S & Balakrishnan N. 2000. Continuous Univariate Distributions. JohnWiley.

## Suggested Online Links/Readings:

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

• <u>https://www.coursera.org/search?query=statistics&</u>

**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** 

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

BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)					
Programme/Class: Bachelor (Research) of ScienceYear: IVSemester: 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:

 $\checkmark$  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	Торіс	No. of Hours
Ι	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, Linear continuity of function of two 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.

## Suggested Online Links /Readings:

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

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

**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**

Course Title	Credits	Credit distribution of the Course			Eligibility	Pre-requisite
		Lecture	Tutorial	Practical/Practice	criteria	(if any)
DSE: Matrix Theory and Non Parametric Inference	4	3		1	To study this course, a student must have passed B. 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	Торіс	No. of Hours
Ι	Inverse of a matrix, Characteristic roots and vectors, vector spaces, orthonormal basis of sub-spaces. generalized Inverse, solutions of non Homogenous equations, quadratic forms (real field).	12-18
Π	Non-parametric methods, Sign test, Run test, Mann-Whitney U- statistics, Kruskal Wallis test, test for Randomness, Test for 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.1994.TheoryofMatrices.2ndEd.WileyEastern
- 8. Narayan Shanti. 1994. A Text book of Matrices. 9th Ed.
- 9. S.Chand & Company
- 10. Gibbons. Non Parametric Statistical Inference.
- 11. SiegelS, JohanN & CasellanJr.1956. Non Parametric Test for Behavioral Sciences. John Wiley.

#### Suggested Online Links/Readings:

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

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

**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**

Course	Credits	Credit distribution of the Course			Eligibility	Pre- requisite of
Title		Lecture	Tutorial	Practical/Practice	criteria	the course (if any)
DSE: Bio- statistics	4	3		1	To study this course, a student must have passed B. 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: S	TATISTICS			Credits:3+1+0
Course Coo	de:- DSE-10/GE-1	Course Title: Bio-statisti	cs	
Course ou After comp ✓ Ability t ✓ Ability t ✓ Ability t ✓ Ability t ✓ Ability t ✓ Ability t	<b>Atcomes:</b> bleting this course a sto to understand the Sun to understand the Cen to understand the Con to understand the Sto to understand the Sto	tudent will have: vival Analysis nsoring Schemes npeting Risk Theory chastic Epidemic Models tistical Genetics	Core: Compulsory	
Unit	.5. 23+73	Торіс		No. of Hours
Ι	HoursSurvival 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			
Π	Competing Risk Theory: Indices for measurement of probability of death under competing risks 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.			
III	Stochastic Epidemic Models: Simple epidemic models, general epidemic       13-18         model definition 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 genotypic array and gametic 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			

- 1. Lee, E.T. and Wang, J.W. (2003): Statistical Methods for Survival data Analysis, 3<sup>rd</sup>Edition, John Wiley and Sons.
- 2. Biswas, S.(2007): Applied Stochastic Processes: A Bio statistical and Population

Oriented Approach, Reprinted 2<sup>nd</sup>Central Edition, New Central Book Agency.

- 3. Kleinbaum, D.G.(1996):Survival Analysis, Springer.
- 4. Chiang, C.L. (1968): Introduction to Stochastic Processes in Bio Statistics, John Wiley and Sons.
- 5. Indrayan, A. (2008): Medical Biostatistics, 2<sup>nd</sup> Edition Chapman and Hall/CRC

## Suggested Online Links/Readings:

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

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

Tiogram	Semester: VII			
Course Code:- Course Title: <b>Practical</b>			al	
Course ou After com Find Find Find Find Find Find Find Find	<ul> <li>Course outcomes:</li> <li>After completing this course a student will have:</li> <li>Find the rank of matrix.</li> <li>Find the inverse of the matrix.</li> <li>Find the eigen values and eigen vectors of the matrix.</li> <li>Find the generalised inverse of the matrix.</li> <li>Find the moore penrose inverse of the matrix.</li> <li>Perform kruskal wallis test.</li> <li>Perform Friedman test.</li> </ul>			
• Fiui	Fitting of various theoretical distributions.			
Credits:01 Core: Com				
	Credits:01	Core: C	ompulsory	
Max. Mar	ks: As per Univ. rule	Core: C Min. Passing Marl	ompulsory ks: As per Univ. rule	
Max. Mar	credits:01 ks: As per Univ. rule Topic	Core: C	ompulsory ss: As per Univ. rule No. of Hours	

Suggested Readings: As suggested for paper I & II			
Suggested Continuous Evaluation Methods (10 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	(05 marks)		
Class Interaction	(03 marks)		
Report Preparation/Presentation	(02 marks)		
Suggested Practical Examination Evaluation Methods: (40Marks)			
Practical Examination Evaluation shall be based on Viva-voce and Practimarks shall be as follows:	cal Exercises. The		
Practical Exercise (Major) 01x15 Marks	15 Marks		
Practical Exercise(Minor) 01x10 Marks	10 Marks		
Viva-voce	15 Marks		
There shall be 04- 05 Practical Exercises in Examination comprise (Compulsory) and 03-04 as Minor (Students have to attend any 01).	ing 01 as Major		

Course prerequisites: To study this course, a student must have opted Sem-VI theory DSE-4.

