

PONDICHERRY UNIVERSITY



SYLLABUS FOR B.Sc. STATISTICS

(CBCS Pattern)

Effective from the Academic Year 2019-2020

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 2019-2020 onwards.

DURATION OF THE COURSE

The duration for the B.Sc., Statistics shall be of six consecutive semesters (three years). The maximum duration allowed for each student to acquire prescribed number of credits in order to complete the Programme of Study shall be twelve consecutive semesters (six years).

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.

PROGRAM OBJECTIVES

The degree of Bachelor of Science in Statistics aims to train the students in the development and application of statistical techniques for analyzing data arising in scientific investigation.

- **Employability**

Statistics graduates shall be suitably employed in Central/State government organizations, financial and banking industries, corporate and insurance sectors for data analysis and drawing conclusions for socio-economic issues.

- **Higher Education**

Statistics graduates can pursue Master's studies in Statistics, Quantitative Finance, Data Science, Operations Research, Actuarial Science and Population Studies in leading universities in India and abroad.

- **Professional and Ethical Values**

Statistics graduates cultivate professional and ethical attitudes with effective communication skills, teamwork and multidisciplinary approach related to data analysis.

PROGRAM OUTCOMES

Graduating students of Statistics from Pondicherry University will

- (i) gain necessary Mathematical skills
- (ii) be Capable of analyzing any numerical data and thereby drawing valid conclusions for making decision related to problems arising from industry, corporate sector, banking and finance, insurance and health industries and Central/State government organizations.
- (iii) get predictive analytical skills
- (iv) be able to conduct sample survey for many socio-economic problems.

MEDIUM OF INSTRUCTION

The medium of instruction for all the courses, except Arabic, Bengali, French, Hindi, Malayalam, Sanskrit, Tamil, and Telugu, **shall be English.**

CREDITS

- Every course (core/elective/foundation) is assigned certain credits. A credit is equated with one period of teaching for theory or two periods for laboratory/ practical course work per week in a Semester.
- One teaching period shall be for 60 minutes duration.
- One credit shall be assigned to one week of field training wherein the students spend the entire duration in the field and supervised by the faculty member(s).
- Maximum two credits shall be assigned to one month of Internship undergone in Institutions / industry / company of high repute as approved by the Chairman of BOS.
- Minimum number of credits to be earned by a student for the award of any UG Programme in Arts, Science, and Commerce disciplines is 120. Out of these, minimum 72 credits are mandatory from Discipline Specific Core Courses (DSC) and Discipline Specific Elective Courses (DSE) put together for obtaining a degree in a particular discipline.
- Minimum number of credit requirements as defined by respective BOS may go beyond 120 for certain Programmes of Study, but not less than 120 credits. It is not mandatory that the total number of credits is evenly distributed among all the six semesters.

COURSE STRUCTURE

- A course also referred to as 'subject' is a component of a given Programme of Study. All the courses need not have same weightage in terms of credits allotted to them.
- Every Programme of Study has Discipline Specific Core (DSC) Courses, Discipline Specific Elective (DSE) Courses, Ability Enhancement Compulsory Courses (AECC), Skill Enhancement Courses (SEC), and

Generic Elective (GE) courses apart from Modern Indian Language (MIL) and English.

- A course may be designed to cover lectures/tutorials/laboratory work/field work/ outreach activities/ project work/vocational training/viva/seminars/term papers/ assignments/presentations/self-study or a combination of some of these.

Course	Course Name	Number of credits
MIL (2 or 4 Semesters)	MIL	6-12 Credits
English (2 or 4 Semesters)	English	6-12 Credits
DSC	DSC Course	48-60 Credits
DSE	DSE Course	24-30 Credits
AECC (2 Semesters)	AECC	(2x2)=4 Credits
SEC (4 Semesters)	SEC	(4x2)= 8 Credits
GE (2 Semesters)	GEC	(2x3) =6 Credits

- At least 60% (72 Credits) of the total minimum credit requirement must be earned by the student in DSC and DSE courses put together as defined by respective Boards of Studies (BOS) in order to obtain a degree in a specific discipline.

PATTERN OF EXAMINATION

- The End-Semester examination for each course in a Programme of Study shall be conducted by the Pondicherry University for a maximum of **75 marks** and Internal Continuous Assessment for **25 marks**.
- Internal assessment for all theory courses shall be done on the basis of two Internal Assessment tests (15 marks from the average of two test marks), term papers/assignments/seminars/case demonstrations/presentations/write-ups/viva etc. (5 marks) and attendance (5 marks). The following weightage shall be given to attendance:
 - 95% - 100% (5 marks)
 - 90% - 94% (4 marks)
 - 85% - 89% (3 marks)
 - 80% - 84% (2 marks)
 - 75% - 79% (1 mark)
- Internal Assessment for practical courses involving Laboratory/Field work/Project work, appropriate distribution of marks for Practical Record/Project Report, Practical end-semester exam, Viva shall be decided by the BOS.
- A schedule of Internal Assessment tests shall be prepared by each College commonly to all departments in the beginning of each semester.

Internal Assessment marks shall be displayed a week before the commencement of end-semester examinations.

- End-semester examination shall be conducted for all courses offered. The duration of the end-semester examination shall be 3 hours.
- Every student has to pay examination fee per Credit basis as fixed by the University.
- A schedule of end-semester examinations will be prepared and displayed by the University much in advance.
- No student with less than 75% in any particular course shall be permitted to attend the end-semester examination and shall be given grade FA-failure due to lack of attendance. However, an overall condonation of 10% is permitted for valid reasons (NCC, NSS, Swachh Bharat, Sports) or valid medical reasons. A student who has been awarded FA shall repeat the course when offered. The Principal/Head of the Department shall ensure that the candidate is informed about the lack of attendance before the commencement of end-semester examination and confirm that such candidates are not permitted to write the examination.
- To pass a course, the student must secure a minimum of 40 out of 100 marks (40%) in the internal and the end-semester examination put together.
- A student who has earned the required number of 120 credits by clearing all the required courses shall be declared as pass even if he/she could not clear optional courses which were taken in excess of the required number of courses.
- Result Passing Board for each Programme of Study shall be constituted by the Pondicherry University from time to time.
- Revaluation and re totaling of the answer scripts shall be allowed within the stipulated period of time as decided by the Controller of Examinations (COE) after paying the required amount of fee.

