PONDICHERRY UNIVERSITY

DEPARTMENT OF STATISTICS

SYLLABUS FOR B.Sc. STATISTICS

(NEP 2020-CBCS Pattern)

Effective from the Academic Year 2023 - 2024

AFFILIATED COLLEGES

PREAMBLE

PONDICHERRY UNIVERSITY

B.Sc. DEGREE COURSE

REVISED REGULATION & SYLLABUS

(UG PROGRAMME IN B.Sc. (STATISTICS) DEGREE COURSE)

The revised syllabus shall be effective from the academic year 2023 -2024 onwards.

DURATION OF THE COURSE

The Curriculum Framework designed by UGC for implementing NEP 2020 specifies that all Undergraduate(UG) degree programmes are to be for a period of 3 years leading to the award of UG Degree.

All UG courses shall focus on conceptual understanding and development of critical thinking in a given field of Study, incidentally, skills such as communication, teamwork, and leadership shall embodied in Teaching-learning process to facilitate for career option in the given field of specialization.

AGE LIMIT

The rules as applicable to other Under Graduate courses as prevailing in Pondicherry University.

ELIGIBILITY FOR ADMISSION

Candidates for admission to the first year of the B.Sc. (Statistics) degree shall require to have **passed Higher Secondary course with Mathematics/Statistics** as one of the subject conducted by the Government of Tamil Nadu or any other equivalent system recognized by the Government of Puducherry based on the admission criteria laid down by Pondicherry University are eligible to apply.

LATERAL ENTRY

As per NEP, students have a choice of entry into the Programme of Study. UGC specifies that about 10% of seats over and above the sanctioned strength shall be allocated to accommodate the Lateral Entry students. The guidelines for lateral Entry are as follows:

1. Lateral Entry for II Year B.Sc. Statistics:
   Student should complete **UG certificate course with major subject as Statistics / Mathematics and minor subject as Mathematics / Statistics** from any University.
2. Lateral Entry for III Year B.Sc. Statistics:
   Student should complete **UG Diploma course in Statistics with minor subject as Mathematics** from any University.

COURSE STRUCTURE

All Academic Programmes offered under NEP shall be offered in terms ofcredits. Each course/subject in a given Programme of study shall carry certain number of credits which will be awarded on completion of the said course.

Exit of the Course:

NEP 2020 introduces the facility to breakdown the Programme of study at Undergraduate (UG) level after completion of every year of study. The students will be awarded the following:

1. Students who opt to exit after completion of first year will be awarded **UG Certificate in Statistics** provided they have earned a minimum of 42 credits and in addition, they have to complete work based vocational course/internship of 4 credits during the summer vacation of the first year
2. Students who opt to exit after completion of second year will be awarded **UG Diploma in Statistics** provided they have earned a minimum of 84 credits and in addition, they have to complete work based vocational course/internship of 4 credits during the summer vacation of the Second year
3. Students who opt to exit they will be awarded **UG degree in B.Sc. Statistics** after successful completion of three years, provided they have earned a minimum of 124 credits.

MEDIUM OF INSTRUCTION

The medium of instruction for B.Sc. Statistics course **shall be in English**.

Breakup of Credits and Courses:

NEP Framework has specified the minimum number of credits that a Bachelor student has to earn in ¾ year period. Table I specifies the number of credits and number of courses that a 3 year UG student is expected to complete in 3 duration.

TABLE I
BREAKUP OF CREDITS AND COURSES

Sl.No.	Component	3 Year Degree
1.	Major Disciplinary Courses	60 Credits (15 Courses of 4 credits each)
2.	Minor Discipline Courses	24 Credits (6 Courses of 4 Credits each)
3.	Multi-Disciplinary Courses	9 Credits (3 courses of 3 credits each)
4.	Ability Enhancement Courses	12 Credits (4 courses of 3 credits each)
5.	Skill Enhancement Course	9 Credits (3 courses of 3 credits each)
6.	Common Value addedcourses	8 Credits (4 course of 2credits each)
7.	Winter Project / Internship Community Engagement	2 Credits (1 field based course)
8.	Total (3 year) creditsrequired	124 Credits

Every Undergraduate (UG) programme offered by a College shall confirm to the Structure specified by the UGC's Framework, 2023. A student of 3 year UG programme is mandated to complete a minimum of 124 credits. An UG student shall complete the following courses under different heads as listed below:

1. Major Disciplinary Courses
2. Minor Disciplinary Courses
3. Multi Disciplinary Courses
4. Ability Enhancement Courses
5. Skill Enhancement Courses
6. Value added/Common Courses
7. Internships and Community Service based projects

NEP Classification of Courses:

i) Major Disciplinary courses (MJD): (60/80 credits)

Major disciplinary courses are subject specific compulsory subjects that a student has to complete to obtain the UG/UG (Hons) Degree in the given discipline. Major disciplinary courses shall constitute 50% of the total credits.

All discipline specific major courses shall be designed for 4 creditseach with one/two additional hours or guidance of teaching at Tutorials/Practicals.

UG programmes may be offered in a single major discipline or in Multiple Major disciplines giving equal weightage in credits. For example a B.Sc. course may be in a single discipline like B.Sc. (Maths) or with multiple major disciplines like B.Sc. (Maths, Physics &Chemistry).

ii) Minor Disciplinary Course (MID): (24/32 credits)

Minor disciplinary courses refer to those subjects which are Allied/Specialisation/Elective subjects to the Major discipline. These allied courses are expected to provide additional understanding of the subject in a specific focused area. For example a B.A. (Political Science) student shall study allied subjects like Public Administration, Sociologyas these subjects have inter linkages with the Major Disciplinary subjects.

iii) Multi-Disciplinary courses (MLD): (9 Credits)

All undergraduate students are mandated to pursue 9 credits worth of courses in such Multi-disciplinary areas/Courses out of 9/10 NEP defined subjects. Colleges may identify any 3 multiple disciplinary streams listed below based on availability of resources and manpower.

a) Natural Sciences
b) Physical Sciences
c) Mathematics & Statistics
d) Computer Science/Applications
e) Data Analysis
f) Social Sciences
g) Humanities
h) Commerce & Management
i) Library Science
j) Media Sciences, etc.

Students are expected to learn basic/introductory courses designed by other departments for this purpose. Colleges may list any 3 introductory courses

(one each in natural Sciences, Physical Sciences, Humanities) for uniform adoption of all UG students.

iv) Ability Enhancement (AEC) courses: (8 Credits)

All Undergraduate (UG) students are mandated to complete atleast 8 Credits worth of Courses which focus on Communication and Linguistic skills, Critical reading, and writing skills. These courses are expected to enhance the ability in articulation and presentation of their thoughts at workplace. Colleges may design these ability enhancement courses tuned to the requirements of given major discipline. Eg. A course in Business Communication is more appropriate in place of literature/prose/poetry.

a) English Language

Ability Enhancement Course	
I. English Language a) English Language & Literature – 1 and 2 b) Functional English – 1 and 2 c) Communicative English – 1 and 2	II. Indian Language (two courses) a) Indian language & Literature – 1 and 2 b) Functional language – 2 c) Communicative language – 1 and 2

v) Skill Enhancement Course: (9 Credits)

These courses focus at imparting practical skills with hands-on Training. In order to enhance the employability of students, Colleges are expected to design such courses that they deem fit for their students for better employment/entrepreneurship/career development, etc. Colleges may also outsource the Skill Enhancement Courses to AICTE approved agencies for conducting short term Training Workshops, Skill India initiatives of GOI and approved Trades by Skill development of corporation are to be considered. Short term courses.

vi) Value Added Common courses (VAC): (8 credits)

Under NEP, the UGC has proposed for 6 to 8 credits worth of common courses which are likely to add value to overall knowledge base of the students. These courses include:

a) Understanding India
b) Environmental Sciences/Education
c) Digital and Technological solutions
d) Health, Wellness, Yoga Education, Sports & Fitness

The course structure and coverage of topics are suggested by UGC in its draft documents, colleges/UG Boards of Studies may design the methodology for conducting these value added courses.

vii) Summer Internship (2 to 4 Credits)

As per the UGC guidelines all UG students should be exposed to 4 to 6 week Summer Internship in an industrial organisations/Training Centres/Research Institution, etc. Such Summer Internship is to be conducted in between 4th Semester and 5th semester. A review of report and award of grade based on Work based learning by students is to be recorded during the 5th Semester.

a) Community Engagement and Service(CES) (2 credits)

All UG students are also mandated to participate in a 15 days community engagement activity during their winter vacation between 5th and 6th Semesters. This Community engagement activity is expected to expose the students to social problems of neighbourhood village students may prepare a report on the activities carried out for a award of 2 credits.

EVALUATION: Total Marks: 100

All Credit courses are evaluated for 100 marks. Internal Assessment component is for 25 marks and the End Semester University exam is for 75 marks. In case of Practical, Project work, etc., it is 50:50 marks for Internal and End-Semester Exams.

Break up of Internal Assessment Marks:

Total Internal Assessment mark for a theory subject is 25 marks. The breakup is:

a)	Mid Semester Exam (one) - 20 Marks
b)	Percentage of Attendance - 5 Marks
Total - 25 Marks	

Marks for Attendance is as follows:

Below 75%	0
75% - 80%	1
80% - 85%	2
85% - 90%	3
90% - 95%	4
95% - 100%	5

Internal Test Scheme:

Principal of the College schedules the Mid-Semester Exam for all courses during 8/9th week of start of classes. All faculty members are expected to conduct this Mid-Semester exam for 1.30 hr duration and evaluate, upload the marks to Controller of Examinations of University. Colleges are also requested to preserve the answer books of Mid-Semester exams until declaration ofresults by the University

Internal Assessment marks for Practicals/Project work/Internships subjects:

Faculty member in-charge of Lab practicals shall evaluate the practical subjects for 50 marks. The break up is as follows:

a) Observation note/Demo note/Work dairy / etc.	20
b) Practical Record/Internship Report / etc.	30
Total	**50**

End-Semester University Exam:

Controller of Examinations (COE) of Pondicherry University schedules the End-Semester exams for all theory and practicalsubjects based on University calendar.

A detailed Exam Time Table shall be circulated to all Colleges atleast 15 days before the start of exams mostly during 15/16th week of the Semester. Question Papers shall be set externally based on BOS approved syllabus. All students who have a minimum of 70% attendance are eligible to attend the end-semester exams. The breakup of end semester marks:

a) Theory subjects: (Sec A, Sec B and Sec C) Question from all units of syllabus	75 marks
b) Practical/Internship Project Worksubjects (Based on Practical Exams/Presentation/Viva)	50 marks

Consolidation of Marks and passing Minimum

Controller of Examinations of the University consolidates the Internal Assessment marks uploaded by the Colleges and marks secured by students in end-semester examination. The total marks will be converted into letter grades as shown in the following Table 2. As per NEP Regulations, the passing minimum is 50% marks (IA + End semester put together) However, Pondicherry University considers 40% marks as pass during first 3 years of study and students who secured less than 50 will be awarded 'P' (Pass Grade)

Arrear Exam:

A student who failed to secure 40% marks in aggregate is declared as Failed and he is eligible to take up supplementary examination by registering to the said course in the following Semester. All other candidates who failed due to shortage of attendance, those who are seeking to improve the grade shall repeat the course.

Letter Grades and Calculation of CGPA:

Total Marks Secured by a student in each subject shall be converted into a letter grade. UGC Framework has suggested a Country wide uniform letter grades for all UG courses. The following Table shows the seven letter grades and corresponding meaning and the grade points for calculation of CGPA.

TABLE – 2

Equivalent Letter Grade	Meaning	Grade Points for Calculation of CGPA
O	Outstanding	10
A+	Excellent	9
A	Very Good	8
B+	Good	7
B	Above Average	6
C	Average	5
P	Pass	4
F	Fail	0
Ab	Absent	0

In order to work out the above letter grades, the marks secured by a student (Total of IA and Semester End) would be categorized for relative grading. The ranges of marks for each grades would be worked as follows:

Highest marks in the given subject = X
Cut of marks for grading purpose = 50 marks
Passing mark (for 3 year of UG) = 40
Number of grades (excepting P grade) (O,A+,A,B+,B,C) = 6
Range of marks = K

$$K = \frac{x - 50}{G}$$

The following table given the range of marks and letter grades. According to K value, one of the following grading scheme will be followed.

(i) If K ≥ 5, then the grades shall be awarded as given in Table II.

Table II		
Range of Marks in %	**Letter Grade Points for**	**Letter Grade Points for**
X to (X-K)+1	O	10
(X-K) to (X-2K)+1	A+	9
(X-2K) to (X-3K)+1	A	8
(X-3K) to (X-4K)+1	B+	7
(X-4K) to (X-5K)+1	B	6
(X-5K) to 50	C	5
40 – 49	P	4
Below 40	F	0
Absent (Lack of Attendance)	Ab	0

(ii) If K<5, then the grades shall be awarded as given in Table III.

Table III		
Range of Marks in %	**Letter Grade Points for**	**Letter Grade Points for**
80-100	O	10
71-79	A+	9
66-70	A	8
61-65	B+	7
56-60	B	6
50-55	C	5
40-49	P	4
Below 40	F	0
Absent (lack of attendance)	Ab	0

Calculation of Semester Grade Point average and CGPA:

Semester Grade Point Average (SGPA) is calculated by taking a weighted average of all grade points secured by a candidate from all subjects registered by him/her in the given Semester. The weights beingthe number of credits that each subject carries.

Cumulative Grade Point Average (CGPA) CGPA shall be calculated as the weighted average of credits that course carries and the value of Gradepoints averaged for all subjects.

Computation of SGPA and CGPA

The following procedure shall be followed to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The SGPA is the ratio of the sum of the product of the number of credits withthe grade points scored by a student in all the courses taken by a student andthe sum of the number of credits of all the courses undergone by a student,

i.e. **SGPA** (Si) = Σ(Ci x Gi) / ΣCi

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

(i) Example for Computation of SGPA where candidate has not failed in any course.

Semester	**Course**	**Credit**	**Letter Grade**	**Grade point**	**Credit Point** (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	B	6	4 X 6 = 24
		20			139
	SGPA				139/20=6.95

(ii) Example for Computation of SGPA where candidate has failed in one course.

Semester	**Course**	**Credit**	**Letter Grade**	**Grade point**	**Credit Point** (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	F	0	4 X 0 = 00
		20			115
	SGPA				115/20=5.75

(iii) Example for Computation of SGPA where candidate has failed in two courses.