**Further Suggestions:** 

# Semester-VIII

# **BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)**

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

**Total Number of Hours = 70-75** 

Course	Credits	Credit	Credit distribution of the Course		Eligibility	Pre-requisite
Title	cicuits	Lecture	Tutorial	Practical/Practice	criteria	(if any)

DSC: Advanced Statistical Inference	4	3		1	To study this course, a student must have passed all Theory papers up to VII semester.	Nil
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	<b>BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)</b>				
Pro	ogramme/Class: Ba	chelor (Research) of Sci	ence	Year: IV	Semester: VIII Paper: DSC-8
Sul	ject: STATISTICS	5			Credits:3+1+0
Сог	rse Code:- DSC-8	Course Title: Advanced	Statistical Inferen	ce	
Con Afte	urse outcomes: er completing this co Ability to understand Ability to understand	ourse a student will have: I the Elements of Decision I the Method of Estimat	on Theory ion		
✓ <u> </u>	Ability to understand	the Testing of Hypothe	esis		
✓ <u>/</u>	✓ Ability to understand the Sequential Analysis				
Max. Marks: 25+75 Minimum Passing Mar				·ks:	
Unit		Торіс			No. of Hours
I	Elements of Deci estimators, Unbia Cramer —Rao ine Bounds, Characte statistic, Rao-Bla	<b>ision Theory</b> : Admissib sedness, Efficiency, Suf equality and its generalizeristics of distribution a ackwell Theorem and L	ility, Properties of ficiency and compl zation, Bhattachary admitting sufficient ehmann - Scheffe	good leteness, a's it theorem.	16-20
IIMethod 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		
ш	<b>Testing of Hypo</b> generalization, U Neyman structure	<b>thesis</b> - Neyman Pearson MP Tests, Unbiased Te e and UMP similar tests,	n Lemma and its ests, UMPU Tests, Likelihood Ratio	Tests with tests and	14-18

	their large sample properties along with simple applications.	
IV	<b>Sequential Analysis-</b> 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 procedure.	14-20

- 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.

## Suggested Online Links/Readings:

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

**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**

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

	<b>BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)</b>						
Programme/Class: Bachelor (Research) of Science Year: IV					Semester: VIII Paper: DSE-11		
Subject:	Subject: STATISTICS					dits: 3+1+0	
Course Code:-DSE-11 Course Title: Linear Estimation and Regression Analysis					nalysis		
Course of After con ✓ Ability ✓ Ability ✓ Ability ✓ Ability	<ul> <li>Course outcomes:</li> <li>After completing this course a student will have:</li> <li>✓ Ability to understand the Simple and multiple Linear regression</li> <li>✓ Ability to understand the Assumptions of regression</li> <li>✓ Ability to understand the Concepts of Least median of squares and its applications</li> <li>✓ Ability to understand the Weighted Least squares method</li> </ul>						
Credits: 05 Core: Compulsory							
Max. Marks: 25+75 Minimum Passing Marks:				•			
Unit Topic				No. of Hours			

Ι	Simple and multiple Linear regression, Least squares fit- Properties and example, Polynomial Regression, Use of orthogonal polynomials	16-20
II	Assumptions of regression, diagnostics and transformations, Examination of Residuals, - Studentized residuals, applications of residuals in detecting outliers, identification of influential observations, Lack of fit, pure error, Testing homoscedasticity and normality of errors, Durbin Watson test, Use of $\mathbb{R}^2$ in examining goodness of fit, other measures of goodness of fit. Cook statistic, M- estimation.	12-18
III	Concepts of Least median of squares and its applications, Concept of Multicollinearity, Analysis of Multiple Regression Models, estimation and testing of regression parameters, sub hypothesis testing, restricted estimation.	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, Backward elimination, Stepwise and Stagewise regression. Introduction to non linear models, Non linear estimation: Least squares for non linear models.	14-20

- 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 -- Identifying Influential Data and Sources Of Collinearity.JohnWiley.
- 9. ChatterjeeS, HadiA, & PriceB. 1999. Regression Analysis by Examples. John Wiley.
- 10. MontgomeryDC,PeckEA&ViningGG.2003.IntroductiontoLinearRegressionAnalysis.3<sup>rd</sup>E d.JohnWiley.
- 11. Draper&Smith.2005.AppliedRegressionAnalysis,JohnWiley

#### Suggested Online Links/Readings:

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

• <u>https://www.coursera.org/search?query=statistics&</u>

**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**

Course	Credits	Credit distribution of the Course			Eligibility	Pre-requisite
Title		Lecture	Tutorial	Practical/Practice	criteria	(if any)
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: I	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 the Missing Plot technique

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

Unit	Торіс	No. of Hours
Ι	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. 2<sup>nd</sup> 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.