SUPPLEMENTARY EXAMINATION

- A failed student who meets the attendance requirement may be permitted to register for the next end-semester examination in the following semester itself.

- Students who have failed due to insufficient attendance and /or less than 40% Internal Assessment marks should repeat the course as and when offered.

GRADING AND GRADE CARD

Letter grades shall be used to assess the performance of students in each course by converting final marks (out of 100) into grades. In case of fractions the marks shall be rounded off to next integer. The following shall be used to convert marks into awarding grades:

Range of Marks	Letter Grade	Grade Point
96-100	O	10
86-95	A+	09
76-85	A	08
66-75	B+	07
56-65	B	06
46-55	C	05
40-45	P	04
Below 40	F	00
Lack of attendance	FA	00

The Semester Grade Point Average (SGPA) shall also be calculated by taking all courses taken by the student in the semester and Cumulative Grade Point Average(CGPA) shall also be calculated by taking all the courses taken by the student in all the semesters (refer computation of CGPA and SGPA section).

The University shall award “class” to students who acquired 120 (or Minimum number of credit requirements as defined by respective BOS may go beyond 120 for certain Programmes of Study, but not less than 120 credits) according to the following:

CGPA	Class
9.00 – 10.00	First Class with Distinction (should not have failed in any course)
7.00 – 8.99	First Class
5.50 – 6.99	Second Class
4.00 – 5.49	Pass

The Grade card shall be issued to the students containing grades obtained by the student in the previous SGPA and CGPA.

The Grade card shall list the following:

- Title of the course taken by the student

- b. Number of credits allotted to the course
- c. The grades secured by the student in each course
- d. Total number of credits earned by the student in that semester
- e. SGPA of the student
- f. Total number of credits earned by the student till that semester
- g. CGPA of the student

FAIRNESS IN ASSESSMENT

To ensure fairness of examination and evaluation following shall be followed.

- In case of at least 50% of core courses offered in different programmes across the disciplines, the assessment of the theoretical component towards the end of the semester should be undertaken by external examiners from outside the university conducting examination, who may be appointed by the Controller of Examinations. In such courses, the question papers will be set as well as assessed by external examiners.
- In case of the assessment of core practical courses, the team of examiners should be constituted on 50 – 50 % basis. i.e., half of the examiners in the team should be invited from outside the University for conducting examination.
- In case of the assessment of project reports / thesis / dissertation etc. the work should be undertaken by internal as well as external examiners.

COMPUTATION OF SGPA AND CGPA

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

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$\text{SGPA (S}_i\text{)} = \Sigma (C_i \times G_i) / \Sigma C_i$$

where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \Sigma (C_i \times S_i) / \Sigma C_i$$

where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

ILLUSTRATION OF COMPUTATION OF SGPA AND CGPA AND FORMAT FOR TRANSCRIPTS

Illustration 1 for calculation of SGPA

The illustration is for a student who has taken six courses of given credits in a semester and performance is given in grade letter which carry certain grade point.

Course	Credit	Grade letter	Grade point	Credit Point Credit x Grade
Course 1	3	A	08	$3 \times 08 = 24$
Course 2	4	B+	07	$4 \times 07 = 28$
Course 3	3	B	06	$3 \times 06 = 18$
Course 4	3	O	10	$3 \times 10 = 30$
Course 5	3	C	05	$3 \times 05 = 15$
Course 6	4	B	06	$4 \times 06 = 24$
	20			139

$$SGPA = 139/20 = 6.95$$

Illustration 2 for calculation of SGPA

A student registered for 6 (six) courses in a semester. At the end of the semester the student got A grade in a 4 credit course , A grade in 2 credit course B+ in a 3 credit course another B+ in a 3 credit course, B in a 3 credit course and F grade in a 3 credit course. Calculation of SGPA of this student is:

$$SGPA = (8 \times 4 + 8 \times 2 + 7 \times 3 + 7 \times 3 + 6 \times 3 + 0 \times 3) / (4 + 2 + 3 + 3 + 3 + 3) = (32 + 16 + 21 + 21 + 18 + 00) / 18 = 108 / 18 = 6.00 \text{ Out of } 10.00.$$

SGPA of the student is 6.00.

Illustration for calculation of CGPA (Example)

The illustration is for calculation of CGPA of a student who studied six semesters in a UG program.

Semester	Credits	SGPA
Semester 1	20	6.95
Semester 2	22	7.80
Semester 3	18	5.65
Semester 4	21	6.04
Semester 5	19	7.21
Semester 6	20	7.85
	Total = 120	

CGPA =

(20 x 6.95 + 22 x 7.80 + 18 x 5.65 + 21 x 6.04 + 19 x 7.21 + 20 x 7.85) divided by 120	= 139.00 + 171.60 + 101.70 + 126.84 + 136.99 + 157.00 = 833.13/120 = 6.94275 Rounded off to 6.94
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CGPA = 6.94. The student has passed in the program and is placed in 2nd Class.

**SCHEME OF EXAMINATION
(Theory Paper)**

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

INTERNAL EXAMINATION

- Maximum Marks: 25.
- Two internal examinations should be conducted and average of the two internal tests shall be taken: 15 Marks
- Assignments: 5 Marks
- Attendance: 5 Marks

EXTERNAL EXAMINATION

- Duration of exam - 3 hours
- Maximum Marks: 75.
- Examinations shall be in two sections.
- Section-A for 15 Marks and Section-B for 60 Marks.