Semester	**Course**	**Credit**	**Letter Grade**	**Grade point**	**Credit Point** (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	F	0	3 X 0 = 00
I	Course 4	3	B	6	3 X 6 = 18
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	F	0	4 X 0 = 00
		20			85
	SGPA				85/20=4.25

The CGPA shall also be calculated in similar way as shown in examples (i), (ii) and (iii) of SGPA for all subjects taken by the students in all the semesters. However, if any student fails more than once in the same subject, then while calculating CGPA, the credit and

grade point related to the subject in which the student fails in multiple attempts will be restricted to one time only. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

In case of audit courses offered, the students may be given (P) or (F) grade without any credits. This may be indicated in the mark sheet. Audit courses will not be considered towards the calculation of CGPA.

Declaration of Results:

Controller of Examinations (COE) of the University shall declare the results of given UG programme following the CGPA secured by students by the end of 6th Semester.

PASS CLASSES

Range of CGPA	Result
9.0 above	First Class with distinction
6.0 above	First Class
5.0 Below 5.99	Second Class
4.0 4.99	Pass Class

SCHEME OF EXAMINATION (Practical Paper)

Total Marks: 100: (Internal: 50 & External: 50)

INTERNAL EXAMINATION: Maximum Marks: 50

- Components of Internal Evaluation (50 Marks)
    1. Attendance
    2. Observation Notebook
    3. Practical Record
    4. Model Practical Exam

END-SEMESTER PRACTICAL EXAMINATION: Maximum marks: 50

SCHEME OF EXAMINATION (Theory Paper)

Total Marks: 100 (Internal: 25 & External: 75)

INTERNAL EXAMINATION: Maximum Marks: 25.

- Mid-Semester Examination for 1.30 Hours duration shall be taken: 20 Marks
- Attendance: 5 Marks

EXTERNAL EXAMINATION : Maximum Marks: 75.

- Examinations shall be in three sections.
- Section-A for 10 Marks, Section –B for 15 Marks and Section-C for 50 Marks.

Question Paper Pattern
SECTION – A: (5 x 2 = 10 Marks) • It is of short answer type. Each question carry 2 marks. • 5 questions to be given by setting 1 question from each unit. • Candidate should Answer all the questions.
SECTION – B: (5 x 3 = 15 Marks) • It is of short answer type. Each question carry 3 marks. • 10 questions to be given by setting 2 questions from each unit. • Candidate should Answer 5 questions out of 10 questions.
SECTION – C: (5 x 10 = 50 Marks) • It is of essay answer type. Each question carry 10 Marks. • 5 questions to be given on internal choice (either or type). One question from each unit. Candidate should answer ALL questions.

SEMESTER WISE CREDITS AND HOURS OF WORK AS PERNEP

SEMESTER I

Code No	Nature of Course	Title of the Course	Credits	Hons of Teacher
MJD 1	Major Disciplinary courses	MJD-1: Descriptive Statistics	4	5
MID 1	Minor Disciplinary Courses (choose any one)	MID-1(A): Mathematics for Statistics	4	5
		MID-1 (B): Introduction to Differential Calculus		
		MID-1(C): Official Statistics		
MLD 1	Multi-Disciplinary courses	MLD-1: Office Automation Tools * (for all)	3	4
AEC	Ability Enhancement courses	English or Tamil / Hindi / French	3	4
SEC	Skill Enhancement Course	SEC-1: Computational Statistics *	3	4
VAC	NEP Value added common courses I & II	VAC-1. Environmental Education	2	4
		VAC-2. Understanding India (Theory/Field based)	2	4
Total Credits/ Total Hours of Work			**21 Credit**	**30 Hours**

SEMESTER II

Code No	Nature of Course	Title of the Course	Credits	Hons of Teacher
MJD 2	Major Disciplinary courses	MJD-2: Probability Theory	4	5
MID 2	Minor Disciplinary courses (choose any one)	MID-2(A): Health and Vital Statistics	4	5
		MID-2 (B): Introduction to Differential Equation		
		MID-2(C): Introduction to Integral Calculus		
MLD 2	Multi- Disciplinary courses	MLD-2: Quantitative Aptitude and Data Interpretation (for all)	3	4
AEC	Ability Enhancement courses	English or Tamil / Hindi / French	3	4
SEC	Skill Enhancement Course	SEC-2: Introduction to Ms-Excel *	3	4
VAC	NEP Value added common courses I & II	VAC-3. Health & Wellness/Yoga Education	2	4
		VAC-4. Digital Technology Education (Theory/Field based)	2	4
Total Credits/ Total Hours of Work			**21 Credit**	**30 Hours**

* Practical Paper which is offered by batch wise classes (If student strength exceed 25)

Students who opt to exit after completion of first year will be awarded **UG Certificate in Statistics** provided they have earned a minimum of 42 credits and in addition, they have to complete work based vocational course/internship of 4 credits during the summer vacation of the first year

SEMESTER III

Code No	Nature of Course	Title of the Course	Credits	Hons of Teacher
MJD 3 MJD 4	Major Disciplinary courses	MJD 3 Distribution Theory MJD 4 Sampling Theory	4 4	5 5
MID 3	Minor Disciplinary courses (choose any one)	MID-3(A) Real Analysis MID-3 (B) Introduction to Linear Algebra MID-3(C) Psychology and Educational Statistics	4	5
MLD3	Multi-Disciplinary courses	MLD-3: Time Series and Index Numbers (for all)	3	5
AEC	Ability Enhancement courses	English or Tamil / Hindi / French	3	4
SEC	Skill Enhancement Course	SEC-3: Statistical Computing with C++ *	3	6
Total Credits/ Total Hours of Work			**21 Credit**	**30 Hours**

SEMESTER IV

Code No	Nature of Course	Title of the Course	Credits	Hons of Teacher
MJD 5 MJD 6 MJD 7	Major Disciplinary courses	MJD 5 Estimation Theory MJD 6 Applied Statistics MJD 7 Statistics Practical– I * (Estimation Theory & Applied Statistics)	4 4 4	5 5 6
MID 4	Minor Disciplinary courses (choose any one)	MID-4(A) Numerical Methods MID-4 (B) Introduction to Complex Analysis MID-4(C) Bio-statistics	4	5
AEC	Ability Enhancement courses	English or Tamil / Hindi / French	3	4
Project	WP/Internship	Community Engagement	2	5
Total Credits/ Total Hours of Work			**21 Credit**	**30 Hours**

* Practical Paper which is offered by batch wise classes (If student strength exceed 25)

Students who opt to exit after completion of second year will be awarded **UG Diploma in Statistics** provided they have earned a minimum of 84 credits and in addition, they have to complete work based vocational course/internship of 4 credits during the summer vacation of the Second year

SEMESTER V

Code No	Nature of Course	Title of the Course	Credits	Hons of Teacher
MJD 8	Major Disciplinary courses	MJD 8: Testing of Hypotheses	4	6
MJD 9		MJD 9: Design of Experiments	4	6
MJD 10		MJD 10: Statistics Practical – II * (Testing of Hypotheses & Design of Experiments)	4	6
MID 5	Minor Disciplinary courses (choose any one)	MID-5(A): _Data Analysis using SPSS *	4	6
		MID-5 (B): Data Analysis using Excel *		
		MID-5(C): SWAYAM – Online course (minimum 8 weeks) related to MID selected by the Department		
SKD	Skill Development Course	MJD 15: – Summer Internship	4	6
		Total Credits/ Total Hours of Work	**20 Credit**	**30 Hours**

SEMESTER VI

Code No	Nature of Course	Title of the Course	Credits	Hons of Teacher
MJD 11	Major Disciplinary courses (compulsory)	MJD 11: Regression Analysis	4	6
MJD 12		MJD 12: Operations Research	4	6
MJD 13		MJD 13: Statistical Quality Control	4	6
MJD 14		MJD 14: Statistics Practical – III * (Regression Analysis & Statistical Quality Control)	4	6
MID 6	Minor Disciplinary courses (choose any one)	MID-6(A) Statistical Analysis using R *	4	6
		MID-6(B) Statistical Analysis using Python *		
		MID-6(C) SWAYAM – Online course (minimum 8 weeks) related to MID selected by the Department		
		Total Credits/ Total Hours of Work	**20 Credit**	**30 Hours**

* Practical Paper which is offered by batch wise classes

Students who opt to exit they will be awarded **UG degree in B.Sc. Statistics** after successful completion of three years, provided they have earned a minimum of 124 credits

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **DESCRIPTIVE STATISTICS**

Course code : **MJD1**

Learning outcomes:	**Pre-requisites:**
Students will be well-prepared to analyze and interpret data effectively and make informed decisions based on their understanding of descriptive statistics. **Skill Training:** 1. Recognize different data types. 2. Understand where and how to obtain data for analysis 3. Create data tables and organize data for analysis. 4. Use appropriate data visualization techniques 5. Calculate and interpret measures of Central Tendency, dispersion, skewness and kurtosis	Knowledge of Basic Mathematics **Specifications:** • Nature of the Course: **Major** • No. of credits:**04** • Pedagogy: **Theory** • **20% of Theory & 80% Problems** **Bridge courses to be done:** 1. Basic Mathematics Review 2. Diagrammatic representation 3. Data Interpretation

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Introduction to Statistics	Introduction to Statistics – Primary and Secondary data – Nominal, Ordinal, Ratio, and Interval scale (with examples) - Graphical Representation of data – Bar-charts, Pie-diagrams, Histograms, Frequency polygon, Ogives	12
II	Measures of central tendency	Measures of central tendency – properties – merits and demerits – mean, weighted mean –median, quartiles, deciles, percentiles and mode – relation between arithmetic mean, geometric mean and harmonic mean.	12
III	Measures of dispersion	Measures of dispersion – characteristics – Coefficient of dispersion – Coefficient of variation – Moments –central moments in terms of raw moments and moments about arbitrary points	12
IV	Skewness and Kurtosis & Curve fitting	skewness and Kurtosis – Pearson's coefficient of skewness – Bowley's coefficient of skewness – coefficient of skewness based upon moments – Curve fitting – Principle of least squares – Fitting of straight line, parabola, exponential and power curve	12
V	Correlation and Regression	Simple correlation – Karl Pearson's coefficient of correlation – Rank correlation – Multiple and Partial correlation coefficient in three variables – Simple Regression – Properties.	12

Unit wise Student activities:

1. Collect diagrams from Magazines / News Papers / Internet etc., and Submit as assignment related to UNIT I
2. Collect recent problems from Magazines / News Papers / Internet etc., and submit as assignment/discuss with class teacher related to UNIT II, III, IV, V

Basic Text Books

1. Gupta,S.C. and Kapoor, V.K.(2014): Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and Sons.
2. Agarwal.B.L(1996): Basic Statistics, 3/e, New Age International (P) Ltd.,.
3. S.P.Gupta (2014), Statistical Methods, Sultan Chand & sons

Reference Books

1. Sanjay Arora & Bansilal (2002): New Mathematical statistics, Meerat Publications, New Delhi
2. Hooda.R.P.(2003): Statistics for Business and Economics, 3/e, Mac Millan.

Web Resource

1. https://www.mathworks.com/help/stats/descriptive-statistics.html
2. http://eagri.org/
3. http://egyankosh.ac.in/
4. http://nsdl.niscair.res.in/

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **MATHEMATICS FOR STATISTICS**

Course code : **MID 1(A)**

Pre-requisites:	**Specifications:**
1. Knowledge of Basic Mathematics	Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **50% of Theory & 50% Problems**

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Matrices	Matrices: Elementary, scalar, Hermitian, skew-Hermitian, symmetric, skew-symmetric, Unitary, triangular, equivalent and similar matrices- Transpose and conjugate of a matrix – Rank of a matrix	12
II	System of Linear Equations	System of Linear Equations- Consistency-Different types of solutions – Inverse of a Matrix. Characteristics Equation – Eigen values and Vectors –Cayley Hamilton Theorem.	12
III	Integral calculus	Successive Differentiation – Leibnitz Theorem – Partial differentiation – Maxima and Minima of functions of two variables- Integration – Properties of Definite Integrals – Reduction formula – Bernoulli's formula - Double Integrals – Evaluation in simple cases only – Use of Jacobian transformation	12
IV	Integral calculus	Definitions of Beta and Gamma Integrals – Recurrence Formula for Gamma Integral Properties of Beta Integral– Application of Beta Gamma Integrals – Relation between Beta and Gamma Integrals	12
V	Laplace Transform	Laplace Transform: Introduction - definition - properties - Laplace transforms of standard functions - derivatives and integrals of transforms - transform of derivatives and integrals	12

Unit wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then the students must complete by the end of the each unit.

Basic Text Books

1. M.K. Venkataraman (1965): Engineering Mathematics, National Publishing Company, Chennai.

Reference Books

1. T.K. Manicavachagom Pillay, T. Natarajan, K.S. Gnanapathy (1999), Algebra, Volume II, S. Viswanathan Printers & Publishers Pvt.Ltd., Chennai.
2. T.K. Manicavachagom Pillay, T. Natarajan, K.S. Gnanapathy, Calculus, Vol I, II & III, S. Viswanathan Printers & Publishers Pvt.Ltd., Chennai
3. B.S. Grewal (2014): Higher Engineering Mathematics, Khanna Publishers

Evaluation methodology: (Theory)

Internal Assessment (Mid-Semester Exam) – 25 Marks

End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **INTRODUCTION TO DIFFERENTIAL CALCULUS**

Course code : **MID 1(B)**

Pre-requisites:	**Specifications:**
Basic Statistics	Nature of the Course: **Major** No. of credits:**04** Pedagogy: **Theory** **100% of Theory & 0% Problems**

Unit No.	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Derivative of a function- Differentiation rules- Rate of change- Derivatives of trigonometric functions- Chain Rule- Implicit differentiation rational exponents Inverse functions and their derivatives- Hyperbolic function	12
II	Application of Derivatives- Increasing decreasing functions - Maxima minima-Error –Approximation- Optimization-Newton method- Mean value theorems- Taylor theorem- Maclaurins theorem	12
III	Asymptotes- Test of concavity& convexity point of inflexion- Multiple point training curves in cartiean& Polar co-ordinates.	12
IV	Successive differentiation- Leibnitz rule- Problems and examples.	12
V	Exponent function a^x , log—functions- Theorems on exponent & Log functions- Partial differentiation- Chain rule- Eulers theorem	12

Unit wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then the students must complete by the end of the each unit.

Basic Text Books

1. George B.Thomas, Maurice D.Weir and Joel Hass, Thomas' Calculus 12th Edition, Pearson Education, 2015

Reference Books

1. Richard Courant and Fritz John, Introduction to Calculus and Analysis, Vol.I, Springer 1999.
2. Serge Lang A First course in Calculus 5th edition, Springer, 1999.