## Suggested Online Links/Readings:

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

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

**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**

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

<b>BACHELOR (RESEARCH) OF SCIENCE (STATISTICS)</b>			
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: Stoch		chastic Process		
Course ou After comp ✓ Ability ✓ Ability	<b>Itcomes:</b> bleting this course to understand the to understand the	a student will have: Stochastic process Markov Process	es	
Credits: 05 Core: Compulsory				
Max. Marks: 25+75 Minimum Passing Marks:				
Unit		Торіс		No. of Hours
Ι	Probability Bivariate pr Process: Int	ability Distributions: Generating functions, riate probability generating function. Stochastic ess: Introduction, Stationary Process.		15-18
II	Markov C transition p Markov c probabilitie Bernoulli tr stability c approach.	Markov Chains: Definition of Markov Chain, transition probability matrix, order of Markov chain, Markov chain as graphs, higher transition probabilities. Generalization of independent Bernoulli trials, classification of states and chains, stability of Markov system, graph theoretic approach.		14-16
III	Poisson Process: postulates of Poisson process, properties of Poisson process, inter-arrival time, pure birth process, Yule Furry process, birth and death process, pure death process.		15-20	
IV	Queuing System: General concept, steady state distribution, queuing model, M/M/1with finite and infinite system capacity, waiting time distribution (without proof). Gambler's Ruin Problem: Classical		15-20	

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

## Suggested Online Links/Readings:

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

**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**

Course Title	Credits	Credit distribution of the Course			Eligibility	Pre-requisite
		Lecture	Tutorial	Practical/Practice	criteria	(if any)
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

Pro	BACHELO	DR (RESEARCH) OI Bachelor (Research) o	SCIENCE (S	TATISTICS Year: IV	) Semester: VIII Paper: DSE- 16/GE-2
Subject: S	STATISTICS				Credits: 3+1+0
Course Code:-DSE- 16/GE-2 Course Title: Economic Statistics and Demography					phy
Course of After com ✓ Ability ✓ Ability ✓ Ability ✓ Ability Credits: 09	utcomes: pleting this course to understand the to understand the to understand the to understand the 5	a student will have: Tests of Randomness Demand Analysis Demography Vital rates and Ratio	s Core: <b>Comp</b> u	ulsory	
Max. Marks: 25+75		Minimum Passing Marks:			
Unit	Торіс		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.				nd nd nd od, 15-18 am its,
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.			nd ily 14-16 w.	
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.			nd on, ole 15-20 rs,	
IV	Vital rates and from Vital Sta	Ratios, definition a atistics, census return	nd construction is, uses of life	n of life tabl table, logis	les 15-20 tic

and other population growth curves, measure of fertility gross net reproduction rates,

#### **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

## Suggested Online Links/Readings:

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

**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: <b>IV</b>	Semester: VIII					
Subject: STATISTICS (Practical)							
Course Code:-	Course Title: Practical						
<ul> <li>Course outcomes:</li> <li>After completing this course a student will have:</li> <li>Find the least square estimator of a multip</li> <li>Find R<sup>2</sup> and check significance of the regression of the regre</li></ul>	le regression model. ession model.						
<ul> <li>Inding various probabilities from 11 W.</li> <li>Oueuing problem.</li> </ul>							
Credits:01	Core: C	ompulsory					
Credits:01	Core: C	ompulsory					