SECTION – A: (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 – B: (5 x 12 = 60 Marks)

- It is of essay answer type. Each question carry 12 Marks.
- 5 questions to be given on internal choice (either or type). One question from each unit. Candidate should answer ALL questions.

**SCHEME OF EXAMINATION
(Practical Paper)**

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

INTERNAL EXAMINATION

- Maximum Marks: 25
- Model Internal Examination by the course teacher: 15 Marks.
- Practical observation book: 5 Marks.
- Attendance: 5 Marks

EXTERNAL EXAMINATION

- Duration of exam - 3 hours
- Maximum Marks: 75
- Six questions to be set and each question carry 15 Marks.
- Candidates should answer any four questions.
- Marks for practical: 60.
- Marks for record: 15
- Record submission for practical paper is mandatory

PONDICHERY UNIVERSITY
STRUCTURE OF COURSECHOICE BASED CREDIT SYSTEM IN
B.Sc. (STATISTICS) PROGRAMME
To be implemented from 2019-20 Onwards

COURSE	SUBJECT CODE	TITLE OF THE PAPER	CREDITS ALLOTED		No. of Hours /week
			Theory	Tutorial/ Practical	
SEMESTER – I					
MIL-1	LBEN/LHIN/ LMAL/LSAN/ LTAM/LTEL/ LFRE 111	Bengali/Hindi/Malayalam/ Sanskrit/Tamil /Telugu/ French	3		4
ENGLISH-1	ENGL 112	English – I	3		4
DSC-1A	STAT 111	Basic Statistics	4		5
DSC-2A	STAT 112	Fundamentals of Probability	4		5
DSC-3A	STAT 113	Mathematics for Statistics	4		5
DSC-4A	STAT 114	Practical -1 (based on the courses STAT 111& STAT 112)		2	4
AECC-1	PADM 115	Public Administration	2		3
Total			22 Credits		30 Hrs.
SEMESTER – II					
MIL-2	LBEN/LHIN/ LMAL/LSAN/ LTAM/LTEL/ LFRE 121	Bengali/Hindi/Malayalam/ Sanskrit/ Tamil/Telugu/ French	3		4
ENGLISH-2	ENGL122	English – II	3		4
DSC-1B	STAT 121	Probability Theory	4		5
DSC-2B	STAT 122	Distribution Theory	4		5
DSC-3B	STAT 123	Health and Vital Statistics	4		5
DSC-4B	STAT 124	Practical -2 (based on the courses STAT 121& STAT 122)		2	4
AECC-2	ENVS 125	Environmental Studies	2		3
Total			22 Credits		30 Hrs.

COURSE	SUBJECT CODE	TITLE OF THE PAPER	CREDITS ALLOTED		No. of Hours /week
			Theory	Tutorial/ Practical	
COURSE	SUBJECT CODE	TITLE OF THE PAPER	CREDITS ALLOTED		No. of Hours /week
			Theory	Tutorial/ Practical	
SEMESTER – III					
MIL-3	LBEN/LHIN/ LMAL/LSAN/ LTAM/LTEL/ LFRE 231	Bengali/Hindi/Malayalam/ Sanskrit/ Tamil/Telugu/ French	3		4
ENGLISH-3	ENGL 232	English – III	3		4
DSC-1C	STAT 231	Sampling Methods	4		5
DSC-2C	STAT 232	Estimation Theory	4		5
DSC-3C	STAT 233	Real Analysis	4		5
DSC-4C	STAT 234	Practical -3 (based on the courses STAT 231 &STAT 232)		2	4
SEC-1	STAT 235	Statistical Computing with C	2		3
Total			22 Credits		30 Hrs.
SEMESTER – IV					
MIL-4	LBEN/LHIN/ LMAL/LSAN/ LTAM/LTEL/ LFRE 241	Bengali/Hindi/Malayalam/ Sanskrit/ Tamil/Telugu/ French	3		4
ENGLISH-4	ENGL 242	English – IV	3		4
DSC-1D	STAT 241	Testing of Hypotheses	4		5
DSC-2D	STAT 242	Statistical Computing with C++	4		5
DSC-3D	STAT 243	Numerical Methods	4		5
DSC-4D	STAT 244	Practical -4 (based on the courses STAT 241, STAT 242& STAT 243)		2	4
SEC-2	STAT 245	Official Statistics	2		3
Total			22 Credits		30 Hrs.

COURSE	SUBJECT CODE	TITLE OF THE PAPER	CREDITS ALLOTED		No. of Hours /week
			Theory	Tutorial/ Practical	
SEMESTER – V					
SEC-3	STAT 351	Data Analysis using SPSS		2	4
DSE-1A DSE-2A DSE-3A	STAT 352	Design of Experiments	4		5
	STAT 353	Applied Statistics	4		5
	STAT 354	Statistical Quality Control	4		5
	STAT 355	Regression Analysis	4		5
DSE- P	STAT 356	Practical – 5 (based on DSE-1A, DSE-2A&DSE-3A)		3	6
GE-1	STAT 357	Industrial Statistics	1	2	5
Total			20 Credits		30 Hrs.

Any **THREE** papers can be selected from STAT 352, STAT 353, STAT 354& STAT 355

SEMESTER – VI					
SEC-4	STAT 361	Statistical Analysis using R		2	4
DSE-1B DSE-2B	STAT 362	Stochastic Processes	4		5
	STAT 363	Operations Research	4		5
	STAT 364	Psychology and Educational Statistics	4		5
DSE-3B	STAT 365	Project Work#		6	12
GE-2	STAT 366	Total Quality Management	2	1	4
Total			19 Credits		30 Hrs.

Any **TWO** papers can be selected from STAT 362, STAT 363, STAT 364

#STAT 365 is Compulsory paper. A Project team consisting maximum of 5 students.

Two hours per week will be allotted to project supervisor per project team.