Evaluation methodology: (Theory)

Internal Assessment (Mid-Semester Exam) – 25 Marks

End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **OFFICIAL STATISTICS**

Course code : **MID 1(C)**

Learning outcomes: 1. Enhance the functions of statistical organization in India 2. Develop the features of official statistics 3. Design the techniques of agricultural and industrial statistics 4. Interpret the results of index numbers 5. Gain knowledge on national income and its measures **Skill Training:** 1. Understanding the functioning of statistical organization in India 2. Deep knowledge in the concepts of official statistics 3. Study basic fundamentals of agricultural and industrial statistics 4. Review the ideas of index numbers and its usages. 5. Impart the understanding of national income and its measures	**Pre-requisites:** Knowledge in Basic Mathematics and Statistics **Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **100% of Theory & 0% Problems** **Bridge courses to be done:** 1. Index numbers 2. Basics in demography

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Statistical Organization	Statistical organization – Population Statistics – Agricultural Statistics – Indices of Agricultural production – Miscellaneous Agricultural Statistics	12
II	Industrial Statistics	Industrial statistics – ASI – Indices of Industrial Production and profits	12
III	Price Statistics	Price statistics – Price index numbers – Labour Bureau; Index number of Retail prices – Indices of security prices.	12
IV	National Income Statistics	Wage statistics – trade statistics – Financial statistics – National income statistics.	12
V	Official Statistics	National sample surveys – Activities and publications of CSO and the Governmental Departments- National Income compilation.	12

Unit wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then the students must complete by the end of the each unit.

Basic Text Books

1. Gupta SP (2017), Statistical Methods (Sultan Chand & Sons)
2. SalujaMR (2017): Indian Official Statistical System (Publication of Indian Econometric Society)

Reference Books

1. Central Statistical Organisation, Guide to Official Statistics 1979 Ed Department of Statistics,Ministry of Planning, India

Web Resource (Websites/Databases/E-Resources)

1. https://agriculture.uk.gov.in/pages/show/221-agriculture=statistics-Data
2. https://byjus.com/free-ias-prep/nsso
3. https://learneclearn.com/course-detail/629525578cf30573e37bf2c1

Evaluation methodology: (Theory)

Internal Assessment (Mid-Semester Exam) – 25 Marks

End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **OFFICE AUTOMATION TOOLS**

Course code : **MJD-1** **Semester : I**

Learning outcomes: 1. Demonstrate a basic understanding of Microsoft Office applications (Word, Excel and PowerPoint). **2.** Perform common tasks such as creating, editing, saving, and printing documents, spreadsheets, and presentations **Skill Training:** 1. To acquiring the practical abilities needed to effectively use Microsoft Office applications, including Word, Excel, PowerPoint **Pre-requisites:** Basic Knowledge in computer	**Specifications:** • Nature of the Course: **Skill Enhancement** • No. of credits:**03** • Pedagogy: **Practical** • **% of Theory & % Problems** **Bridge courses to be done:** 1. Introduction to Computers 2. Basic Arithmetic Skills

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Introduction to Microsoft Windows	Introduction to Microsoft windows – Desktop icons and their functions – Dialog boxes – Taskbar – parts of windows – logoff and shutdown - Keyboard Shortcut keys – Working with notepad and wordpad – Introduction to Microsoft office	12
II	Introduction to Ms.Word	MS-WORD: Learning Word Basics – Formatting a Word Document – Working with Longer Document	12
III	Advanced Tools in Ms. Word	Organizing Content Using Tables and Charts - Sort Table Data, Control Cell Layout, Perform Calculations in a Table, Create a Chart Simplifying and Managing Long Documents - Create and Modify Text Styles, Create Custom List or Table Styles - Controlling the Flow of a Document: Insert Section Breaks, Insert Columns - Mail Merge: The Mail Merge Feature, Merge Envelopes and Labels	12
IV	Ms-Excel	MS-EXCEL: Creating a Simple Spreadsheet – Editing a Spreadsheet – Working with Functions and Formula – Formatting Worksheets – Completing Your Spreadsheet – Creating Charts	12
V	Ms-PowerPoint	MS-POWERPOINT: Creating and Viewing Presentations – Editing a Presentation – Working with Presentation Special Effects	12

Practical Exercises:

The faculty member will allocate the list of practical exercises based on the syllabus.

Basic Text Books

1. Wayne, WL(2019), Microsoft Excel: Data Analysis & Business Model, PHI

Reference Books

1. Microsoft Office XP – fast & easy, DIANE KOERS Publisher: Prentice Hall of India Private Limited, New Delhi, 2001

Web Resource (Websites/Databases/E-Resources)

1. https://www.slideshare.net/SrinivasaRao110/msoffice-syllabus
2. https://edu.gcfglobal.org/en/topics/office/

Student Activities:

1. Observation Note Books
2. Practical Record

Evaluation Methodology:

- Break up Marks (Internal:**50**; End-Semester:**50**)
    - Components of Internal Evaluation (50 Marks)
        1. Attendance
        2. Observation Notebook
        3. Practical Record
        4. Model Practical Exam
    - End-Semester Practical Exams (50 Marks)

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **COMPUTATIONAL STATISTICS**

Course code : **SEC -1** **Semester : II**

Pre-requisites:	**Specifications:**
Basic Mathematics	• Nature of the Course: **SEC** • No. of credits:**04** • Pedagogy: **Practical** • **% of Theory & 100% Problems**

Sl. No.	**List of Practicals**	**No. of Sessions**
1	Diagrammatic Representation Bar Chart, Pie Diagram	6
2	Construction of Discrete and Continuous Frequency Tables from raw data	6
3	Graphical Representation - Histogram	6
4	Summary Statistics	6
5	Two way tables and plots	6
6	Simple correlation, Rank correlation	6
7	Simple Regression	6
8	Fitting of straight line, second degree, exponential and power curves	6

Student Activities:

1. Observation Note Books
2. Practical Record

Evaluation Methodology:

- Break up Marks (Internal: **50**; End-Semester: **50**)
    - Components of Internal Evaluation (50 Marks)
        1. Attendance
        2. Observation Notebook
        3. Practical Record
        4. Model Practical Exam
    - Components of End-Semester Exams (50 Marks)

      Answer ANY FOUR out of six questions

Faculty Qualifications/Specialization for conducting Practicals:

M.Sc. Statistics with NET/SET
or
Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **PROBABILITY THEORY**

Course code : **MJD 2** **Semester II**

Learning outcomes:	**Pre-requisites:**
1. To understand the basic principles of probability including the laws for unions, intersections, and complementation in problem-solving situations. **2.** To provide students with the foundations of Addition, Multiplicative, and Baye's theorems. **Skill Training:** Practicing simple probability problems, working with real-time problems and understanding how probability theory can be used in various contexts, will help students to become proficient in applying these skills in their academics.	Basic Knowledge of Mathematics, Calculus, Permutations and Combinations **Specifications:** • Nature of the Course: **Major** • No. of credits:**04** • Pedagogy: **Theory** • **80% of Theory & 20% Problems** **Bridge courses to be done:** 1. Mathematics Fundamentals 2. Statistics Primer 3. Calculus Review 4. Introduction to Set Theory

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Introduction to probability	Introduction to probability theory – Random experiments, Events, Sample space, Algebra of events, Operations on events – Classical approach to probability – Mathematical and Statistical Probability - Axiomatic approach to probability – Simple problems	12
II	Theorem of Probability	Addition theorem - Conditional Probability – Independence of events – Multiplication theorem – Bayes theorem – Simple problems.	12
III	Distribution Functions	Random variables – Discrete and Continuous Random Variable – Probability Mass function and Probability Density function – Distribution function – Properties – Simple problems	12
IV	Mathematical Expectations	Mathematical Expectation of random variables and its properties - Moment generating function– Cumulant generating function – Characteristic function – Definition - their properties for discrete and continuous variates – Simple problems	12
V	Convergence Probability	Chebyshev's inequality - Definition of convergence in probability and distributions - Weak Law of Large numbers (WLLN) - Central Limit theorem for i.i.d case (statement only)	12

Unit wise Student activities:

Introduction to Probability:

Dice Experiment

Probability Card Game

Probability Distributions

Coin Toss Experiment

Probability Problems Worksheet

Conditional Probability and Independence

Tree Diagram Practice

Dependent Events Experiment

Basic Text Books

1. Hogg, R.V., Mc Kean J W and Craig, A.T. (2005): Introduction to Mathematical Statistics, 6/e, Pearson Edition.
2. A. M. Mood, F. A. Graybill, D. C. Boes (2002), Introductory to the Theory of Statistics, 3/e, Mc Graw hill
3. Gupta, S.C. and Kapoor, V.K.(2000):Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and Sons.

Reference Books

1. Bansilal and Sanjay Arora (2002): New Mathematical Statistics, Satyaprakashan Publications, New Delhi.
2. Rohatgi V.K. and Md. Ehsanes Saleh A.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication.
3. Bhat B.R, Srivenkataramana T and Rao Madhava K.S(1996): Statistics: A Beginner's Text, Vol.II, Nw Age International(P) Ltd.
4. Murray R. Spiegel, John J. Schiller, R. Alu Srinivasan (2013), Schaum's Outline of Probability and Statistics, Fourth Edition, The McGraw-Hill Companies, Inc.

Web Resource (Websites/Databases/E-Resources)

1. https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2014
2. http://www.probability.net
3. https://www.edx.org/learn/probability-and-statistics/

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **HEALTH AND VITAL STATISTICS**

Course code : **MID-2 (A)** **Semester II**

Learning outcomes: 1. To understand the mortality and fertility rates 2. To construct the life table using Vital statistics **Skill Training:** 1. Mortality and Fertility rates are arrived at using vital statistics 2. Population projection is made by different methods	**Pre-requisites:** Basic statistics, Probability Theory **Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **80% of Theory & 20% Problems** **Bridge courses to be done:** 1. Basics in Statistics 2. Basics in Probability Theory

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Health statistics data sources	Health statistics: Introduction, utilization of basic data - sources of health statistics - problems in the collection of sickness data - measurement of sickness, -hospital statistics and the international classification of diseases - sources of demographic data in India: census, vital events, registration, survey, extent of under registration	12
II	Measures of mortality	Measures of mortality - Crude and specific rates - infant mortality rate - direct and indirect standardization of death rates - complete life table structure - interrelationship among life functions uses of life table	12
III	Measures of fertility	Measures of fertility – CBR, ASBR, GFR and TFR - cohort fertility analysis measures of migration - crude, specific and standardized rates - survival ratio - National growth rate method	12
IV	Forces of mortality	Forces of mortality - Gompertz and Makeham law - Abridged life table - Construction by Reed Merril King and Graville methods	12
V	Population projection	Population growth and change - Arithmetic, geometric and exponential growth rates - population estimation and projection – GRR, NRR component method of projection - logistic curve	12

Unit-wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit.

Basic Text Books

1. Parimal Mukhopadhyay (2011), Applied Statistics, Books & Allied (P) Ltd
2. Bhaskar.D.Misra (1982): An introduction to the study of population, South Asian Publishers Pvt. Ltd

Reference Books

1. Barclay.G.W. (1958): Techniques of population Analysis, John Wily, New York
2. Keyfitz.N. (2005): Applied Mathematical Demography, John Wiley, New York

Web Resource (Websites/Databases/E-Resources)

1. https://crsorgi.gov.in/web/index.php/auth/login
2. https://data.gov.in/
3. https://data.who.int/countries/356

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **DIFFERENTIAL EQUATION**

Course code : **MID-2 (B)** **Semester : II**

Pre-requisites: Basic Mathematics	**Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **100 % of Theory & 0% Problems**

Unit No.	Detailed Syllabus	No. of Hours of Teaching
I	Exact differential equations- Integrating factors – Linear differential equations- Bernoulli equation – Modeling : Electric circuits – Orthogonal trajectories of curves	12
II	Homogeneous linear equations of second order – Second order homogeneous equations with constant coefficients – Case of complex roots- Complex exponential function – Differential operators – Modeling : Free oscillations – Euler-cauchy equation – Existence and uniqueness theory – Wronskian	12
III	Non homogeneous equations – Solution by undetermined coefficients – Solution by variation of parameters – Modeling of electric circuits – Higher order linear differential equations – Higher order homogeneous equations with constant coefficients	12
IV	Introduction: vectors, matrices, eigenvalues – Introductory examples – Basic concepts and theory – Homogeneous systems with constant coefficients, phase plane, critical points – Criteria for critical points, Stability	12
V	Laplace transform- Inverse transform, linearity- Shifting – Transforms of derivatives and integrals- Differential equations – Unit step function- Second shifting theorem- Dirac's delta function – Convolution- Integral equations – Partial fractions- Differential equations – Systems of differential equations	12

Unit wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit.

Basic Text Books

Erwin Kreyszig, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, 1999. Unit-I: Sections 1.5-1.8

Unit-II: Sections 2.1-2.7

Unit-III: Sections 2.8-2.10, 2.13, 2.14

Unit-IV: Sections 3.0-3.4

Unit-V: Sections 5.1-5.7

Reference Books

1. George F. Simmons, Differential Equations, Tata McGraw-Hill, New Delhi, 1972.
2. Boyce and Di Prima, Differential Equations and Boundary Value Problems, Wiley,10th edition 2012.
3. Earl A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall of India Private Ltd, 1991

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **INTRODUCTION TO INTEGRAL CALCULUS**

Course code : **MID-2 (C)** **Semester : II**

Pre-requisites:	**Specifications:**
Basic Mathematics	Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **100% of Theory & 0% Problems**

Unit No.	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Integration of rational algebraic functions – Integration of irrational algebraic functions - Properties of definite integrals	12
II	Integration by parts – Bernoulli's formula – Reduction formulae	12
III	Evaluation of double integral – Changing of order of integration - Double integral in Polar co-ordinates – Triple integral	12
IV	Jacobian – Change of variables in the case of two variable and three variables – Transformation from Cartesian to polar co-ordinate - Transformation from Cartesian to spherical co-ordinates	12
V	Properties – relation between Beta and Gamma functions - Recurrence formula	12

Unit wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit.