		s per emirine
Торіс		No. of Hours
<ul> <li>** Practical papers based on the above Graduate course.</li> <li>Find the least square estimator of model.</li> <li>Find R<sup>2</sup> and check significance</li> <li>Analysis of BIBD.</li> <li>Analysis of 2<sup>2</sup> and 2<sup>3</sup> factorial experime</li> <li>Analysis of 3<sup>2</sup> factorial experime</li> <li>Analysis of split plot design.</li> <li>Constructing transition graphs for Finding various probabilities for</li> </ul>	60	
Suggested Readings: As suggested for paper I a Suggested Continuous Evaluation Methods (10 Continuous Internal Evaluation shall be based on I Class Activities and Overall performance. The ma	& II marks): Practical File/Record, rks shall be as follows:	
Practical File/Record		(05 m a m l m)
Class Interaction		(05 marks)
Class Interaction		(05 marks) (03 marks)
Class Interaction Report Preparation/Presentation Suggested Practical Examination Evolution M	lethods: (40Morks)	(05 marks) (03 marks) (02 marks)
Class Interaction Report Preparation/Presentation Suggested Practical Examination Evaluation M Practical Examination Evaluation shall be based marks shall be as follows:	<b>lethods: (40Marks)</b> on Viva-voce and Practic	(05 marks) (03 marks) (02 marks) cal Exercises. The
Class Interaction Report Preparation/Presentation Suggested Practical Examination Evaluation M Practical Examination Evaluation shall be based marks shall be as follows: Practical Exercise (Major) 01x15 Marks	<b>lethods: (40Marks)</b> on Viva-voce and Practic	(05 marks) (03 marks) (02 marks) cal Exercises. The 15 Marks
Class Interaction Report Preparation/Presentation Suggested Practical Examination Evaluation M Practical Examination Evaluation shall be based marks shall be as follows: Practical Exercise (Major) 01x15 Marks Practical Exercise(Minor) 01x10 Marks	<b>Iethods: (40Marks)</b> on Viva-voce and Practic	(05 marks) (03 marks) (02 marks) cal Exercises. The 15 Marks 10 Marks
Class Interaction Report Preparation/Presentation Suggested Practical Examination Evaluation M Practical Examination Evaluation shall be based marks shall be as follows: Practical Exercise (Major) 01x15 Marks Practical Exercise(Minor) 01x10 Marks Viva-voce	Iethods: (40Marks) on Viva-voce and Practic	(05 marks) (03 marks) (02 marks) cal Exercises. The 15 Marks 10 Marks 15 Marks
Class Interaction Report Preparation/Presentation Suggested Practical Examination Evaluation M Practical Examination Evaluation shall be based marks shall be as follows: Practical Exercise (Major) 01x15 Marks Practical Exercise(Minor) 01x10 Marks Viva-voce There shall be 04- 05 Practical Exercises i (Compulsory) and 03-04 as Minor (Students have	Iethods: (40Marks) on Viva-voce and Praction n Examination comprisito attend any 01).	(05 marks)         (03 marks)         (02 marks)         (02 marks)         cal Exercises. The         15 Marks         10 Marks         15 Marks         01 as Majo
Class Interaction Report Preparation/Presentation Suggested Practical Examination Evaluation M Practical Examination Evaluation shall be based marks shall be as follows: Practical Exercise (Major) 01x15 Marks Practical Exercise(Minor) 01x10 Marks Viva-voce There shall be 04- 05 Practical Exercises i (Compulsory) and 03-04 as Minor (Students have Course prerequisites: To study this course, a study	Iethods: (40Marks) on Viva-voce and Praction n Examination comprisi to attend any 01). dent must have opted Sem	(05 marks) (03 marks) (02 marks) cal Exercises. Th 15 Marks 10 Marks 15 Marks ng 01 as Majo

# 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	Pre- requisite of
		Lecture	Tutorial	Practical/Practice	criteria	the course (if any)
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: Ma	ster 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 and it's distribution and applications.

✓ Ability to understand the Principal Components and Canonical Correlations analysis.

Ab	Ability to understand the Discriminant Analysis, Discriminant function.					
	Credits: 5	Compulsory				
Max. Marks: 25+75 Minimum Passing Marks						
Unit	Торіс		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,					
п	Hotelling's T2 statistic as a function of the It's distribution and applications, Maha distribution	he Likelihood Ratio criterion, lanobis D2 statistic and it's	13-18			
III	Principal Components and Canonical Analysis, Cluster Analysis	Correlations Analisis, Factor	14-20			
IV	Discriminant Analysis, Discriminant funct Analysis, MANOVA	tion (for two variables), Path	15-20			

- 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. An introduction to Multivariate Statistical Analysis. John Wiley.
- 6. DillonWR&GoldsteinM.1984.MultivariateAnalysis-Methodsand Applications. John Wiley.
- $7.\ Morrison DF. 1976. Multivariate Statistical Methods. McGraw Hill.$
- 8. GillNC. Multivariate Statistical Inference

#### Suggested Online Links/Readings:

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

Course	Credits	Credit distribution of the Course			Eligibility	Pre-requisite of the course
Title		Lecture	Tutorial	Practical/Practice	criteria	(if any)
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 outcomes:					
After completing this course a student will have:					
$\checkmark$ Ability to understand the reliability theory.					
$\checkmark$ Ability to understand	l the system reliability.				

	Credits: 5 Compulsory				
	Max. Marks: 25+75 Minimum Passing Ma				
Unit	Торіс	No. of Hours			
Ι	$I \qquad \begin{array}{c} \textbf{RELIABILITY}  \textbf{THEORY:}  Definition  of  Reliability, \\ Maintainability and Availability ,Basic functions of Reliability and \\ their relationships- Reliability Function, Cumulative failure \\ distribution function, failure density function, hazard rate, \\ Relationship between functions R(t),F(t), f(t) and \lambda(t), Mean \\ time to system failure and mean time between failure, Bath Tub Curve, \\ Estimation of Reliability from failure data \end{array}$				
п	IISystem 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				
III	Definition of Redundancy, Fully Redundant Redundant system, Active Redundancy and Reliability of k out of n system, Reliability system with perfect switching, Standby sys	14-20			
IV	Definition of a complex system, Decomposet set and cut set method, cut set method, Ti distributions, exponential, Gamma, Weil Linearly increasing Hazard model	osition Method, Minimal path e set method, Life oull and Log Normal models,	15-20		

- 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.