Distribution of Credits

Course	No. of Credits	
MIL	12	Multiple Indian Languages
ENGLISH	12	English
DSC	56	Discipline Specific Course
DSE	29	Discipline Specific Elective
AECC	04	Ability Enhancement Compulsory Course
SEC	08	Skill Enhancement Course (Open to students of all Departments)
GE	06	Generic Elective(Open to students of all Departments)
Total	127	

Course Objectives: To learn the basic concepts of Statistics such as types of data and graphical approach to data. To learn averages, deviation measures and relations

Course Outcomes: Students will be able to classify and analyze the data

UNIT 1

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

UNIT 2

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.

UNIT 3

Measures of dispersion – characteristics – Coefficient of dispersion – Coefficient of variation – Moments – central moments in terms of raw moments and moments about arbitrary points

UNIT 4

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.

UNIT 5

Simple correlation – Karl Pearson's coefficient of correlation – Rank correlation — Multiple and Partial correlation coefficient in three variables

Books for Study:

1. Goon A.M, Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol. I, World Press, Calcutta
2. Gupta, S.C. and Kapoor, V.K. (2014): Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and Sons.
3. Agarwal, B.L. (1996): Basic Statistics, 3/e, New Age International (P) Ltd.,
4. S.P. Gupta (2014), Statistical Methods, Sultan Chand & sons

Books for Reference:

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.

DSC-2A**STAT 112: FUNDAMENTALS OF PROBABILITY**

Course Objectives: To learn the concept of probability and random variables

Course Outcomes: Students will be able to define sample space for random experiment and also compute the probability for events in the sample space.

UNIT 1

Sets and Counting – set operations – Finite and countable sets – counting elements in finite sets – inclusion-exclusion principle – product sets – classes of sets-power sets and partition – counting principle – permutations and combinations – simple problems .

UNIT 2

Relations - operations of Relations - Partial orders – Functions - Inverses and composition – One-to-one correspondence and the cardinality of a set –The addition and multiplication rules

UNIT 3

Introduction to probability theory – Random experiments, Events, Sample space, Algebra of events, Operations on events – Classical approach to probability – Axiomatic approach to probability – Simple problems.

UNIT 4

Addition theorem - Conditional Probability – Independence of events – Multiplication theorem – Bayes theorem and its applications

UNIT 5

Random variables – Discrete and Continuous Random Variable – Probability Mass function and Probability Density function – Distribution function – Properties.

Books for Study

1. Herstein, I N (1978), Topics in Algebra 2nd Edition, Wiley Eastern Limited.
2. Hogg, R.V., Mc Kean J W and Craig, A.T. (2005): Introduction to Mathematical Statistics, 6/e, Pearson Edition.
3. Murray R. Spiegel, John J. Schiller, R. Alu Srinivasan (2013), Schaum's Outline of Probability and Statistics, Fourth Edition, The McGraw-Hill Companies, Inc.

Books for Reference

1. A. M. Mood, F. A. Graybill, D. C. Boes (2002), Introductory to the Theory of Statistics, 3/e, Mc Graw hill
2. Gupta, S.C. and Kapoor, V.K. (2000): Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and Sons.

DSC-3A**STAT 113: MATHEMATICS FOR STATISTICS****Course Objectives:**

To learn the basic concepts of matrices and Linear Equations

To learn partial differentiation, Gamma Integral and Laplace transform

Course Outcomes: On completion of the course, students will be able to apply mathematical techniques for deriving statistical distributions.

UNIT 1

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

UNIT 2

System of Linear Equations- Consistency-Different types of solutions – Inverse of a Matrix. Characteristics Equation – Eigen values and Vectors –Cayley Hamilton Theorem.

UNIT 3

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

UNIT 4

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.

UNIT 5

Laplace Transform: Introduction - definition - properties - Laplace transforms of standard functions - derivatives and integrals of transforms - transform of derivatives and integrals

Books for Study:

1. M.K. Venkataraman (1965): Engineering Mathematics, National Publishing Company, Chennai.
2. T.K. Manicavachagom Pillay, T. Natarajan, K.S. Gnanapathy (1999), Algebra, Volume II, S. Viswanathan Printers & Publishers Pvt.Ltd., Chennai.
3. T.K. Manicavachagom Pillay, T. Natarajan, K.S. Gnanapathy, Calculus, Vol I, II & III, S. Viswanathan Printers & Publishers Pvt.Ltd., Chennai.

Books for Reference:

1. B.S. Grewal (2014): Higher Engineering Mathematics, Khanna Publishers

SEMESTER – I

2 Credits

DSC-3A

STAT-114: PRACTICAL -1

(using calculator/MS Excel based on the courses STAT-111)

Course Objectives: To provide practical application of visualization techniques and statistical methods

Course Outcomes: Students will be able to analyze and interpret results of visualization tools besides developing computational skills.

BASIC STATISTICS

1. Diagrammatic Representation Bar Chart, Pie Diagram
2. Construction of Discrete and Continuous Frequency Tables from raw data
3. Graphical Representation - Histogram
4. Summary Statistics
5. Two way tables and plots
6. Simple correlation
7. Rank correlation
8. Fitting of straight line, second degree
9. Fitting of exponential and power curves

SEMESTER – II**4 Credits****DSC-1B****STAT-121: PROBABILITY THEORY**

Course Objectives: To learn the concepts of random variables, marginal and conditional distributions. To learn convergence in probability and Central Limit theorem

Course Outcomes: On completion of the course, students will be able to know the characteristic properties of distributions.

UNIT 1

Distributions of functions of random variables - transformations of random variables of discrete and continuous type – Jacobian transformation –simple problems

UNIT 2

Mathematical Expectation of random variables and its properties - Moment generating function– Cumulant generating function and their properties

UNIT 3

Characteristic function – Definition - their properties and uses for discrete and continuous variates – Simple problems

UNIT 4

Bivariate distributions – Discrete and Continuous type - Joint Density Function - Marginal distributions – Conditional distributions – Conditional Expectation and their properties

UNIT 5

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)

Books for Study:

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

Books for Reference:

1. Bansilal and sanjayArora (2002): New Mathematical Statistics, Satyaprakashan Publications, New Delhi.
2. Rohatgi V.K. and Md. EhsanesSalehA.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication.
3. Bhat B.R, Srivenkataramana T and RaoMadhavaK.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.