Basic Text Books

Calculus Volume II , S.Narayanan and T.K. Manickavasagam Pillai (2008)

Unit I : Chapter 1 : 7.3, 7.4, 7.5, 8, 11

Unit II : Chapter 1: 12,13,

Unit III: Chapter 5 : 2.1, 2.2, 3.1, 4

Unit IV : Chapter 6: 1.1, 1.2, 2.1,2.2,2.3,2.4

Unit V: Chapter 7: 2.1, 2.2, 2.3, 3, 4, 5

Reference Books

1. Integral Calculus, N. P. Bali, Laxmi Publications, Delhi, (1991)
2. Calculus, George B.Thomas, Jr. and Ross L. Finney, 9' Edition, Pearson Education,(2006)

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **QUANTITATIVE APTITUDE AND DATA INTERPRETATION**

Course code : **MLD 2** **Semester : II**

Learning outcomes: 1. develop a strong foundation in numerical proficiency 2. Ability to analyze and solve a wide range of quantitative problems 3. To interpret and analyze data presented in various forms, including tables, graphs, charts, and word problems. **Skill Training:** 1. Problem-Solving Skills 2. Critical Thinking 3. Quantitative Comparison 4. Pattern Recognition **Pre-requisites:** Knowledge in Arithmetic skills	**Specifications:** Nature of the Course: **Skill Enhancement** No. of credits:**03** Pedagogy: **Theory** **0% of Theory & 100% Problems** **Bridge courses to be done:** 1. Mathematical logic 2. Problem-Solving Skills

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Number System	Whole numbers, Integers, Rational and irrational numbers, Fractions, Square roots and Cube roots, Surds and Indices, Problems on Numbers, Divisibility, Steps of Long Division Method for Finding Square Roots	10
II	Interest and Index	Basic concepts, Different formulae of Percentage, Profit and Loss, Discount, Simple interest, Ratio and Proportion, Mixture	10
III	Time Problems	Time and Work, Pipes and Cisterns, Basic concepts of Time, Distance and Speed ; relationship among them	10
IV	Shapes	Concept of Angles, Different Polygons like triangles, rectangle, square, right angled triangle, Pythagorean Theorem, Perimeter and Area of Triangles, Rectangles, Circles	10
V	Diagrammatic Interpretation	Raw and Grouped Data, Bar Graphs, Pie charts, Mean, Median and Mode, Events and Sample Space, Probability	10

Unit wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit

Basic Text Books

Dr. R.S Aggarwal, Quantitative Aptitude, S.Chand, 2023 edition

Reference Books

G.P. Gupta and Sanjeet Burnwal, General Quantitative Aptitude for Competitive Exams - SSC/ Banking/ Defence/ Railway/ Insurance - 2nd Edition 2020, Disha Publication,

Web Resource (Websites/Databases/E-Resources)

1. https://www.indiabix.com/
2. https://unacademy.com/lesson/overview-of-the-course/QFL7YNCS

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **INTRODUCTION TO MS-EXCEL**

Course code : **SEC-2** **Semester : II**

Learning outcomes: 1. To acquire proficient in using Microsoft Excel, including understanding the interface, menus, and basic navigation 2. To develop the ability to perform various data analysis tasks, such as sorting, filtering, and conditional formatting **Skill Training:** 1. Apply Excel for financial and statistical analysis 2. Learn time-saving techniques and shortcuts to work more efficiently in Excel.	**Pre-requisites:** Basic Statistics, Computer basics **Specifications:** Nature of the Course: **Skill Enhancement** No. of credits:**03** Pedagogy: **Practical** **0% of Theory & 100% Problems** **Bridge courses to be done:** 1. Introduction to Computer Fundamentals 2. Basic Arithmetic skills 3. Introduction to statistics

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Introduction to Excel	File Operations – Open, Save, close – Data operations – Creating forms to enter data – concatenation of text, numbers – Splitting of data into columns – Sort and reverse sort – Grouping and ungrouping of data	12
II	Data Representation	One dimensional, two dimensional data presentation – Histogram, line diagram – Box plots – Scatter plots. Bar charts – stack, subdivided, pie charts, radar graphs	12
III	Summary Statistics	Arithmetic Mean, Median, Mode, Geometric mean and Harmonic mean, Range, Quartile Deviation	12
IV	Dispersion	Mean Deviation, Standard Deviation, Coefficient of Variation. Central and Non-Central moments and their interrelationship. Sheppard's correction for moments. Skewness and kurtosis	12
V	Correlation	Simple Correlation – Correlation graph, Rank Correlation, Simple Regression	12

Practical Exercises:

The faculty member will allocate the list of practical exercises based on the syllabus.

Basic Text Books

1. Sarma KVS (2010), Statistics Made Simple: Do it Yourself on PC, PHI, India, 2/e
2. Wayne, W L (2019), Microsoft Excel: Data Analysis & Business Model, PHI.

Reference Books

1. Nelson, S.L and Nelson, E C (2018), Microsoft data analysis for dummies, Wiley
2. Berk, K. N and Carey, P (2000), Data Analysis with Microsoft Excel, S.Chand (G/L) & Company Ltd, 3/e

Web Resource (Websites/Databases/E-Resources)

1. https://support.microsoft.com/en-us/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb
2. https://www.w3schools.com/EXCEL/index.php
3. https://edu.gcfglobal.org/en/topics/excel/

Student Activities:

1. Observation Note Books
2. Practical Record

Evaluation Methodology:

- Break up Marks (Internal:**50**; End-Semester:**50**)
    - Components of Internal Evaluation (50 Marks)
        1. Attendance
        2. Observation Notebook
        3. Practical Record
        4. Model Practical Exam
    - End-Semester Practical Exams (50 Marks)

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **DISTRIBUTION THEORY**

Course code : **MJD 3** **SEMESTER III**

Learning outcomes: 1. Gain expertise in deriving and working with PDFs for continuous distributions and PMFs for discrete distributions. 2. Understand their properties and how to use them to calculate probabilities and moments. **Skill Training:** Practicing discrete and continuous probability distribution problems, working with real-time problems and understanding how distribution functions can be used in various contexts, will help students to become proficient in applying these skills in their academics.	**Pre-requisites:** Calculus, Algebra, Probability theory **Specifications:** • Nature of the Course: **Major** • No. of credits:**04** • Pedagogy: **Theory** • **100% of Theory & % Problems** **Bridge courses to be done:** 1. Differential calculus 2. Integral calculus 3. Probability concepts

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Univariate and Bivariate distribution function	Concept of univariate and bivariate distributions – discrete and continuous type – joint density function – marginal density function – conditional distribution function and conditional density function – marginal and conditional expectation.	14
II	Discrete Distributions	Discrete Distributions – Uniform, Bernoulli, Binomial, Poisson, Negative Binomial, Geometric distribution and their characteristics.	14
III	Continuous distributions	Continuous distributions - Uniform, Normal, Exponential, Gamma, Beta, Cauchy Distributions – Characteristics - Properties of these distributions Normal distribution and its characteristics	16
IV	Sampling Distributions	Sampling Distributions – t, F and Chi-square – derivation of their probability density functions -properties of t, F and chi-square – relation among t, F and chi-square distributions-	14

V	Order Statistics	Order Statistics – Distribution of minimum, maximum and r^{th} order statistics – joint distribution of r^{th} and s^{th} order statistics – distribution of range and mid-range.	10

Unit wise Student activities:

Assign problems that require students to calculate the mean and variance of specific probability distributions. Encourage them to discuss the implications of these values.

Basic Tex Books

1. Gupta, S. C and Kapoor, V.K (2010), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
2. Murray R. Spiegel, John J. Schiller, R. Alu Srinivasan (2013), Schaum's Outline of Probability and Statistics, Fourth Edition, The McGraw-Hill Companies, Inc.
3. Rohatgi V.K. and Md. Ehsanes Saleh A.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication

Reference Books

1. Hogg R.V. and Craig A.T. (1998): Introduction to Mathematical Statistics, 4th edition, Collier Macmillan Press.
2. Bhat B.R, Srivenkataramana T and Rao Madhava K.S.(1996): Statistics: A Beginner's Text, Vol. II, New Age International(P) Ltd.
3. Mood A.M., Graybill F.A and Boes D.C. (2002): Introduction to the TheoryofStatistics, McGraw Hill.

Web Resource

1. https://nptel.ac.in/courses/111105090
2. https://stattrek.com/probability-distributions/binomial?tutorial=prob
3. https://www.khanacademy.org/math/statistics-probability/sampling-distributions-library

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **SAMPLING THEORY**

Course code : **MJD 4** **SEMESTER III**

Learning outcomes: Understand the key terms and concepts related to sampling Techniques, such as random sampling, stratified sampling, Systematic Sampling and cluster sampling **Skill Training:** 1. Understanding Sampling Concepts 2. Probability and Non-Probability Sampling 3. Sampling Frame Development 4. Survey Design and Questionnaire Construction 5. Data Collection Techniques	**Pre-requisites:** 1. Basic Mathematics 2. Descriptive Statistics 3. Probability Theory **Specifications:** • Nature of the Course: **Major** • No. of credits:**04** • Pedagogy: **Theory** • **80% of Theory & 20% Problems** **Bridge courses to be done:** 1. Basic Statistics 2. Mathematics Review 3. Introduction to Sample Survey

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Introduction to Sampling Methods	Concept of sampling – Need for sampling – Population and sample – sampling unit and sample frame – types of population – basic properties of population – sample survey and census – Principal steps in a Sample Survey – Notion of sampling and non-sampling errors.	12
II	Simple Random Sampling	Simple random sampling with and without replacement – Estimation of Population mean and proportion and their variances	12
III	Stratified Random Sampling	Stratified sampling – Principles of stratification – estimation of population mean and its variance – allocation techniques: Proportional, optimal and Neyman – estimation of gain due to stratification - Determination of sample size	16
IV	Systematic Sampling	Systematic Sampling – Estimation of population mean and its sampling variance – comparison of systematic, simple random and stratified random sampling	12
V	Cluster Sampling	Cluster sampling with equal sized clusters – estimation of population mean and variance.	8

Unit wise Student activities:

1. Sampling Simulation Game
2. Sample Size Calculation Exercises
3. Sampling Frame Creation
4. Sampling from Real Data
5. Sampling Plan Development
6. Field Visits

Basic Text Books

1. Daroga Singh and F.S.Choudhary (1986), Theory and analysis of Sample Survey Designs, Wiley Eastern Ltd.
2. S.C. Gupta and V.K.Kapoor (2007), Fundamentals of Applied Statistics, Sultan Chand and Sons.

Reference Books

1. W.G.Cochran(1999), Sampling Techniques, 3rd Edition, Wiley Eastern Ltd.
2. Pandurang.V.Sukhatme and Balkrishna.V.Sukhatme(1970): Sampling Theory of Survey with application, Asia Publication House.
3. ParimalMukhopadhyay (2008): Theory and Methods of Survey Sampling**,** Prentice Hall of India

Web Resource (Websites/Databases/E-Resources)

1. https://www.tutorialspoint.com/statistics/sampling_methods.htm
2. https://www.khanacademy.org/math/statistics-probability/designing-studies/sampling-methods-stats/a/sampling-methods-review
3. https://www.researchgate.net/publication/355278081_A_beginner's_Guide_to_Sampling_Methods_in_Medical_Research

Journals/Magazines

1. https://academic.oup.com/jssam (Journal of survey statistics and methodology)

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **REAL ANALYSIS**

Course code : **MID-3 (A)** **Semester: III**

Learning outcomes: 1. Have an idea about the concept of sets and functions 2. Compute the sequence of real numbers. 3. Obtain the series of real numbers. 4. Construct the limit of real valued functions in one variable and uniformly continuous functions. 5. Know the concept of differentiability of functions. **Skill Training:** 1. Impart the significance of the series of real number and its convergence and divergence. 2. Develop the functions and extreme value theorem and it usage 3. Get acknowledge on mean value theorems and its applications	**Pre-requisites:** Knowledge in Mathematics **Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **100% of Theory & 0% Problems** **Bridge courses to be done:** 1. Basic Mathematics 2. Set Theory 3. Mathematical Logic 4. Functions and relations 5. Sequences and series

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Concept of real numbers	Real valued functions – Equivalence – Countability – Real numbers – Least upper bound – Greatest lower bound. Sequence of real numbers : Limit of a sequence - Convergent sequences, Divergent sequences - Bounded sequences - Monotone sequences – Cauchy's first and second theorem on limits – Cauchy's general principle of convergence	12
II	Series of real numbers	Series of real numbers : Convergence and divergence - series with non-negative terms – comparison test – p-test, D'Alembert's ratio test, Cauchy's Root test - Alternating series - Conditional convergence and absolute convergence – Leibnitz test (proof of the test can be omitted, only problems).	12
III	Functions	Functions : Limit of real valued function in one variable, continuity – types of discontinuities – algebra of continuous functions – Extreme value theorem – Intermediate value theorem – Uniformly Continuous functions	12
IV	Theorem in Functions	Increasing and Decreasing functions – Differentiability – Darboux'sTheorm – Rolle's Theorem – Mean value theorem for derivatives – Taylor's Series expansion	12

V	Riemann Integration	Riemann Integration – Definition and existence of the integral – refinement of partitions – Darboux's theorem – Conditions of Integrability – Integrability of sum and modulus of integrable functions – Integration and Differentiation – Fundamental Theorem of Calculus	12

Unit-wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit.

Basic Text Books

1. D. Somasundaram and B. Choudhary (2002) : A first course in Mathematical Analysis, Narosa Publishing house
2. R. R. Goldberg (1970) : Methods of Real Analysis, Oxford & IBH.

Reference Books

1. T. M. Apostol(1985): Mathematical Analysis, Narosa Publishing House.
2. W. Rudin(1976): Principles of Mathematical Analysis, 3/e, McGraw Hill Company.
3. Malik S.C. and SavitaArora (2010): Mathematical Analysis, 4/e, New Age International Publishers

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **INTRODUCTION TO LINEAR ALGEBRA**

Course code : **MID-3 (B)** **Semester : III**

Pre-requisites: Basic Mathematics	**Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **100% of Theory & 0% Problems**

Unit No.	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Abstract Algebra Concepts – Groups- Subgroups- Fields- examples Vector space- Subspace-linear combinations and systems of linear equations- Linear dependence and linear independence- Basis and dimension	12
II	Linear Transformations- Null spaces- Range spaces- Dimension theorem- Matrix representation of linear transformation- composition of linear transformations and Matrix multiplication- Invertability and Isomorphism- The change of coordinate matrix	12
III	Elementary matrix Operations and elementary matrices- The rank of a matrix and matrix inverses- systems of linear equations- Theory and computation	12
IV	Determinants of order 2 and order n- propertie4s of determinants- Important facts about determinants- Eigen values and Eigen vectors- Diagonalizability- Invariant spaces and Cayley- Hamilton theorem	12
V	Inner products and norms- The Gram-Schmidt orthogonalisation process and orthogonal complements	12

Unit-wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit.