## Suggested Online Links/Readings:

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

• <u>https://www.coursera.org/search?query=statistics&</u>

**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**

Course	Credits	Credit distribution of the Course			Eligibility	Pre-requisite
Title		Lecture	Tutorial	Practical/Practice	criteria	(if any)
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: Ma	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 pre posterior data based modeling and analyses.
- $\checkmark$  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 Mar			
Unit	Торіс		No. of Hours	
I	Review of Basic Probability Concepts. Bayesian Approaches, Concept of Inv Theorem. Classes of Prior Distributions. Parameter Exponential Family Models, statistics of fixed dimension.	Comparing Likelihood and erse Probability and Bayes Conjugate Families for One Models admitting sufficient	15-20	
п	Generalized Maximum Likelihood Estim Bayes estimation under various loss Bayesian interval estimation: Credible Comparison with classical confidence int studies to conduct posterior analysis.	13-18		
ш	Prior and posterior odds. Bayes factor. types of testing hypothesis problems.	Lindley's Paradox. Various	15-18	
IV	Predictive density function, Regressio	n 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, 2<sup>nd</sup> ed Springer Verlag.

#### Suggested Online Links/Readings:

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

**Course Prerequisites:** To study this course, a student must have passed all Theory papers up to VII 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	Credits	Credit distribution of the Course			Eligibility	Pre-requisite
Title		Lecture	Tutorial	Practical/Practice	criteria	(if any)
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**

Prog	Programme/Class: Master of Science			Year: V	Semest Paper:	er: IX DSE-19
Subj	ect: STATIS	ГІСS			Credits	:: 3+1+0
Course Code:- Course Title: Time Series Analysis						
Cou	rse outcomes:					
After	completing th	his course a student wil	l have:			
✓ A	bility to under	stand the Linear Static	nary mo	dels.		
✓ A	bility to under	stand the Moving Aver	age and	mixed processes.		
✓ A	bility to under	stand the Forecasting.				
✓ A	bility to under	stand the Model ident	ificatior	n techniques.		
Credits: 5 Compulsory						
Max. Marks: 25+75 Minimum Passing Marks:						
Unit	Торіс					No. of Hours
I	Definition of component- Autocorrelati Correlogram	Time series and its of Variate difference ion and partial autoco Analysis.	compone e metl orrelation	nts, Measurement o hod, Harmonic functions, Periodo	f Irregular Analysis, ogram and	15-20
II	Linear Stationary models: Autoregressive ,Moving Average andmixedprocesses,LinearnonStationarymodels,Autoregressiveintegratedm ovingaverageprocesses			Average tegratedm	13-18	
ш	Forecasting: Minimum mean square forecast and their properties, calculating and updating forecast.				15-18	
IV	Model identi estimation: estimates, Se detection	Added identification: techniques and objectives, initial estimates, Model estimation: Likelihood function, sum of squares function, Least square estimates, Seasonal models, Intervention analysis models and Outlier detection				

- 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. RobertH Shumway. 2000. Time Series Analysis and it's Applications. Springer

## Suggested Online Links/Readings:

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

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

## Semester-IX

# MASTER OF SCIENCE (STATISTICS)

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

## **Total Number of Hours = 70-75**

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

	МА	STER O	<b>F SCIENCE</b>		
Progra	Programme/Class: Master of Science Year: V			Semester: IX Paper: DSE- 21/ GE-3	
Subjec	et: STATISTICS				Credits: 3+1+
Course	e Code:- DSE-21/GE-3 Course	e Title: Bi	io Informatics		<b>_</b>
Course	e outcomes:				
After c	ompleting this course a student w	vill have:			
✓ Abi	lity to understand the Basic Biolo	gy.			
✓ Abi	lity to understand the Computing	g techniqu	ies.		
✓ Abi	lity to understand the Tools for B	10 informa	tics.		mo dola
• Abi	Credite: 5	gnment a	nd data base search us	mpulsor	models.
	Cicuits, 5		Co	mpuisory	
Max. Marks: 25+75 Minimum Passing Marks			arks:		
Unit	nit Topic			No. of Hours	
I Basic Biology: Cell, genes , gene structure, gene expression and regulation, bioenergetics, single nucleotide polymorphism, expressed sequence tag, Structural and functional Genomics, Organization and structure of genomes, assembling of physical maps, strategies and techniques for genome sequencing and analysis			ion, nes, tag, 15-20 nes, ome		
IIComputing techniques:OS and programming languages, - Linux, pert, biioperl, cgi, MySQL ,php MyAdmin: Coding for browsing Biological tables on the web, parsing and annotation of genomic sequences, Database designing, Computer Networks: Internet, World wide Web, Web, browsers EMBnet, NCBI, Database on public domain pertaining to Nucleic acid sequences, protein sequences, SNPs etc, ,Searching sequence databases.			ux, sing ces, Yeb, leic nce		
ш	data bequences, protein sequences, bitt's etc, searching sequencedatabases, Structural databases.Tools for Bioinformatics: DNA Sequence Analysis- Features of DNASequence Analysis ,Approaches to EST analysis, Pairwise alignmenttechniques, Comparing two sequences, PAM and BLOSUM, GlobalAlignment(The Needleman and Wunsch algorithms)Localalignment(The Smith-Waterman Algorithm),Dynamic Programming,Pairwise database searching, Sequence Analysis- BLAST and other relatedtools			NA hent obal cal 15-20 ing, ited	