STAT-122: DISTRIBUTION THEORY

Course Objectives: To learn the concepts of Discrete distribution, Binomial, Poisson and continuous distribution. To learn the basic concepts of sampling distribution and order statistics

Course Outcomes: On completion of the course, students will be able to know the characteristic properties of various discrete and continuous distributions and deriving the distribution of order statistics.

UNIT 1

Discrete Distributions – Uniform, Bernoulli, Binomial, Poisson, Negative Binomial, Geometric, Hypergeometric distribution and their characteristics.

UNIT 2

Continuous distributions - Uniform, Exponential, Gamma, Beta, Cauchy, Pareto Distributions – Characteristics Properties of these distributions

UNIT 3

Normal distribution and its characteristics - Bivariate Normal distribution – Marginal and conditional distributions

UNIT 4

Sampling Distributions – t, F and Chi-square – derivation of their probability density functions – relation among t, F and chi-square distributions- characteristic properties of t, F and chi-square

UNIT 5

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.

Books for Study:

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 RaoMadhavaK.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.

Books for Reference:

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. EhsanesSalehA.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication

DSC-3B

STAT 123: HEALTH AND VITAL STATISTICS

Course Objectives: To learn the basic concepts of health statistics and utilization of data. To learn the measures of mortality and fertility

Course Outcomes: Students will gain sufficient theoretical knowledge pertaining to population dynamics.

UNIT 1

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

UNIT 2

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

UNIT 3

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

UNIT 4

Forces of mortality -Gompertz and Makeham law - Abridged life table -Construction by Reed Merrill King and Graville methods

UNIT 5

Population growth and change - Arithmetic, geometric and exponential growth rates - population estimation and projection – GRR, NRR component method of projection - logistic curve

Books for study

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.

Books for Reference

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

SEMESTER – II

2 Credits

DSC-4B

STAT124: PRACTICAL -2

(using calculator/MS Excel based on the courses STAT122&STAT123)

Course Objectives: To provide practical application of discrete, continuous distributions and measures of population statistics

Course Outcomes: On completion of the course, students will be able to demonstrate the computational aspects of various distributions and Health, Vital statistics

DISTRIBUTION THEORY

1. Fitting of distributions - Binomial, Poisson, Geometric
2. Fitting normal distribution – Area method and ordinate method

HEALTH AND VITAL STATISTICS

1. Crude specific and Standardized death rates
2. Construction of life tables
3. Crude specific and general fertility rates

STAT 231: SAMPLING METHODS

Course Objectives: To learn the importance of Sampling and different methods of sampling techniques.

Course Outcomes: Students will be competent to design and conduct sample surveys.

UNIT 1

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.

UNIT 2

Simple random sampling with and without replacement – Estimation of Population mean and proportion and their variances

UNIT 3

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

UNIT 4

Systematic Sampling – Estimation of population mean and its sampling variance – comparison of systematic, simple random and stratified random sampling

UNIT 5

Cluster sampling with equal sized clusters – estimation of population mean and variance.

Books for study:

1. W.G.Cochran(1999), Sampling Techniques, 3rd Edition, Wiley Eastern Ltd.
2. Daroga Singh and F.S.Choudhary(1986), Theory and analysis of Sample Survey Designs, Wiley Eastern Ltd.
3. S.C. Gupta and V.K.Kapoor(2001), Fundamentals of Applied Statistics, Sultan Chand and Sons.

Books for Reference:

1. Pandurang.V.Sukhatme and Balkrishna.V.Sukhatme(1970): Sampling Theory of Survey with application, Asia Publication House.
2. ParimalMukhopadhyay (2008): Theory and Methods of Survey Sampling, Prentice Hall of India

STAT 232: ESTIMATION THEORY

Course Objectives: This course focuses on point and interval estimation techniques.

Course Outcomes: Students will gain sufficient knowledge in estimating various population characteristics using different estimating procedures.

UNIT 1

Point estimation – Properties of estimators – Unbiasedness –Consistent estimators - Properties of consistent estimators – sufficient condition for consistency – Simple problems

UNIT 2

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.

UNIT 3

Methods of moments – Method of Maximum Likelihood (M.L.E.) – Properties of Maximum Likelihood Estimators (without proof) –Simple Problems

UNIT 4

Method of Least Squares – Method of Minimum Chi-square –Properties - Simple problems

UNIT 5

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.

Books For Study:

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 the Theory of Statistics, McGraw Hill.
3. Rohatgi V.K. and Md. EhsanesSalehA.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication.

Books for Reference:

1. Gupta, S. C and Kapoor, V.K (2010), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
2. Kale, B.K, Muralidharan, K, (2015), Parametric Inference: An introduction, Alpha Science International Ltd.
3. Srivastava, ManojKumar , Khan, Abdul Hamid , Srivastava, Namita, (2014), Statistical Inference: Theory Of Estimation, PHI Learning Private Limited.

DSC-3C

STAT233: REAL ANALYSIS

Course Objectives: To learn Real number system, convergence and divergence
To learn functions, algebra of functions and Riemann integration

Course Outcomes: Students will learn the mathematical concepts pertaining to sequences and series, functions, its derivative and integration.

UNIT 1

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

UNIT 2

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).

UNIT 3

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

UNIT 4

Increasing and Decreasing functions – Differentiability – Darboux's Theorem – Rolle's Theorem – Mean value theorem for derivatives – Taylor's Series expansion

UNIT 5

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

Books for Study:

1. Malik S.C. and Savita Arora (2010): Mathematical Analysis, 4/e, New Age International Publishers
2. D. Somasundaram and B. Choudhary (2002) : A first course in Mathematical Analysis, Narosa Publishing house
3. R. R. Goldberg (1970) : Methods of Real Analysis, Oxford & IBH.