Basic Text Books

1. Stephen H. Friedberg, Arnold J. Insel and Lawrence E. Spence, Linear Algebra, 4th Edition, Printice Hall of India Pvt. Ltd., 2006
   Unit I: 1.2 to 1.6

   Unit II: 2.1 to 2.5

   Unit III: 3.1 to 3.4

   Unit IV: 4.1 to 4.4 and 5.1 to 5.2, 5.4

   Unit V: 6.1, 6.2

Reference Books

1. S. Kumaresan, Linear Algebra Geometric Approach, Prentice Hall of India Pvt. Ltd., 2000.
2. N. Herstien, Topics in Algebra, 2nd Edition, John Wiley & Sons, 2003

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **Psychology and Educational Statistics**

Course code : **MID-3 (C)** **Semester : III**

Pre-requisites: Basic Statistics	**Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **100% of Theory & % Problems**

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Introduction	Introduction of Psychology and Educational Statistics : Some Scaling procedures – Scaling of scores on a test - Scaling of Sources on a Test – Z or σ- scores, Standard Scores, Normalised Scores and T-Scores with examples	12
II	Test Scores	Calculation of T-Scores for a given frequency distribution – Uses of T-scores – Comparison of T-scores and standardized scores – Percentile scores – Advantage and disadvantage scores - Scaling of ranking in terms of normal probability curve	12
III	Reliability of Test Scores	Reliability of Test Scores: Definition of Reliability, Error Variance, Index of Reliability, Parallel Tests.	12
IV	Test Reliability Methods	Methods of determining test reliability : The Test-Retest Method – Parallel Forms Method – Split-half Method – The Rulon Method of Estimating Reliability	12
V	Validity of Test Scores	Validity of Test Scores: Estimation of Validity, Types of Validity – Predictive Validity – Content Validity – Construct Validity. Validity and Test Length. Comparison between Reliability and Validity - Intelligence Tests and Intelligence Quotient	12

Unit-wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit.

Basic Text Books

1. S.C. Gupta, V.K. Kapoor (2021); 'Fundamentals of Applied Statistics', Sultan Chand & Sons.

Reference Books

1. Henrey E. Garrett (2005); 'Statistics in Psychology and Education', Paragon International Publishers, New Delhi.
2. Roger Watt, Elizabeth Collins (2019); 'Statistics for Psychology – A guide for beginners', SAGE Publishers
3. S.K. Mangal (2010); 'Statistics in Psychology and Education", Second Edition, PHI Learning Private Limited, New Delhi.
4. Albert K. Kurtz, Samuel T. Mayo (1979); 'Statistical Methods in Education and Psychology', Springer – Verlag Publishers

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **TIME SERIES AND INDEX NUMBERS**

Course code : **MLD 3** **Semester : III**

Pre-requisites:	**Specifications:**
Basic Mathematics	• Nature of the Course: Multidisciplinary • No. of credits:**03** • Pedagogy: **Theory** • **20% of Theory & 80 % Problems**

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hoursof Teaching**
I	Concept of time series	Concept of time series - components of a time series - Additive and Multiplicative models - Resolving the components of a time series - Evaluation of trend by least square method and Methods of moving averages	12
II	Seasonal Variations	Seasonal Variations – Measurement of seasonal variations : Method of Simple average - Ratio to moving average - Ratio to trend	12
III	Seasonal Variations	Link relative method - Cyclical fluctuations - Random component in time series - Variate difference method	12
IV	Index numbers	Concept of Index numbers – Definitions and uses, Limitations – Weighted Index numbers -Laspeyre's, Paasche's, Fisher's, Marshall Edgeworth index numbers – Fixed and Chain base index numbers	12
V	Index numbers	Optimum tests for index numbers: Time and factor reversal test - Cost of living index number - Construction and uses of wholesale price index	12

Unit wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit.

Basic Text Books

1. Kapoor V.K. and Gupta S.C. (1978): Fundamentals of Applied Statistics, Sultan Chand ans Sons.

Reference Books

1. Goon A.M, Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
2. Saluja M.R. (1972): Indian official Statistical Systems, Statistical PublishingSociety, Calcutta and The Indian Econometric Society, Hyderabad.
3. Croxton F.E, Cowden D.J and Kelin S (1973): Applied General Statistics,Prentice Hall of India.
4. Guide to current Indian Official Statistics. Central Statistical Organization,Govt. of India
5. Mukhopadhyay P. (1999): Applied Statistics, New Central Book Agency Pvt.Ltd., Calcutta

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **STATISTICAL COMPUTING WITH C++**

Course code : **SEC-3** **Semester : III**

Learning outcomes: 1. Students should have a solid grasp of the basic syntax, data types, variables, and operators in C++. 2. Mastery of core OOP principles like classes, objects, inheritance, polymorphism, encapsulation, and abstraction 3. Skills to identify and fix common programming errors and debugging techniques **Skill Training:** 1. Participate in coding challenges on platforms like LeetCode, HackerRank, and Codeforces to sharpen your problem-solving skills 2. Learn to use Git for version control. It helps you track changes in your code and collaborate with others effectively	**Pre-requisites:** Knowledge in Mathematics, Computer Science and Statistics **Specifications:** • Nature of the Course: **Skill Enhancement** • No. of credits:**03** • Pedagogy: **Practical** • **% of Theory & % Problems** **Bridge courses to be done:** 1. Basic concepts of Flowcharts and algorithm 2. Knowledge on logical thinking 3. Problem solving skills

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Introduction to C++	Introduction to C++ - Applications of C++ - Structure of a Simple C++ Program – Compiling and Executing C++ programs. Keywords – Identifiers – Constants – Basic Data Types – Variable declaration – Operators - Precedence – Array Handling	12
II	Functions	Introduction to Functions – Library Functions - Steps in writing user defined functions – Inline Functions – Recursion – Default parameters – Call by value – Call by reference	12
III	OOPs	Object oriented programming paradigm – Basic OOP concepts – Benefits – Object Oriented Programming languages – Applications – Class definition – Member functions – Static members – Constructor and destructors : various types	12
IV	Operators	Operator overloading: Unary , binary – Rules for Operator overloading – Type conversions - Function overloading – Friend and Virtual Functions. Inheritance : Various Types , Applications – Abstract classes – Virtual base classes	12

V	IO Streams	Introduction to Streams - Formatted IO – Unformatted IO. Files in C++ : Introduction, various operations, modes – Sequential and random files – Error handling in File operations – Command-line arguments	12

Practical Exercises:

The faculty member will allocate the list of practical exercises based on the syllabus.

Basic Text Books

1. E.Balagurusamy (2013): Object Oriented Programming With C++, McGraw-Hill Education, Sixth Edition.

Reference Books

1. Herbert Schildt (2017): C++ The Complete Reference, McGraw Hill Education, Fourth Edition.

Web Resource (Websites/Databases/E-Resources)

1. https://www.geeksforgeeks.org/c-plus-plus/
2. https://www.codecademy.com/learn/learn-c-plus-plus

Student Activities:

1. Observation Note Books
2. Practical Record

Evaluation Methodology:

- Break up Marks (Internal:**50**; End-Semester:**50**)
    - Components of Internal Evaluation (50 Marks)
        1. Attendance
        2. Observation Notebook
        3. Practical Record
        4. Model Practical Exam
    - End-Semester Practical Exams (50 Marks)

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **ESTIMATION THEORY**

Course code : **MJD 5** **SEMESTER IV**

Learning outcomes:	**Pre-requisites:**
1. Understand the fundamental concepts in estimation theory, such as point estimation, interval estimation 2. The role of point estimators in approximating population parameters and define properties of a good estimator, including unbiasedness and consistency **Skill Training:** 1. Understanding Estimation Principles 2. Understand and practice the method of moments for estimating parameters based on sample moments.	Knowledge in probability and distribution theory **Specifications:** • Nature of the Course: **Major** • No. of credits:**04** • Pedagogy: **Theory** • **100 % of Theory** **Bridge courses to be done:** 1. To review the fundamental of Sequence, series and convergence in mathematics 2. A basic course in statistics, covering concepts like descriptive statistics, probability

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Unbiasedness & Consistancy	Point estimation – Properties of estimators – Unbiasedness –Consistent estimators - Properties of consistent estimators – sufficient condition for consistency – Simple problems	12
II	Efficiency & Sufficiency	Concept of efficiency – Minimum Variance Unbiased Estimator (MVUE) – Cramer-Rao inequality - Simple Problems – Concept of Sufficient statistics with illustration – Neyman Factorization theorem discrete case with proof–Concept of UMVUE - Rao-Blackwell theorem - Simple problems.	12
III	Method of Estimation of Parameter	Methods of moments – Method of Maximum Likelihood (M.L.E.) – Properties of Maximum Likelihood Estimators (without proof) –Simple Problems	12
IV	Method of Estimation of Parameter	Method of Least Squares – Method of Minimum Chi-square –Properties - Simple problems	12

V	Interval Estimation	Interval Estimation - Concepts of Confidence Interval and Confidence Coefficient –Exact Confidence Intervals for mean, difference of means, variance, ratio of variance of two independent normal populations - Proportions (single and difference) – Large sample confidence interval.	12

Unit wise Student activities:

1. Provide students with sample datasets and ask them to estimate population parameters using various estimation methods, such as point estimation or interval estimation
2. Give students datasets with known population parameters and ask them to calculate by the method of maximum likelihood estimators / Moments / Least square for those parameters

Basic Text Books

1. Rohatgi V.K. and Md. EhsanesSalehA.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication
2. Gupta, S. C and Kapoor, V.K (2010), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.

Reference Books

1. Hogg R.V., Craig A.T. and Joseph W Mckean(2005): Introduction to Mathematical Statistics, 6th edition, Pearson.
2. Mood A.M., Graybill F.A and Boes D.C. (1974): Introduction to Theory of Statistics, McGraw Hill.
3. Kale, B.K, Muralidharan, K, (2015), Parametric Inference: An introduction, Alpha Science International Ltd.

Web Resource (Websites/Databases/E-Resources)

1. https://nptel.ac.in/courses/111/105/111105043/
2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ma19/

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **APPLIED STATISTICS**

Course code : **MJD 6**

SEMESTER IV

Learning outcomes: 1. To formulate linear and non-linear models for Time series data and give projections for future. 2. To understand the basic problems in the construction of index numbers and to know various types of index numbers. 3. To analyse the demand and supply of various products with respect to their elasticity **Skill Training:** 1. The varieties of index numbers are highlighted. 2. The mathematical models for time series data, such as supply and demand analysis	**Pre-requisites:** Mathematical Knowledge **Specifications:** • Nature of the Course: **Major** • No. of credits:**04** • Pedagogy: **Theory** • **20% of Theory & 80% Problems** **Bridge courses to be done:** 1. Basic Mathematics 2. Basic Statistics

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Time Series and Trend Method	Concept of time series - components of a time series - Additive and Multiplicative models - Resolving the components of a time series - Evaluation of trend by least square method and Methods of moving averages	12
II	Seasonal and Cyclic Variations	Seasonal Variations – Measurement of seasonal variations : Method of Simple average - Ratio to moving average - Ratio to trend - Link relative method - Cyclical fluctuations - Random component in time series - Variate difference method	12
III	Index Numbers	Index numbers – Definitions and uses – Weighted Index numbers -Laspeyre's, Paasche's, Fisher's, Marshall Edgeworth index numbers – Fixed and Chain base index numbers	12
IV	Index Numbers	Optimum tests for index numbers - Cost of living index number - Construction and uses of wholesale price index	12
V	Demand Analysis	Demand Analysis - Theory and analysis of consumer's demand -Law of demand - Price elasticity of demand -	12

		estimation of demand curves - forms of demand functions - Demand and Supply utility and indifference maps - determination of price and supply and demand	

Unit wise Student activities:

1. Ask them to identify and describe any trends and seasonality components for the time series data. Encourage them to use visualization techniques
2. Assign exercises involving the construction and comparison of different price / quantity indices to illustrate the differences in index number formulas.

Basic Text Books

1. Kapoor V.K. and Gupta S.C. (1978): Fundamentals of Applied Statistics, Sultan Chand ans Sons.
2. Saluja M.R. (1972): Indian official Statistical Systems, Statistical PublishingSociety, Calcutta and The Indian Econometric Society, Hyderabad

Reference Books

1. Croxton F.E, Cowden D.J and Kelin S (1973): Applied General Statistics,Prentice Hall of India.
2. Guide to current Indian Official Statistics. Central Statistical Organization,Govt. of India
3. Goon A.M, Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
4. Mukhopadhyay P. (1999): Applied Statistics, New Central Book Agency Pvt.Ltd., Calcutta.

Web Resource (Websites/Databases/E-Resources)

1. https://www.youtube.com/watch?v=DtCPLDuzk8M&list=PLmPJQXJiMoUVr07-VnwDiki89DqyuSS21
2. https://study.sagepub.com
3. https://www.coursera.org>

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Degree programme : **B.Sc. Statistics**

Title of the Course : **STATISTICS PRACTICAL - I**

Course Code : **MJD 7** **SEMESTER IV**

Learning outcomes: 1. Understand the fundamental concepts in estimation theory, such as point estimation, interval estimation 2. To understand the basic problems in the construction of Time series data for different components. 3. To understand the basic problems in the construction of index numbers and to know various types of index numbers. 4. Understand the key terms and concepts related to sampling Techniques, such as random sampling, stratified sampling, Systematic Sampling and cluster sampling **Skills expected:** 1. To know the basic arithmetic skills 2. Ability to solving statistical problems using scientific calculator	**Associated Theory Course: (Topics)** 1. Estimation Theory 2. Applied Statistics 3. Sampling Theory **Specifications:** • Nature of the Course: **Major** • No. of Credits: **4** • Total No. of Lab sessions: 60 Demo Classes: 10 Lab Practicals: 50 **Pre-Requisites:** 1. Concepts of Estimation Theory 2. Concepts of Time series Analysis and index number 3. Concepts of Basic Sampling Theory

Sl. No.	List of Practical	No. of Sessions
	ESTIMATION THEORY	
1.	Estimation of the parameters for the discrete and continuous distribution by the Method of Moments	3+3
2.	Estimation of the parameters for the discrete and continuous distribution by the Method of Maximum Likelihood	3+3
3.	Confidence Intervals for the parameters of Normal distribution Single Mean	1+1
4.	Confidence Intervals for the parameters of Normal distribution Two Population Means	1+1
5.	Confidence Intervals for the parameters of Normal distribution Single Variance	1+1
6.	Confidence Intervals for the parameters of Normal distribution Two Population Variances	1+1
7.	Confidence Interval for Single Proportion and Two Proportions	1+1
	APPLIED STATISTICS	
8.	Time series: Curve fitting by principle of least squares straight line, Exponential and Logistic curves	4+4
9.	Seasonal fluctuations: Ratio to trend method, Ratio to moving average method and Link relative method	4+4

10.	Index numbers: Calculation of indices using Laspeyre's, Paasche's, Marshall-Edgeworth, Bowley's and Fisher's formula, Time reversal test and factor reversal test	4+4
SAMPLING THEORY		
11.	Simple Random Sampling with and without replacement	3+3
12.	Stratified Sampling (proportional and optimum allocation)	3+3
13.	Systematic Sampling	1+1