IV	Multiple alignment and database search using motif models, ClustalW, Phylogeny, Databases on SNPs, EM algorithms and other methods to discover common motifs in bio sequences, Gene production based on Neural Networks, Genetic Algorithms, Hidden Markov models, Computational analysis of protein sequences, structure and function, Design and Analysis of microarray experiments.	13-18
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- 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: The Machine Learning Approach.
- 6. 201Ed.(Adaptive Computation and Machine Learning). MITPress.
- 7. Baxevanis AD & Francis BF. (Eds.). 2004.
- 8. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. John Wiley.
- 9. BergeronBP.2002. Bio Informatics Computing. Prentice Hall.
- 10. Ewens WJ & GrantGR. 2001. Statistical Methods in Bioinformatics: An Introduction (Statistics for Biology and Health). Springer.
- 11. JonesNC& PevznerPA.2004.An Introduction to Bioinformatics Algorithms. 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.

#### Suggested Online Links/Readings:

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

**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: Practica	al			

#### **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. Marl	ks: As per Univ. rule		Min. Passing Marks: A	s per Univ. rule
		<b>m</b> •		NT CIT

	Торіс	No. of Hours
	<ul> <li>** Practical papers based on the above Theory papers for Post Graduate course.</li> <li>Perform PCA.</li> <li>Perform factor analysis.</li> <li>Perform discriminant analysis.</li> <li>Perform T<sup>2</sup> test and MANOVA.</li> <li>Perform MANOVA.</li> <li>Perform Canonical correlation analysis.</li> <li>Find the different Reliability functions of failure data.</li> <li>Finding the Reliability of series and parallel systems.</li> <li>Finding the Reliability of complex system.</li> <li>Corellogram analysis.</li> <li>Periodogram analysis.</li> </ul>	60
Suggested	Readings: As suggested for paper I & II	

#### Suggested Continuous Evaluation Methods (10 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	(05 marks)
Class Interaction	(03 marks)
Report Preparation/Presentation	(02 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) 01x15 Marks	15 Marks
Practical Exercise(Minor) 01x10 Marks	10 Marks
Viva-voce	15 Marks
There shall be 04- 05 Practical Exercises in Examination comprise (Compulsory) and 03-04 as Minor (Students have to attend any 01).	ing 01 as Major
Course prerequisites: To study this course, a student must have opted Sem	-VI theory DSE-4.

**Further Suggestions:** 

## Semester-X

# **MASTER OF SCIENCE (STATISTICS)**

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

# **Total Number of Hours = 70-75**

Course	Credits	Credit distribution of the Course			Eligibility	Pre-requisite of the course
Title		Lecture	Tutorial	Practical/Practice	criteria	(if any)
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

Cour	se Code:-	Course Title: Advanced	l 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.         ✓ Ability to understand the Ratio and regression method of estimation.         ✓ Max. Marks: 25+75       Minimum Passing Marks:				
Unit		Торіс		No. of Hours
I	Fundamentals of sampling. Adva Simple random	15-20		
п	Stratified samp sampling, comp periodicity, circ	13-18		
III	IIIRatio 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 stage design, No of measuremen varying probabi Cumulative me Thompson estin strategies due to inclusion proba sampling, Multi	g, Multistage sampling on Sampling errors, prob t, Interpenetrating su lities with and without thod and Lahiri's me nator, Ordered and und o Midzuno-Sen, Sampfo bility proportional to si stage sampling with uneq	with special reference to two olems of Non Response, errors ab-sampling, Sampling with replacement, PPS sampling, thod of selection, Horvitz- ordered estimators, Sampling ord and Rao-Hartley-Cochran, ze sampling, PPS systematic qual probabilities.	15-20

- Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor.
   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.