Books for Reference :

1. T. M. Apostol (1985): Mathematical Analysis, Narosa Publishing House.
2. W. Rudin (1976): Principles of Mathematical Analysis, 3/e, McGraw Hill Company.

DSC-4C

STAT 234:PRACTICAL -3

(based on the courses STAT 231& STAT 232using calculator)

Course Objectives: To provide practical applications of sampling and estimation theory.

Course Outcomes: Students will gain hands on training in solving numerical examples pertaining to sampling techniques and estimation theory.

SAMPLING METHODS

1. Simple random sampling
2. Stratified random sampling Proportional allocation
3. Stratified random sampling Optimum allocation
4. Systematic sampling

ESTIMATION THEORY

1. Estimation of the parameters for the discrete and continuous distribution by the
 - Method of Moments
 - Method of Maximum Likelihood.
2. Confidence Intervals for the parameters of Normal distribution
 - Single Mean
 - Two Population Means
 - Single Variance
 - Two Population Variances
3. Confidence Interval for Single Proportion and Two Proportions

SEC-1**STAT 235: STATISTICAL COMPUTING WITH C**

Course Objectives: To learn the fundamental concepts of “C” Programming

Course Outcomes: On completion of the course, students will be able to write programs in C independently.

UNIT 1

Introduction – C character set, Identifiers and keywords. Data Type, Declarations, Expressions, statements and symbolic constants, Input-Output: getchar, putchar, scanf, printf, gets, puts, functions, pre-processor commands, #include, define preparing and running a complete C program.

UNIT 2

Operators and expressions: Arithmetic, Unary, Logical, bit-wise, assignments and conditional Operator, Library functions.

UNIT 3

Control statements: while, do-while statement, nested loops, if-else, nested if-else, switch, break, continue and goto statements, comma operator.

UNIT 4

Arrays: declaration of one and two dimensional arrays –Strings and operations on strings, String Library functions.

UNIT 5

Functions: Defining and accessing: Passing arguments, Call by reference, Call by Value, Function Prototypes, Recursion. Use of library functions. Structures, Array of Structures

Books for Study:

1. B. S. Gottfried (1998): Programming in C, Schaum's Outline series.
2. E. Balagurusamy (2017): Programming in ANSI C, Tata McGraw Hill. Schildt Herbert: C Made Easy, McGraw Hill.

Books for Reference:

1. Kernighan and D. Ritchie (1988): The C programming Language, Prentice Hall of India.
2. Yeshwant Singh Kanitkar (2003): Exploring C, BPB Publications.

DSC-1D**STAT 241: TESTING OF HYPOTHESES**

Course Objectives: To learn the concepts of Hypotheses and derive test statistics using different test procedures.

Course Outcomes: Students will gain theoretical knowledge in deriving test procedures for simple and composite hypothesis under parametric and non-parametric methods.

UNIT 1

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.

UNIT 2

Monotone Likelihood Ratio Property – Examples - Uniformly most powerful tests – definition – UMP test for one parameter exponential family and simple applications –.

UNIT 3

Likelihood Ratio tests – Definition and properties - simple applications- Test of significance: Exact and Asymptotic test based on Normal distribution.

UNIT 4

Tests based on Student's t, Chi-square and F-distributions, Chi-square test for goodness of fit and independence of attributes.

UNIT 5

Non-parametric methods: Sign test – Wilcoxon Signed rank test- Mann Whitney U test - Median test - Run test – Kolmogorov-Smirnov test for one sample and two samples

Books For Study:

1. Manoj Kumar Srivastava, Namita Srivastava(2009):Statistical Inference: Testing of Hypotheses), PHI, New Delhi
2. Hogg R.V., Craig A.T. and Joseph W McKean(2005): Introduction to Mathematical Statistics, 6th edition, Pearson.

Books for Reference:

1. Freund J.E. (2000): Mathematical Statistics, Prentice Hall of India.
2. Goon A.M, Gupta M.K., Das Gupta B. (1980): An Outline of Statistical Theory, Vol. 2, 6th revised edition, World Press, Calcutta.
3. Hogg R.V. and Tanis E.A.(2001) : Probability and Statistical Inference, Pearson Education Asia.
4. Rohatgi V.K. and Md. EhsanesSalehA.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication.

DSC-2D

STAT 242: PROGRAMMING IN C++

Course Objectives: To learn the concept of fundamental concepts of OOPs and C++ programming.

Course Outcomes: On completion of the course, students will be able to write programs in C++ independently.

UNIT 1

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.

UNIT 2

Introduction to Functions – Library Functions - Steps in writing user defined functions – Inline Functions – Recursion – Default parameters – Call by value – Call by reference.

UNIT 3

Object oriented programming paradigm – Basic OOP concepts – Benefits – Object Oriented Programming languages – Applications – Class definition – Member functions – Static members – Constructor and destructors : various types .

UNIT 4

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.

UNIT 5

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.

Books for Study:

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

Book for Reference:

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

DSC-3D

STAT 243: NUMERICAL METHODS

Course Objectives: To learn the solution of Algebraic and transcendental equations, Finite differences, interpolation techniques

Course Outcomes: Students will gain sufficient knowledge in using interpolation techniques for finding roots of polynomial equations and evaluating integrals of functions.

UNIT 1

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.

UNIT 2

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.

UNIT 3

Interpolation with equal 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.

Interpolation with unequal intervals: Divided differences and their properties – Newton's divided difference formula – Lagrange's formula – simple problems only.

UNIT 4

Inverse interpolation: Iteration or successive approximation method – Lagrange's method — simple problems.

Numerical Integration: Trapezoidal rule – Simpson's 1/3 and 3/8 rules – Weddle's rule – Euler's summation formula

UNIT 5

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.