Reference Materials:

1. Work Books: Faculty will provide work book material during the practical session
2. Hand books/Demo Dairy : Statistical Table book
3. Web Resources: Faculty will provide the web resource detail during the practical session
4. Major Equipments Required for conducting Practicals: NA
5. Major Stores required for conducting Practicals: NA
6. Licensed Software required for lab: SPSS for windows 24.0

Student Activities:

1. Observation Note Books
2. Practical Record

Evaluation Methodology:

- Break up Marks (Internal:**50**; End-Semester:**50**)
    - Components of Internal Evaluation (50 Marks)
        1. Attendance
        2. Observation Notebook
        3. Practical Record
        4. Model Practical Exam
    - Components of End-Semester Exams (50 Marks)
        1. Questions should be asked from Estimation Theory, Applied Statistics and Sampling Theory.
        2. Answer ANY TWO out of three questions from Section A : Estimation Theory (15 Marks)
        3. Answer ANY TWO out of three questions from Section B : Applied Statistics (20 Marks)
        4. Answer ANY TWO out of three questions from Section C : Sampling Theory (20 Marks)

Faculty Qualifications/Specialization for conducting Practicals:

M.Sc. Statistics with NET/SET
or Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **NUMERICAL METHODS**

Course code : **MID-4 (A)** **Semester : IV**

Pre-requisites: Basic Mathematics	**Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **20% of Theory & 80% Problems**

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Solution of Algebraic and Transcendental Equations	Bisection method – Regula Falsi method – Iteration method - Newton Raphson method – Horner's Method Simultaneous equations: Direct methods; Gauss Elimination method – Gauss-Jordan method – Iterative methods: Gauss-Jacobi method - Gauss Siedal iterative method	12
II	Finite differences	Forward and backward differences – Differences of a polynomial – Relation between the Operators E, Δ, δ, μ and backward difference operator, and their basic properties – Application to summation of series	12
III	Interpolation with equal and unequal intervals	Newton's forward and backward differences formulae. Central differences: Gauss's forward and backward differences formulae – Stirling's, Bessel's and Laplace-Everett's formula – Simple problems only Divided differences and their properties – Newton's divided difference formula – Lagrange's formula – simple problems only	12
IV	Inverse interpolation Numerical Integration	Iteration or successive approximation method – Lagrange's method — simple problems Trapezoidal rule – Simpson's 1/3 and 3/8 rules – Weddle's rule – Euler's summation formula	12
V	Difference equation	Introduction - Definitions - Formation of difference equations- Linear difference equations – Rules for finding the complementary function – Rules for finding the particular integral – Difference equations reducible to linear form – Simultaneous difference equations with constant coefficients	12

Unit-wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit.

Basic Text Books

1. S.S.Sastry (1998): Introductory Methods of Numerical Analysis, Prentice-Hall of India.
2. M. K. Venkatraman (2008): Numerical Methods in Engineering and Science, National Publishing company, India

Reference Books

1. Scarborough B (2005): Numerical Mathematical Analysis, Oxford University Press.
2. B. S. Grewal(1997): Numerical Methods in Engineering and Science, Khanna Publishers, India

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **INTRODUCTION TO COMPLEX ANALYSIS**

Course code : **MID-4 (B)** **Semester : IV**

Pre-requisites: Basic Mathematics	**Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **100% of Theory & 00% Problems**

Unit No.	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Complex numbers- Complex plane - Polar form of complex numbers- Powers and roots – Derivative- Analytic function - Cauchy- Riemann equations. Laplace's equation - Geometry of Analytic Functions- Conformal mapping	12
II	Exponential function - Trigonometric functions - Hyperbolic functions – Logarithm - General power - Linear fractional transformation	12
III	Line integral in the complex plane - Cauchy's integral theorem - Cauchy's integral formula - Derivatives of analytic functions	12
IV	Sequences- Series- Convergence tests - Power series - Functions given by power series - Taylor series and maclaurin Series	12
V	Laurent series - Singularities and zeros, Infinity - Residue integration method evaluation of real integrals	12

Unit-wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit.

Basic Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, 1998.
   Unit-I: Sections 12.1-12.5;

   Unit-II: Sections 12.6-12.9;

   Unit-III: Sections 13.1-13.4;

   Unit-IV: Sections 14.1-14.4;

   Unit-V: Sections 15.1-15.4

Reference Books

1. L. Ahlfors, Complex Analysis, McGraw-Hill International Edition, 1979.
2. R.V. Churchill, Complex Variables and Applications, 4th Edition, Mc Graw –Hill, 1948.
3. A.Mood, F.Graybill, and D.Boes, Introduction to the Theory of Statistics, Tata McGraw Hill (Third Edition) 2008.
4. George Grätzer, Lattice Theory: Foundation, Springer Basel AG, 2011

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Mathematics/Statistics with NET/SET

or

Ph.D in Mathematics/Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **BIO-STATISTICS**

Course code : **MID-4(C)** **Semester : IV**

Learning outcomes: 1. To impart the applications of Statistical Measures in health sciences. 2. To explore various Data Visualizations and Statistical Inference in Biostatistics and Survival Analysis **Skill Training:** 1. Biostatistics is a collection of methods and techniques in Statistics applied in the field of Health Sciences 2. Biostatistics focus on estimating risk associated to drug interventions or treatment procedures or exposure.	**Pre-requisites:** Basic Knowledge in Probability, Distributions, Estimation Theory and Testing of Statistical Hypothesis **Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Theory** **100% of Theory & 0% Problems** **Bridge courses to be done:** 1. Basics in Health and vital Statistics 2. Basic Knowledge in Applied Statistics

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Data Types	Role of Biostatistics in Health Sciences – Introduction - Applications - types of Data - Nominal, Ordinal, Interval and Ratio Scales - Tests for normality - Graphical - Steam - Leaf plot, Scatter Diagram -- Theory driven methods – One Sample K-S test and Shapiro - Wilk statistic - Simple problems	12
II	Clinical Trials	Clinical Trials - Introduction - Definition - Types of trial - Phases of Trial - Randomization Simple, Block and Stratified Randomization Methods Concept of blinding - Single, double and triple blinding - Designs for CT's - Cross - Over Designs (fixed sample trials)	12
III	Epidemiological Study Designs	Epidemiological Study Designs - Cohort Study Designs and it's analysis - Advantages and Disadvantages - Relative Risk and its Interpretation – Case control Design and it's analysis - Advantages and disadvantages - Odds Ratio and its Interpretation Measures of disease frequency - Incidence – Prevalence and their relation - Simple problems.	12
IV	Bio Assays	Bio Assays - Introduction - Types of Bioassays - Potency Ratio – Regression Based Methods - Slope Ratio - Parallel line - Feller's Theorem – Simple problems	12

V	Bio Assays	Dose Response Curves - Definition and its Importance - Four parameters of sigmoid Shape and its different forms - Concept of probit and logit models - Quantile Response Assays.	12

Unit-wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit.

Basic Text Books

1. B. Antonisarny, Solomon Christopher and Prasanna Samuel (2010), Tata McGraw Hill, Biostatistics: Principles and Practice.
2. Armitage, P (1974), Statistical Methods in Medical Research, Blackwell Scientific Publishing Company.

Reference Books

1. Sylvia Wasserthial and Smoller, (2OO1) Biostatistics and Epidemioiory - A Primer for Health and Biomedical professionels, 3ra Edition, Springer
2. Rastogi, V.B.(2006): Fundamentals of biostatistics, ANE Books, India

Web Resources

1. https://www.britannica.com/technology/pharmaceutical-industry/Drug-discovery-anddevelopment
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1200696
3. https://www.cancer.org/treatment/treatments-and-side-effects/clinical-trials/what-youneed-to-know/phases-of-clinical-trials.html
4. https://www.fda.gov/patients/learn-about-drug-and-device-approvals/drug-developmentprocess

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **COMMUNITY ENGANEMENT**

Course code : **Project WP/Internship**

Community Engagement:

The Community Engagement Learning Project is a short course that provides students with the opportunity to engage with a not-for-profit or government organization by undertaking a group project identified by the organization.

Students will explore the concept of community engagement, the role of the community sector in nearby area, the context in which the sector operates, and the tools the sector has available to it to deliver services, influence policy and programs, and provide information to its client groups.

Students will have the opportunity to develop a range of skills through the seminar program as well as engaging with a local organization that delivers services to the community.

Guidelines for the course

1. Community Engagement course shall be normally offered in the IV semester.
2. A Community Engagement course shall be assessed for a maximum of 100 marks. The assessment may be based on the report, presentation, and viva-voce.
3. A Community Engagement course may be undertaken by a group of students and the maximum number of students in a team shall not exceed five. However, the Community Engagement course report shall be submitted by each member of the team separately.
4. A Community Engagement course shall be supervised by a faculty member assigned by the Head of the Department.
5. There shall be an internal examiner for the evaluation of the Community Engagement course.
6. A Community Engagement course should encourage a student to be able to interact with the end user.
7. A Community Engagement course should be chosen such that there is enough scope to apply and demonstrate the subjects learnt in the course.

SCHEME OF EXAMINATION

Total Marks: 100

Internal marks (based on Internship report, work dairy, etc.): 50 marks

External marks (based on presentation, viva-voce, etc.): 50 marks

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **TESTING OF HYPOTHESES**

Course code : **MJD 6**

SEMESTER V

Learning outcomes: 1. To know the concepts of hypothesis testing. 2. To differentiate between large and small samples and apply apt testing procedures. 3. To explain various non-parametric tests and its applications. 4. To illustrate the concepts with various numerical examples. **Skill Training:** 1. Start by grasping the fundamental concepts and clearly state the null and alternative hypotheses. Make sure they are mutually exclusive 2. Select an appropriate statistical test based on the data type 3. Apply the selected statistical test to the data to calculate the test statistic and p-value 4. To become proficient in hypothesis testing, practice with different types of data	**Pre-requisites:** Distribution theory Estimation Theory **Specifications:** • Nature of the Course: **Major** • No. of credits:**04** • Pedagogy: **Theory** • **100% of Theory & 0% Problems** **Bridge courses to be done:** 1. Concepts of Probability and distribution theory 2. Theory of estimation

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Statistical Hypothesis	Statistical Hypothesis – Simple and composite hypothesis, Null and Alternative Hypothesis – Two types of errors – Critical region – p-value – Power of test – Most powerful test – Neymann Pearson Lemma – Simple problems.	12
II	MLR & UMP	Monotone Likelihood Ratio Property – Examples - Uniformly most powerful tests – definition – UMP test for one parameter exponential family and simple applications.	12
III	LRT	Likelihood Ratio tests – Definition and properties - simple applications- Test of significance: Exact and Asymptotic test based on Normal distribution.	12

IV	Small Sample tests	Tests based on Student's t, Chi-square and F-distributions, Chi-square test for goodness of fit and independence of attributes.	12
V	Non-parametric test	Non-parametric methods: Sign test – Wilcoxon Signed rank test- Mann Whitney U test - Median test - Run test – Kolmogrov-Smirnov test for one sample and two samples	12

Unit wise Student activities:

1. Provide dataset to the students and ask them to formulate hypotheses and test them using statistical tools like t-tests or chi-square tests etc. and give the instruction to the student to do with softwares like Excel/ SPSS / R.

Basic Text Books

1. Gupta, S. C and Kapoor, V.K (2010), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
2. Goon A.M, Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol. II, World Press, Calcutta.

Reference Books

1. Kale, B.K, Muralidharan, K, (2015), Parametric Inference: An introduction, Alpha Science International Ltd.
2. Manoj Kumar Srivastava, Namita Srivastava(2009):Statistical Inference: Testing of Hypotheses), PHI, New Delhi
3. Hogg R.V., Craig A.T. and Joseph W Mckean(2005): Introduction to Mathematical Statistics, 6th edition, Pearson.

Web Resource (Websites/Databases/E-Resources)

1. https://online.stat.psu.edu/statprogram
2. https://www.cliffsnotes.com/study-guides/statistics
3. https://www.statisticshowto.com/
4. https://www.khanacademy.org
5. https://www.nedarc.org
6. http://egyankosh.ac.in/

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **DESIGN OF EXPERIMENTS**

Course code : **MJD 7** **SEMESTER V**

Learning outcomes: 1. To understand the basic terms used in design of experiments 2. To carry out analysis of variance one-way and two-way 3. To use appropriate experimental designs to analyze the experimental data **Skill Training:** 1. Begin with a strong foundation in the fundamental principles of experimental design, including factors, levels, treatments, and response variables 2. Learn about various experimental designs, including completely randomized design, randomized block design, and factorial design	**Pre-requisites:** Distribution Theory Statistical Inference **Specifications:** • Nature of the Course: **Major** • No. of credits:**04** • Pedagogy: **Theory** • **100% of Theory & 0% Problems** **Bridge courses to be done:** 1. Basic Sampling procedures 2. Basic Data Analysis and Visualization

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	ANOVA Models	Basic principles for designing statistical experiments: Randomization, Replication and local control - determination of experimental units and notion of experimental error - Analysis of variance with One way – Two way classification; Models and estimation of parameters	12
II	CRD	Completely Randomized Design (CRD) – Model - estimation of parameters and their standard error – Analysis of data arising from such design, multiple comparison test: Least Significant Difference test	12
III	RBD	Randomized Block Design (RBD) - Models and estimation of parameters - Estimation of one and two missing observations – Efficiency of RBD relative to CRD	12
IV	LSD	Latin Square Design (LSD)– Model and estimation of parameters - Estimation of one and two missing observations – Efficiency of LSD relative to CRD and RBD	12
V	Factorial Design	Factorial Experiments: 2^2, 2^3 designs - estimation of main effects and interactions and their standard errors	12

Unit wise Student activities

1. Games like the "Experimental Game" or "Paper Helicopter Experiment" can help students learn the principles of experimental design through play
2. Identify real-time datasets for CRD, RBD, LSD and Factorial design then analyze the data

Basic Text Books

1. Gupta S.C.and KapoorV.K. (2001): Fundamentals of Applied Statistics, Sultan Chand & Sons.
2. Montgomery D.C.(2010): Design and Analysis of Experiments, John Wiley.