## Suggested Online Links/Readings:

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

**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**

Course	Credits	Credit distribution of the Course			Eligibility	Pre-requisite
Title	cicuits	Lecture	Tutorial	Practical/Practice	criteria	(if any)

DSC: Statistical Computing	4	3		1	To study this course, a student must have passed all Theory papers up to IX semester.	Nil
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		MASTER O	F SCIENCE		
Progra	amme/Class: Ma	aster of Science		Year: V	Semester: X Paper: DSE-23
Subjec	et: STATISTICS	5		L	Credits: 3+1+0
Course	e Code:-	Course Title: Statistical	Computing		
Course After c ✓ Abi ✓ Abi ✓ Abi	Course outcomes: After completing this course a student will have: ✓ Ability to understand the Introduction to Statistical packages and computing. ✓ Ability to understand the Matrix computations in linear models. ✓ Ability to understand the Spatial Statistics. ✓ Ability to understand the Regression Analysis				g.
	Credits: 5 Compulsory				
	Max. Marks: 25+75 Minimum Passing Ma				arks:
Unit		Торіс			No. of Hours
Introduction to Statistical packages and computing, data types and structures, pattern recognition, classification, association rules, graphical methods, Data analysis principles and practice.				15-20	
IIMatrix 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	
ш	Monte Carlo Methods.IIISpatial 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

	Random number generators, Regression Analysis (both linear and	
IV	non linear), ANOVA and ANCOVA, EML Algorithm, Gibbs	15-18
1,	Sampling, Some advanced statistical computing	

- 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

#### Suggested Online Links/Readings:

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

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

## Semester-X

## MASTER OF SCIENCE (STATISTICS)

## **DISCIPLINE SPECIFIC ELECTIVES (DSE-24)–Econometrics**

## **Total Number of Hours = 70-75**

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

MASTER OF SCIENCE					
Prog	Programme/Class: Master of Science Year: V				Semester: X Paper: DSE-24
Subj	ect: STATISTIC	S			Credits: 3+1+0
Cour	se Code:-	Course Title: Econome	trics		
Cour After ✓ Al ✓ Al ✓ Al	Course outcomes:         After completing this course a student will have:         ✓ Ability to understand the econometrics.         ✓ Ability to understand the models and identification.         ✓ Ability to understand the Simultaneous equations.         ✓ Ability to understand the Identification Problems.         Credits: 5				
Max. Marks: 25+75 Minimum Passing Ma					rks:
Unit		Торіс			No. of Hours
I	IModels and identification, meaning of Econometrics, formulation of economic phenomenon with specification analysis, Endogenous and Exogenous Variables.15-20				15-20
II Simultaneous equations, meaning of structure and model problems involved in construction of economic models, concept of Multicollinearity.			15-20		

ш	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 with properties (Bias and Moment matrix), Maximum Likelihood estimators, full information and limited information maximum likelihood estimators ,Monte Carlo Studies.	15-20

- 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.
- 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

## Suggested Online Links/Readings:

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

**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**

Course	Cradits	Credit distribution of the Course		Elig	ibility	Pre-requisite	
Title	Creatis	Lecture	e Tutorial Practical/Practice		cri	teria	(if any)
DSC: Operation Research	4	3		1	To stu course studer have all papers IX ser	udy this e, a nt must passed Theory s up to mester.	Nil
			MAST	TER OF SCIENCE			
Programm	Programme/Class: Master of Science					Year: V	Semester: X Paper: DSE-25
Subject: STATISTICS Credits: 3					Credits: 3+1+0		
Course Co	de:-	Course	e Title: Op	eration Research			
Course ou	tcomes:						
After comp	oleting this	course a s	tudent will	have:			
✓ Ability	to understa	and the ope	eration rese	arch.			
✓ Ability	to understa	and the inv	ventory con	peration research.			
✓ Ability	to understa	and the aut	elling theo	rv.			
Tionity	C	redits: 5			Co	mpulsory	7
						<b>1</b>	
Max. Marks: 25+75				Mir	imum F	Passing M	arks:

Unit	Торіс	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
Π	Application to the allocation of resources and industry, Transportation and Assignment Techniques.	15-20
ш	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

- 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.

## Suggested Online Links/Readings:

- <u>http://heecontent.upsdc.gov.in/SearchContent.aspx</u>
- <u>https://swayam.gov.in/explorer?searchText=statistics</u>
- <u>https://nptel.ac.in/course.html</u>
- <u>https://www.edx.org/search?q=statistics</u>
- 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	Credits	Credit distribution of the Course			Eligibility	Pre-requisite of the course
Title		Lecture	Tutorial	Practical/Practice	criteria	(if any)
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 SC	CIENCE	
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 Statis	stics	

## **Course Title: Actuarial Statistics**

**Course outcomes:** 

After completing this course a student will have:

- $\checkmark$  Ability to understand the Life tables and it's relation with survival function.
- $\checkmark$  Ability to understand the multiple life functions.
- $\checkmark$  Ability to understand the Insurance payable at the moment of death and at the end of the year of death-level benefits insurance.