Books for Study:

1. S.S.Sastry (1998): Introductory Methods of Numerical Analysis, Prentice-Hall of India.
2. B. S. Grewal(1997): Numerical Methods in Engineering and Science, Khanna Publishers, India
3. M. K. Venkatraman (YEAR): Numerical Methods in Engineering and Science, National Publishing company, India

Books for Reference:

1. Scarborough B (2005): Numerical Mathematical Analysis, Oxford University Press.

SEMESTER – IV

2 Credits

DSC-4D

STAT 244: PRACTICAL -4

(based on the courses STAT 241 using Calculator / SPSS)

Course Objectives: To provide practical applications of small and large sample tests.

Course Outcomes: Students will gain hands on training in solving numerical examples pertaining to various test procedures.

1. Large Sample Tests: Means, Variances and Proportions
2. Test based on Chi-square distribution: Population variance, testing the goodness of fit, independence of attributed
3. Test based on tdistribution: Single mean, Difference of means, Paired t test, Correlation coefficient
4. Test based on F distribution: Equality of two population variance
5. Non-parametric tests – Sign test, Wilcoxon test, Mann-Whitney U test, Median test, Run test, Kolmogorov –Smirnov one sample test.

STAT 245: OFFICIAL STATISTICS

Course Objectives: This course will enlighten about statistical organizations in India and statistics pertaining to agriculture and industry.

Course Outcomes: Students will gain knowledge about the applications of statistics in Agriculture, index numbers for national development and the methods of conducting census.

UNIT 1

Statistical organization – Population Statistics – Agricultural Statistics – Indices of Agricultural production – Miscellaneous Agricultural Statistics

UNIT 2

Industrial statistics – ASI – Indices of Industrial Production and profits

UNIT 3

Price statistics – Price index numbers – Labour Bureau; Index number of Retail prices – Indices of security prices.

UNIT 4

Wage statistics – trade statistics – Financial statistics – National income statistics.

UNIT 5

National sample surveys – Activities and publications of CSO and the Governmental Departments- National Income compilation.

Books for Study

1. Gupta SP (2017), Statistical Methods (Sultan Chand & Sons)
2. Saluja MR (2017): Indian Official Statistical System (Publication of Indian Econometric Society)
3. Central Statistical Organisation, Guide to Official Statistics 1979 Ed Department of Statistics, Ministry of Planning, India

SEC-3**STAT 351: DATA ANALYSIS USING SPSS (DSE)**

Course Objectives: to learn the different statistical analysis with the help of the statistical software SPSS

Course Outcomes: Students will get equipped with handling and analyzing the data. Also it enables software and programming skills

Unit 1

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

Unit 2

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.

Unit 3

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.

Unit 4

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.

Unit 5

One way and Two Way Analysis of Variance, 2^2 , 2^3 factorial designs

Books for Study

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. Robert Ho (2006), Handbook of Univariate and Multivariate Data Analysis and Interpretation with SPSS, Chapman and Hall, CRC Press
3. Sarma KVS (2010), Statistics Made Simple – Do It Yourself on PC, Second Edition, PHI Learning

Books for Reference

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.

DSE**STAT 352: DESIGN OF EXPERIMENTS**

Course Objectives: To learn the basic principles of design of statistical experiments and models. To learn CRD, RBD, LSD and factorial design with suitable real life examples.

Course Outcomes: Students will gain knowledge about different experimental designs

UNIT 1

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

UNIT 2

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

UNIT 3

Randomized Block Design (RBD) - Models and estimation of parameters - Estimation of one and two missing observations – Efficiency of RBD relative to CRD

UNIT 4

Latin Square Design (LSD)– Model and estimation of parameters - Estimation of one and two missing observations – Efficiency of LSD relative to CRD and RBD

UNIT 5

Factorial Experiments: 2^2 , 2^3 designs - estimation of main effects and interactions and their standard errors

Books for study:

1. Das.M.N and Giri.N.C(1986): Design and Analysis of Experiments, Wiley Eastern Limited.
2. Gupta S.C.and KapoorV.K. (2001): Fundamentals of Applied Statistics, Sultan Chand & Sons.
3. Goon A.M, Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol. II, World Press, Calcutta.

Books for Reference:

1. W.T.Federer(1967): Experimental Design, Oxford & IBH Publishing Co.
2. Montgomery D.C.(1991): Design and Analysis of Experiments, John Wiley.

STAT 353: APPLIED STATISTICS

Course Objectives: To learn the concepts of time series, evaluation of trend by various methods. To learn about the measurement of seasonal variations, To learn Index numbers, optimum tests for index number and demand analysis

Course Outcomes: Students will gain knowledge about time series, index numbers and demand analysis

UNIT 1

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.

UNIT 2

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

UNIT 3

Index numbers – Definitions and uses– Weighted Index numbers -Laspeyre's, Paasche's, Fisher's, Marshall Edgeworth index numbers – Fixed and Chain base index numbers

UNIT 4

Optimum tests for index numbers - Cost of living index number - Construction and uses of wholesale price index

UNIT 5

Demand Analysis - Theory and analysis of consumer's demand -Law of demand - Price elasticity of demand - estimation of demand curves - forms of demand functions - Demand and Supply utility and indifference maps - determination of price and supply and demand

Books for Study:

1. Goon A.M, Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
2. Kapoor V.K. and Gupta S.C. (1978): Fundamentals of Applied Statistics, Sultan Chand and Sons.
3. Saluja M.R. (1972): Indian official Statistical Systems, Statistical Publishing Society, Calcutta and The Indian Econometric Society, Hyderabad.

Books for Reference :

1. Croxton F.E, Cowden D.J and Kellin S (1973): Applied General Statistics, Prentice Hall of India.
2. Guide to current Indian Official Statistics. Central Statistical Organization, Govt. of India
3. Mukhopadhyay P. (1999): Applied Statistics, New Central Book Agency Pvt.Ltd., Calcutta.