Reference Books

1. Das.M.N and Giri.N.C(1986): Design and Analysis of Experiments, Wiley Eastern Limited.
2. W.T.Federer(1967): Experimental Design, Oxford & IBH Publishing Co.
3. Goon A.M, Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol. II, World Press, Calcutta

Web Resource (Websites/Databases/E-Resources)

1. http://home.iitk.ac.in/~shalab/anova/chapter4-anova-experimental-design-analysis.pdf
2. https://www.itl.nist.gov/div898/handbook/pri/section3/pri3.htm

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

Or

Ph.D in Statistics

Title of the UG Degree programme: **B.Sc. Statistics**

Title of the Course: **STATISTICS PRACTICAL – II**

Course Code: **MJD10** **SEMESTER V**

Learning outcomes: 1. Understand the fundamental concepts in Testing of Hypotheses and Design of Experiment 2. Proficiency to apply suitable test for small sample and large sample tests 3. Gain knowledge to apply different ANOVA models to suitable dataset **Skills expected:** 1. To know the strong arithmetic skills 2. Ability to solving statistical problems using scientific calculator	**Associated Theory Course: (Topics)** 1. Testing of Hypotheses 2. Principles of Design of Experiments **Specifications:** • Nature of the Course: **Major** • No. of Credits: **4** • Total No. of Lab sessions:70 • Demo Classes:10 • Lab Practicals: 60 **Pre-Requisites:** Distribution Theory, Statistical Inference

Sl. No.	List of Practicals	No. of Sessions
	TESTING OF HYPOTHESES	
1.	Large Sample Tests: Means, Variances and Proportions	3+3
2.	Test based on Chi-square distribution: Population variance, testing the goodness of fit, independence of attributed	3+3
3.	Test based on t distribution: Single mean, Difference of means, Paired t test, Correlation coefficient	3+3
4.	Test based on F distribution: Equality of two population variance	3+3
5.	Non-parametric tests – Sign test, Wilcoxon test, Mann-Whitney U test, Median test, Run test, Kolmogorov –Smirnov one sample test	6+6
	DESIGN OF EXPERIMENTS	
6.	ANOVA One way and Two way classification Model	3+3
7.	Completely Randomised Design and Multiple Comparison Methods (LSD)	3+3
8.	Randomised Block Design and R.B.D. with one or two missing values	3+3
9.	Latin Square Design and L.S.D. with one or two missing values	4+4
10.	2^2 Factorial Design, 2^3 Factorial Design	4+4

Reference Materials:

1. Work Books: Faculty will provide work book material during the practical session
2. Hand books/Demo Dairy : Statistical Table book
3. Web Resources: Faculty will provide the web resource detail during the practical session
4. Major Equipments Required for conducting Practicals: NA
5. Major Stores required for conducting Practicals: NA
6. Licensed Software required for lab: SPSS for windows 24.0

Student Activities:

1. Observation Note Books
2. Practical Record

Evaluation Methodology:

1. Break up Marks (Internal:**50**; End-Semester:**50**)
   - Components of Internal Evaluation (50 Marks)
     1. Attendance
     2. Observation Note book
     3. Practical Record
     4. Model Practical Exam
   - Components of End-Semester Exams (50 Marks)
     1. Questions should be asked from both Testing of Hypotheses and Design of Experiments equally.
     2. Answer ANY TWO out of three questions from Section A : Testing of Hypotheses (25 Marks)
     3. Answer ANY TWO out of three questions from Section B : Design of Experiments (25 Marks)

Faculty Qualifications/Specialization for conducting Practicals:

M.Sc. Statistics with NET/SET
or
Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **DATA ANALYSIS USING SPSS**

Course code : **MID-5 (A)** **SEMESTER : V**

Learning outcomes:	**Pre-requisites:**
1. To calculate and interpret descriptive statistics 2. Create basic charts and graphs to visualize data using SPSS 3. To calculate and interpret different statistical tools **Skill Training:** 1. To train with the Graphical and diagrammatic representation using SPSS 2. To understand the analysis and interpretation of various statistical tools	Basic understanding of SPSS and Statistics **Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Practical** **0% of Theory & 100% Problems** **Bridge courses to be done:** 1. Review of Basic SPSS Skills. 2. Review of Statistical Tools

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	SPSS file handling	Basic of SPSS – Importing and Exporting of files – value labels, Recoding and Computing new variables – visual binning - Selection of cases (simple and multiple selection) – splitting and merging of files	12
II	Diagrams and Tabulation	Graphical plots: Box Plot both simple and multiple, Scatter plot – 2D and 3D, Histogram both simple and paneled by rows and columns using categorical variables, Bar and Pie charts, Frequencies, Custom tables – two way and multi way, Cross Tabulations	12
III	Regression model	Fitting of Curves: Parabola, cubic and exponential – correlation and regression: simple, multiple – Rank correlation –test for intercept and slope – variable selection: forward, backward and stepwise	12
IV	Testing of Hypotheses	Testing of Hypotheses – one sample, two sample and paired samples t – test; F-test for two sample variances; Chi-square test for independence of attributes, Sign Test, Mann-Whitney U test, Wilcoxon-Sign rank test, Median test	12
V	Analysis of Variance	CRD, RBD, LSD, 2^2 and 2^3 factorial designs	12

Practical Exercises:

The faculty member will allocate the list of practical exercises based on the syllabus.

Basic Text Books

1. Ajai S. Gaur and Sanjaya S Gaur (2009), **Statistical Methods for Practice and Research -** A Guide to Data Analysis Using SPSS, Second Edition, SAGE Publications Pvt. Ltd
2. Sarma KVS (2010), Statistics Made Simple – Do It Yourself on PC, Second Edition, PHI Learning

Reference Books

1. William E Wagner, III (2010), Using IBM® SPSS® Statistics for Social Statistics and Research Methods, Third Edition, PINE FORGE PRESS, An Imprint of SAGE
2. Sabina Landau and Brian S. Everitt (2004), A Hand book of Statistical Analysis using SPSS, Chapman and Hall, CRC Press
3. Andy Field (2009), Discovering Statistics Using SPSS (Introducing Statistical Methods Series), Third Edition, SAGE Publications Ltd
4. Robert Ho (2006), Handbook of Univariate and Multivariate Data Analysis and Interpretation with SPSS, Chapman and Hall, CRC Press

Web Resource

1. https://www.youtube.com/watch?v=PNH8GikRQ0&list=PLVI_iGT5ZuRmXlbuwMKi04R6Oe1G3De8G
2. https://www.youtube.com/watch?v=0S89RyIVu2k
3. https://www.youtube.com/watch?v=4xh__fom8RQ&list=PL1KfpzgIY2wEbolUFFy5pkt-te96mjP6s

Evaluation methodology: (Practical)

Internal Assessment (Mid-Semester Exam) – 50 Marks

End-Semester University Exam – 50 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **DATA ANALYSIS USING EXCEL**

Course code : **MID-5 (B)** **SEMESTER : V**

Learning outcomes:	**Pre-requisites:**
1. To demonstrate proficiency in using Excel for Summary Statistics and Graphical Representation 2. To demonstrate proficiency in analysis of statistical data using Excel **Skill Training:** 1. To calculate and interpret basic descriptive statistics using Excel functions 2. To perform Statistical tests using Excel	knowledge of Excel and Statistics **Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Practical** **0% of Theory & 100% Problems** **Bridge courses to be done:** strong foundation in both Excel and statistical analysis

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	File Management	File Operations – Open, Save, close – Data operations – Creating forms to enter data – concatenation of text, numbers – Splitting of data into columns – Sort and reverse sort – Grouping and ungrouping of data	12
II	Graphical Representation	One dimensional, two dimensional data presentation – Histogram, line diagram – Box plots – Scatter plots. Bar charts – stack, subdivided, pie charts, radar graphs	12
III	Summary Statistics	Arithmetic Mean, Median, Mode, Geometric mean and Harmonic mean, Range, Quartile Deviation	12
IV	Dispersion	Mean Deviation, Standard Deviation, Coefficient of Variation. Central and Non-Central moments and their interrelationship. Sheppard's correction for moments. Skewness and kurtosis	12
V	Statistical Tests	Correlation Analysis - Regression Analysis - T-Test (Two-Sample) - Paired T-Test - Chi-Square Test - ANOVA (Analysis of Variance)	12

Practical Exercises:

The faculty member will allocate the list of practical exercises based on the syllabus.

Basic Text Books

1. Wayne, W L (2019), Microsoft Excel: Data Analysis & Business Model, PHI

Reference Books

1. Nelson, S.L and Nelson, E C (2018), Microsoft data analysis for dummies, Wiley
2. Berk, K. N and Carey, P (2000), Data Analysis with Microsoft Excel, S.Chand (G/L) & Company Ltd, 3/e
2. Sarma KVS (2010), Statistics Made Simple: Do it Yourself on PC, PHI, India, 2/e

Web Resource (Websites/Databases/E-Resources)

1. https://www.dummies.com/category/articles/excel-33644/
2. https://support.microsoft.com/en-us/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb
3. https://www.w3schools.com/EXCEL/index.php
4. https://edu.gcfglobal.org/en/topics/excel/

Evaluation methodology: (Practical)

Internal Assessment (Mid-Semester Exam) – 50 Marks

End-Semester University Exam – 50 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

Or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **SWAYAM ONLINE COURSE**

Course code : **MID-5 (C)** **SEMESTER : V**

Specifications:

Nature of the Course : **Minor**

No. of credits : **04**

Pedagogy : **Theory / Practical**

Course Details:

1. This course related to Statistics or Mathematics subjects which is not offered in the syllabus
2. The Course title will be decided by the head of department.
3. The duration of the online course should be 8 to 12 weeks
4. The selection of the course must be 4 credits
5. The Head of the Department will assign a faculty to monitor the enrolled students

Evaluation methodology: (Practical)

1. Internal Assessment:

- As secured from the online course internal mark
  (convert into 25 Marks)

2. End-Semester University Exam:

- As secured from the online course End Term Exam marks
  (convert into 75 Marks)

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **SUMMER INTERNSHIP**

Course code : **SKD (Skill Development Course)**

Guidelines for the course

1. A Summer Internship course shall be normally offered in the V semester.
2. A Summer Internship course shall be assessed for a maximum of 100 marks. The assessment may be based on the report, presentation, and viva-voce.
3. A Summer Internship course may be undertaken by a group of students and the maximum number of students in a team shall not exceed five. However, the Summer Internship course report shall be submitted by each member of the team separately.
4. A Summer Internship course shall be supervised by a faculty member assigned by the Head of the Department.
5. There shall be an internal examiner for the evaluation of the Summer Internship course.
6. A Summer Internship course should encourage a student to be able to interact with the end user.
7. A Summer Internship course should be chosen such that there is enough scope to apply and demonstrate the subjects learnt in the course.

SCHEME OF EXAMINATION

Total Marks: 100

Internal marks (based on Internship report, work dairy, etc.): 50 marks

External marks (based on presentation, viva-voce, etc.): 50 marks

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **REGRESSION ANALYSIS**

Course code : **MJD 12**

SEMESTER VI

Learning outcomes:	**Pre-requisites:**
1. To develop a deeper understanding of linear regression models and its limitations 2. To know how to diagnose and apply corrections to some problems with the generalized linear model found in real data **Skill Training:** 1. To develop a combination of statistical, analytical, and technical skills 2. Begin with simple linear regression to grasp the basic concepts of regression analysis	Basic Knowledge of Mathematics (Matrix Algebra), Distribution Theory, Estimation and Testing of Hypotheses **Specifications:** a. Nature of the Course: **Major** b. No. of credits:**04** c. Pedagogy: **Theory** **d. 100% of Theory & 0% Problems** **Bridge courses to be done:** 1. Concept of Simple correlation and regression 2. Basic Matrix operation 3. Testing of Hypotheses 4. Basic idea of ANOVA

Unit No.	**Unit Heading**	**Detailed Syllabus**	**No. of Hours of Teaching**
I	Simple Regression model	Simple Regression model: Description of data model – lines of regression – Properties of regression coefficients – least square estimates and simple problems	12
II	Simple Linear Regression	Simple Regression model: Index of fit – Predicted values and standard errors – Evaluation of fit – Analysis of residuals. Effect of outliers in simple linear regression – Model adequacy and residual plots – Deletion of data points	12
III	Transformation of variables	Transformation of variables – transformation to stabilize variance – Removal of hetroscedasticity – Principle of weighted least squares	12
IV	Multiple regression model	Multiple regression model: Description of data model – Properties of least square estimators – R2 and adjusted R2 – Test for regression coefficients - Predicted values and standard errors	12
V	Multiple correlation coefficient	Multiple correlation coefficient - Selection of variables – Forward selection procedure – Backward elimination procedure – Stepwise method (algorithms only) - Test of hypothesis on the linear model - Multicollinearity – sources, causes and methods of detection of using VIF	12

Unit wise Student activities

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit

Basic Text Books

1. N.R.Draper and H.Smith(2011), Applied Regression Analysis, 3/e, Wiley

Reference Books

1. S.Chatterjee and Hadi, A (2013): Regression Analysis by Example, 5/e, John Wiley & Sons, New York. Chapter 1,2,3 and relevant portions in chapters 4,5,6,7,8,9
2. Montgomery, Peck and Vining (2006): Introduction to Linear Regression Analysis, 3/e, John Wiley & Sons

Web Resource (Websites/Databases/E-Resources)

1. https://www/kaggle.com/
2. https://nptel.ac.in/courses/111/104/111104074
3. https://guides.emich,edu/

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **OPERATIONS RESEARCH**

Course code : **MJD 13** **SEMESTER VI**

Learning outcomes: 1. To impart knowledge on how to formulate a real –life problem in a mathematical form and find a criterion for solving it. 2. Choose the best (optimal) alternative among the available alternative courses of action. 3. To explore various techniques available in Operations Research. 4. Apply the techniques in different areas such as transportation, production and marketing **Skill Training:** 1. Build a strong foundation in mathematics, including calculus, linear algebra, and probability. Statistics is essential for data analysis and modeling	2. Gain expertise in network optimization, which includes problems related to routing, transportation, and supply chain design **Pre-requisites:** Basic Knowledge of Mathematics, Statistics and Computers. **Specifications:** e. Nature of the Course: **Major** f. No. of credits:**04** g. Pedagogy: **Theory** **h. 20% of Theory & 80% Problems** **Bridge courses to be done:** 1. Matrix operations 2. Basic Algebra

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Introduction to Operations Research	Introduction to Operations Research – Principal Components of Decision problem – Phases of Operations Research – Various models in Operations Research	12
II	LPP	Linear Programming – Graphical Solution – Simplex method - Big M-Method and two-Phase methods – Principle of Duality – Conversion of primal to dual	12
III	Transportation	Transportation Problem: Initial Basic Solution by North West Corner Rule, Least Cost and Vogel's Approximation Methods – Optimal solution by Modified Distribution Method (MODI) – Assignment problem – Simple problems	12
IV	Sequencing problem	Sequencing problem: 'n' jobs and 2 machine problem – 'n' jobs and 'm' machine problems – 2 jobs and 'm' machine problem – Game Theory – pure and mixed strategies – saddle point - Optimal solution of two person zero sum game : Dominance property - Graphical Solution of (2 x n and m x 2) games	12

V	Network analysis	Network analysis: PERT and CPM - Basic Concepts - Constructions of the network – Concepts of Slack and float in network analysis - Determination of the floats and critical path	12

Unit wise Student activities

1. Understand how to formulate and solve LP problems
2. Gain expertise in network optimization, which includes problems related to routing, transportation, and supply chain design

Basic Text Books

1. Hamdy.A.Taha(1999): Operations Research, 6th Edition, Macmillan Publishing Co. Inc.
2. KantiSwarup et al.: Opertaions Research, Sultan Chand and Sons, New Delhi.
3. Goel and Mittal (1982): Operations Research, PragatiPrakashan, Meerut

Reference Books

1. Hiller F.S. and Libermann G.J(2011): Introduction to Operations Research, McGraw Hill.
2. Sharma J.K.(2001): Operations Research: Theory and Applications, Macmillan India Ltd.