✓ Abi	ility to understand the Net premiums.		
	Credits: 5	Compulsory	
	Max. Marks: 25+75	Minimum Passing Mar	ks:
Unit	Торіс		No. of Hours
I	Insurance and utility theory, models sums, survival function, curtate futu Life tables and it's relation with assumptions for fractional ages, son select and ultimate tables.	for individual claims and their re lifetime, force of mortality survival function, examples, ne analytical laws of morality,	15-20
II	Multiple life functions, joint life insurance and annuity benefits evaluation, central rate of multiple d Distribution of aggregate claims, co and it's applications, Principles of compound interest, N interest and discount, compound continuous compounding	e and last survivor status, through multiple numerical ecrement ompound Poisson Distribution fominal and effective rates of interest, accumulation factor,	15-20
111	Insurance payable at the moment of year of death-level benefit insur- deferred insurance and varying be commutation functions, Life annuiti life annuities, discrete life annuitie payment, commutation functions, we complete annuities-intermediate and	f death and at the end of the rance, endowment insurance, benefit insurance, recursions, es, single payment, continuous s, life annuities with monthly varying annuities, recursions , apportionable annuities-due.	15-18
IV	Net premiums: Continuous and dis payment premiums, accumulation reserves, Continuous and discrete r on a semi continuous basis, rese premium, reserves on an apportion basis, reserves at fractional duration years, recursive formulas and diffe commutation functions.	crete premiums, true monthly type benefits, Net premium net premium reserve, reserves rves based on true monthly able or discounted continuous ns, allocation of loss to policy rential equations for reserves,	15-20

- 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

#### Suggested Online Links/Readings:

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

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

Programme/Class: Master of Science	Year: V	Semester: X
Subject: STAT	<b>FISTICS (Practical)</b>	
Course Code:-	Course Title: Practice	al
<ul> <li>Course outcomes:</li> <li>After completing this course a student will have</li> <li>Find the estimate of mean and variance for Cl</li> <li>Find the estimate of mean and variance for tw</li> <li>Find the estimate of mean and variance for do</li> <li>Cumulative and Lahiri method of selecting va</li> <li>Find the estimate of mean and variance for va</li> <li>2 SLS method.</li> <li>3 SLS method.</li> <li>Graphical method for LPP problems.</li> <li>Simplex method for LPP problems.</li> <li>Transportation problem.</li> <li>Assignment problem.</li> </ul>	uster sampling. o stage sampling. uble sampling. rying probability samplin rious varying probability	g. sampling schemes.
Credits:01	Core: C	ompulsory
Max. Marks: As per Univ. rule	Min. Passing Mark	s: As per Univ. rule
Торіс		No. of Hours
<ul> <li>** Practical papers based on the Post Graduate course.</li> <li>Find the estimate of mean and va</li> <li>Find the estimate of mean and va</li> </ul>	above Theory papers ariance for Cluster sampli ariance for two stage	ng. 60

sampling.				
<ul> <li>Find the estimate of mean and variance for double sampling.</li> </ul>				
<ul> <li>Cumulative and Lahiri method of selecting varying</li> </ul>				
Find the estimate of mean and variance for various varying				
probability sampling schemes				
<ul> <li>◆ 2 SLS method.</li> </ul>				
<ul><li>✤ 3 SLS method.</li></ul>				
<ul> <li>Graphical method for LPP problems.</li> </ul>				
<ul> <li>Simplex method for LPP problems.</li> </ul>				
<ul> <li>Transportation problem.</li> </ul>				
<ul> <li>Assignment problem.</li> </ul>				
Suggested Readings: As suggested for paper I & II				
Suggested Continuous Evaluation Methods (10 marks):				
Continuous Internal Exclustion shall be based on Drastical Eile (Descend				
Continuous Internal Evaluation shall be based on Practical File/Record,				
Class Activities and Overall performance. The marks shall be as follows:				
Practical File/Record	(05 marks)			
Class Interaction	(03 marks)			
Report Preparation/Presentation	(02 marks)			
Suggested Practical Examination Evaluation Methods: (40Marks)				
Practical Examination Evaluation shall be based on Viva-voce and Practic marks shall be as follows:	cal Exercises. The			
Practical Evancies (Major) 01x15 Marks	15 Marks			
T Tacucai Exercise (Major) UIXI5 Marks				
Practical Exercise (Minor) 01x10 Marks	10 Marks			
Practical Exercise (Minor) 01x10 Marks Viva-voce	10 Marks 15 Marks			
Tractical Exercise (Minor) 01x15 Marks         Practical Exercise (Minor) 01x10 Marks         Viva-voce         There shall be 04- 05 Practical Exercises in Examination comprise (Compulsory) and 03-04 as Minor (Students have to attend any 01).	10 Marks 15 Marks ng 01 as Major			
Tractical Exercise (Minor) 01x15 Marks         Practical Exercise (Minor) 01x10 Marks         Viva-voce         There shall be 04- 05 Practical Exercises in Examination comprise (Compulsory) and 03-04 as Minor (Students have to attend any 01).         Course prerequisites: To study this course, a student must have opted Sem	10 Marks         15 Marks         ng 01 as Major         -VI theory DSE-4.			