Web Resource (Websites/Databases/E-Resources)

1. https://www.classcentral.com/course/swayam-operationsresearch-14219
2. https://onlinecourses.nptel.ac.in/noc19_ma29/preview
3. https://www.edx.org/course/operations-research-an-active-approach
4. https://www.nptel.ac.in/noc/courses/noc17/SEM1/noc17-mg10/

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **STATISTICAL QUALITY CONTROL**

Course code : **MJD 14** **SEMESTER VI**

Learning outcomes: 1. Construct control charts for process parameters 2. Effectively interpret the results from the control chart for variables 3. Carry out the results from the control chart for attributes 4. Adopt appropriate acceptance sampling plans for attributes 5. Find the applications of variable sampling plans **Skill Training:** 1. Understand the need of statistical quality control techniques 2. Impart the knowledge on control charts for variables and its applications in industries 3. Impart the knowledge on control charts for attributes and its applications in industries	4. Study the acceptance sampling plans for attributes 5. Inculcate the deep knowledge in the concept of variable sampling plans and it features. **Pre-requisites:** Basic knowledge in Statistics, Mathematics and Computer skills **Specifications:** i. Nature of the Course: **Major** j. No. of credits:**04** k. Pedagogy: **Theory** **l. 80% of Theory & 20% Problems** **Bridge courses to be done:** 1. Basic Statistics 2. Basic Distribution Theory 3. Basic Statistical Inference

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	Concept of Quality	Concept of Quality – Quality movement in India – Standardization for Quality – Quality movement – Quality management – Quality circles	12
II	Control Limits	Need for SQC in industries – process control – chance and assignable causes of variations – concepts of specification and tolerance limits – process capability – statistical basis for control charts –	12
III	Control Charts for variable and Attributes	Control chart for variables – $\bar{X}$, R and S - chart - their construction and analysis. Control charts for attributes – p, np, c and U charts – their construction and analysis	12
IV	Acceptance Sampling	Product control – fundamental concepts of acceptance sampling by attributes – producer's and consumer's risk – concepts of AQL, LTPD, AQL and AOQL – Single sampling plan OC, AOQ, ASN, ATI curves	12
V	Double Sampling Plan	Double sampling plan for attributes – derivation and construction of OC, AOQ, ASN, ATI curves – notion of sequential sampling plan.	12

Unit wise Student activities:

Identify key concepts in every unit and the faculty allocates different ways of activities for students such as Assignments/student seminars/quizzes / MCQs/etc. then same to be completed at the end of each unit

Basic Text Books

1. S.C.Gupta and V.K.Kapoor(1999), Fundamentals of Applied Statistics, Sultan Chand and Sons

Reference Books

1. Montgomery.D.C. (2010), Introduction to Statistical Quality Control: A Modern Introduction, 6th Edition, John Wiley and Sons.
2. D Grant.E.L. and Leavenworth.R.S. (1996), Statistical Quality Control, McGraw Hill

Web Resource (Websites/Databases/E-Resources)

1. http://bmepedia.weebly.com/uploads/2/6/6/8/26683759/unit_4_quality_control.pdf
2. http://www.gdcboysang.ac.in/About/droid/uploads/contents%20of%20UNIT%20iiipart%20%20A.pdf
3. https://www.youtube.com/watch?v=E2JCHsi8knA
4. http://ndl.ethernet.edu.et/bitstream/123456789/78721/2/Lecture%20Note%20Statistical%20Quality%20Control%20.pdf

Evaluation methodology: (Theory)

1. Internal Assessment (Mid-Semester Exam) – 25 Marks
2. End-Semester University Exam – 75 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Degree programme: **B.Sc. Statistics**

Title of the Course: **STATISTICS PRACTICAL - III**

Course Code: **MJD15**

SEMESTER VI

Learning outcomes: 1. Understand the fundamental concepts in Regression Analysis and quality control 2. To understand the basic problems in the construction of Control Charts. 3. To understand the basic problems in the construction of regression equations and to know the influenced independent variable in the model. **Skills expected:** 1. To know the basic arithmetic skills 2. Ability to solving statistical problems using scientific calculator	**Associated Theory Course: (Topics)** 1. Regression Analysis 2. Statistical Quality Control **Specifications:** • Nature of the Course: **Major** • No. of Credits: **4** • Total No. of Lab sessions: 60 • Demo Classes: 10 • Lab Practicals: 50 **Pre-Requisites:** 1. To know the concepts of Matrix operations 2. Concepts of Statistical quality control

Sl. No.	**List of Practicals**	**No. of Sessions**
	REGRESSION ANALYSIS	
1.	Simple Linear Regression	5+5
2.	Multiple Regression	10+10
	STATISTICAL QUALITY CONTROL	
3.	$\bar{X}$, R and S charts	3+3
4.	p chart	3+3
5.	np chart	3+3
6.	c chart	3+3
7.	u chart	3+3

Reference Materials:

1. Work Books: Faculty will provide work book material during the practical session
2. Hand books/Demo Dairy : Statistical Table book
3. Web Resources: Faculty will provide the web resource detail during the practical session
4. Major Equipments Required for conducting Practicals: NA
5. Major Stores required for conducting Practicals: NA
6. Licensed Software required for lab: SPSS for windows 24.0

Student Activities:

1. Observation Note Books
2. Practical Record

Evaluation Methodology:

- Break up Marks (Internal:**50**; End-Semester:**50**)
    - Components of Internal Evaluation (50 Marks)
        1. Attendance
        2. Observation Notebook
        3. Practical Record
        4. Model Practical Exam
    - Components of End-Semester Exams (50 Marks)
        1. Questions should be asked from both Regression Analysis and Statistical Quality Control.
        2. Answer ANY TWO out of three questions from Section A : Regression Analysis (25 Marks)
        3. Answer ANY TWO out of three questions from Section B : Statistical Quality Control (25 Marks)

Faculty Qualifications/Specialization for conducting Practicals:

M.Sc. Statistics with NET/SET
or
Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **STATISTICAL ANALYSIS USING R**

Course code : **MID-6 (A)** **SEMESTER : VI**

Learning outcomes: 1. This course imparts knowledge on programming in R and the use of R for effective data analysis. 2. The course covers practical issues in statistical computing which includes programming in R, reading data into R, accessing R packages, writing R functions, debugging, profiling R code, and organizing and commenting R code. 3. Topics in statistical data analysis to be covered with working examples **Skill Training:** 1. To impart efficient Data Handling Techniques 2. To equip students with Statistical Programming Skills based on real life examples and datasets 3. To Understand critical programming language concepts 4. To Configure statistical programming software and Collect detailed information using R profiler	**Pre-requisites:** Basic Knowledge of programming and Statistics **Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Practical** **0% of Theory & 100% Problems** **Bridge courses to be done:** 1. Knowledge on algorithm and programming 2. Knowledge on Statistical tests

Unit No.	Unit Heading	Detailed Syllabus	No. of Hoursof Teaching
I	Introduction to R	Introduction to R: R as a calculator, statistical software and a programming language,R preliminaries, getting help, data inputting methods (direct and importing from other spread Sheet applications like Excel), data accessing, and indexing, Graphics in R, built in functions, saving, storing and retrieving work	12
II	Descriptive statistics	Descriptive statistics: diagrammatic representation of univariate and bivariate data, measures of central tendency, partition values, measures of dispersion, summaries of a numerical data, skewness and kurtosis, random sampling with and without replacement	12
III	Probability Distributions	Probability Distributions: R as a set of statistical tables-cumulative distribution, probability density function, quantile function, and simulate from the distribution, plotting probability curves for standard distributions	12

IV	Statistical Inference	Statistical Inference: One- and two-sample tests, z-test, t-test, F-test, chi-square test of independence and goodness of fit, interval estimation for mean, difference of mean and variance, tests for normality	12
V	Statistical Models	Correlation – Simple and Multiple regressions – Analysis of Variance: CRD, RBD, LSD	12

Practical Exercises:

The faculty member will allocate the list of practical exercises based on the syllabus.

Basic Text Books

1. Dr.Mark Gardener(2012), Beginning R The statistical Programming Languages, John Wiley & Sons
2. Sudha G. Purohit, SharadD.Gore, and ShailajaR.Deshmukh (2008), Statistics Using R, Narosa Publishing House, India

Reference Books

Michale J. Crawley (2009), THE R BOOK, John Wiley & Sons

Web Resource (Websites/Databases/E-Resources)

1. https://cran.r-project.org/
2. https://www.rdocumentation.org/
3. https://stackoverflow.com/questions/tagged/r

Evaluation methodology: (Practical)

Internal Assessment (Mid-Semester Exam) – 50 Marks

End-Semester University Exam – 50 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

Or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **STATISTICAL ANALYSIS USING PYTHON**

Course code : **MID-6 (B)** **SEMESTER : VI**

Learning outcomes: 1. To understand Python environment, Python Packages and data types. 2. To comprehend knowledge on Python fundamentals like commands and statements, I/O statements, Operators and function and arguments. 3. To model the relationship between variables and visualize features present in the data through diagrammatic representation. 4. To carry out parametric tests and non-parametric tests. **Skill Training:** 1. To understand Python environment and import and export of datasets. 2. To know the fundamentals of Python through statements, data types, operators, conditional and functions.	3. To bring out diagrammatic representations leading to a clear analysis of data. 4. To model the relationships among variables using large data sets. 5. It enables implementation of various tests of hypotheses under parametric and nonparametric settings. **Pre-requisites:** Basic knowledge in Statistics and Computer skills **Specifications:** Nature of the Course: **Minor** No. of credits:**04** Pedagogy: **Practical** **0% of Theory & 100% Problems** **Bridge courses to be done:** 1 Knowledge on algorithm and programming 2 Knowledge on Statistical tests

Unit No.	Unit Heading	Detailed Syllabus	No. of Hours of Teaching
I	**Introduction to Python**	Introduction to Python – Origin of Python, why use of Python, Benefits of Python. Creating Python Platform. Interactive Development Environment – Setting working directory, packages, Import and Export of Excel, CSV files.	12
II	**Python Fundamentals**	Python fundamentals – Statements, comments, indentation, Assigning variables, data types, input and output statements. Mathematical and statistical operators, conditional statements, loop statements, methods and arguments.	12
III	**Data Visualization Tools**	Diagrammatic representation – simple bar diagram, Multiple bar diagram, subdivided bar diagram, Pie diagram, Scatter plot, Histogram, Box plot. Measures of central tendency, Measure of dispersion.	12

IV	**Regression Models**	Simple Correlation - Linear Regression – Multiple Linear Regression-Logistic Regression- Dealing with Multicollinearity	12
V	**Statistical Tests**	Parametric testing of Statistical Hypothesis – One Sample t test – independent sample t test – paired t test – one way ANOVA- two way ANOVA. Non- Parametric testing of Statistical Hypothesis – Sign Test – Wilcoxon – MannWitney – Kruskal Wallis	12

Practical Exercises:

The faculty member will allocate the list of practical exercises based on the syllabus.

Basic Text Books

1. Manohar Swamynathan (2017), Mastering Machine Learning with Python in Six Steps, APress
2. Tom M. Mitchell (2017), Machine Learning, Tata McGraw Hill

Reference Books

1. Rance D. Necaise (2018), Data Structures and Algorithms using Python, Wiley Student Edition
2. Donaldson, T (2014) Visual Quick start Guide Python, Pearson, 3rd Edition
3. William McKinney (2017), Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython, O'Rilley

Web Resource (Websites/Databases/E-Resources)

4. https://www.tutorialspoint.com/python/index.htm
5. https://www.geeksforgeeks.org/data-visualization-different-charts-python/
6. https://docs.python.org/3/tutorial/
7. https://www.geeksforgeeks.org/linear-regression-python-implementation/
8. https://machinelearningmastery.com/statistical-hypothesis-tests-in-python-cheatsheet/

Evaluation methodology: (Practical)

Internal Assessment (Mid-Semester Exam) – 50 Marks

End-Semester University Exam – 50 Marks

Qualifications/Specializations required for faculty to handle the subject:

M.Sc. Statistics with NET/SET

or

Ph.D in Statistics

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject : **SWAYAM ONLINE COURSE**

Course code : **MID-6 (C)** **SEMESTER : VI**

Specifications:

Nature of the Course : **Minor**

No. of credits : **04**

Pedagogy : **Theory / Practical**

Course Details:

1. This course related to Statistics or Mathematics subjects which is not offered in the syllabus
2. The Course title will be decided by the head of department.
3. The duration of the online course should be 8 to 12 weeks
4. The selection of the course must be 4 credits
5. The Head of the Department will assign a faculty to monitor the enrolled students

Evaluation methodology:

1. Internal Assessment:
   - As secured from the online course internal mark
     (convert into 25 Marks)
2. End-Semester University Exam:
   - As secured from the online course End Term Exam marks
     (convert into 75 Marks)

Title of the UG Programme : **B.Sc. Statistics**

Title of the subject :

Course code : **Project WP/Internship**

Guidelines for the course

1. Community Engagement course shall be normally offered in the IV semester.
2. A Community Engagement course shall be assessed for a maximum of 100 marks. The assessment may be based on the report, presentation, and viva-voce.
3. A Community Engagement course may be undertaken by a group of students and the maximum number of students in a team shall not exceed five. However, the Community Engagement course report shall be submitted by each member of the team separately.
4. A Community Engagement course shall be supervised by a faculty member assigned by the Head of the Department.
5. There shall be an internal examiner for the evaluation of the Community Engagement course.
6. A Community Engagement course should encourage a student to be able to interact with the end user.
7. A Community Engagement course should be chosen such that there is enough scope to apply and demonstrate the subjects learnt in the course.

SCHEME OF EXAMINATION

Total Marks: 100

Internal marks (based on Internship report, work dairy, etc.): 50 marks

External marks (based on presentation, viva-voce, etc.): 50 marks