STAT 354: STATISTICAL QUALITY CONTROL

Course Objectives: To understand the concept of quality, process control and product control using control chart techniques and sampling inspection plan. To have an idea about quality management, quality circles, quality movement and standardisation for quality

Course Outcomes: Students will get to know about the practical applications of quality control techniques and will be able to apply them in industry.

UNIT 1

Concept of Quality – Quality movement in India – Standardization for Quality – Quality movement – Quality management – Quality circles

UNIT 2

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 –

UNIT 3

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.

UNIT 4

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.

UNIT 5

Double sampling plan for attributes – derivation and construction of OC, AOQ, ASN, ATI curves – notion of sequential sampling plan.

Books for Study:

1. Montgomery.D.C. (2010), Introduction to Statistical Quality Control: A Modern Introduction, 6th Edition, John Wiley and Sons.
2. S.C.Gupta and V.K.Kapoor(1999), Fundamentals of Applied Statistics, Sultan Chand and Sons.

Books for Reference:

1. Grant.E.L. and Leavenworth.R.S. (1996), Statistical Quality Control, McGraw Hill.

DSE**STAT 355: REGRESSION ANALYSIS**

Course Objectives: To learn simple regression, transformation of variables and multiple correlation coefficient and multiple regression model and related practical applications.

Course Outcomes: Students will gain knowledge about modeling the data

UNIT 1

Simple Regression model: Description of data model – lines of regression – Properties of regression coefficients – least square estimates and simple problems

UNIT 2

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

UNIT-3

Transformation of variables – transformation to stabilize variance – Removal of heteroscedasticity – Principle of weighted least squares.

UNIT 4

Multiple regression model: Description of data model – Properties of least square estimators – R^2 and adjusted R^2 – Test for regression coefficients - Predicted values and standard errors

UNIT 5

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

Books for study

1. Montgomery, Peck and Vining (2006): Introduction to Linear Regression Analysis, 3/e, John Wiley & Sons
2. N.R.Draper and H.Smith(2011), Applied Regression Analysis, 3/e, Wiley

Books for Reference:

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

SEMESTER – V

3 Credits

**DSE-P
STAT356: PRACTICAL -5**

(Based on ANY THREE courses from STAT 352, STAT 353, STAT 354 & STAT 355
Using Calculator and SPSS)

Course Objectives: To provide practical applications of designed experiments, applied statistics, quality control and regression analysis.

Course Outcomes: Students will gain hands on training in solving numerical examples through SPSS

DESIGN OF EXPERIMENTS

1. One way classification and Two way classification Model
2. Completely Randomised Design and Multiple Comparison Methods
3. Randomised Block Design and R.B.D. with one or two missing values
4. Latin Square Design and L.S.D. with one or two missing values
5. 2^2 Factorial Design, 2^3 Factorial Design

APPLIED STATISTICS

1. Time series: Curve fitting by principle of least squares straight line, Exponential and Logistic curves.
2. Seasonal fluctuations: Ratio to trend method, Ratio to moving average method and Link relative method.
3. Index numbers: Calculation of indices using Laspeyre's, Paasche's, Marshall-Edgeworth, Bowley's and Fisher's formula.

STATISTICAL QUALITY CONTROL

Problems based on

1. \bar{X} , R and S charts
2. p chart,
3. np chart
4. c chart
5. u chart

REGRESSION ANALYSIS

1. Simple Linear Regression
2. Multiple Regression

GE-1**STAT 357: INDUSTRIAL STATISTICS**

Course Objectives: To learn the concepts of inventory control policies and forecasting methods

To learn the concepts of reliability for some specific real life distribution

Course Outcomes: Students will gain knowledge related to application of forecasting and reliability techniques to industrial problems.

UNIT 1

Inventory planning: Concept of planned inventory policies Deterministic models Policy when inventory levels are reviewed continuously and demands occur uniformly with and without shortage costs Economic order quantity.

UNIT 2

Policy for production planning when inventory levels are reviewed periodically Stochastic models Single period model with no set up cost having zero or non zero initial stock $\{(s, S)$ policy} Solving special cases using computer packages.

UNIT 3

Forecasting: Concept of forecasting and its applications in manufacturing and non-manufacturing industrial situations Different methods of forecasting including average, last value, weighted average (exponential smoothing)

UNIT 4

Forecasting in presence of linear trends using least square methods Forecasting in presence of seasonal effects Solving special cases using computer package.

UNIT 5

Reliability: Definitions and relationships between survival function, hazard, function, hazard rate of a non-negative random variable, Life Time distributions: Weibull, Gamma, Lognormal and Exponential distributions

Books for study:

1. Taha H A (1999): operations Research, Macmilan publishing co.
2. Hiller F S and Libermann G J (1995): Introduction to Operations Research, 6tr, Edition. McGraw Hill.
3. Bain L J and Enghardt (1991): Statistical Analysis of Reliability and Life Testing Models, Marckel Dekker.

STAT 361: STATISTICAL ANALYSIS USING R(Lab Based)

Course Objectives: To learn the statistical analysis with the help of the statistical software R

Course Outcomes: On completion of course, students will be able to solve statistical problems using R

UNIT 1

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.

UNIT 2

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.

UNIT 3

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.

UNIT 4

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.

UNIT 5

Correlation – Simple and Multiple regressions - Analysis of Variance

Books for Study

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

Books for References:

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

DSE**STAT 362: STOCHASTIC PROCESSES**

Course Objectives: To learn the concepts of stochastic process - Markov chain-Stationary process, queuing models

Course Outcomes: Students will gain theoretical knowledge and computing skills for solving problems

UNIT 1

Definition of stochastic process - classification of stochastic processes according to time parameter and state space – examples of stochastic processes – definition of stationary process – stationary process with independent increments.

UNIT 2

Markov chains : Definition and examples of Markov chain, Transition Probability Matrix - Higher order Transition Probabilities: Chapman-Kolmogorov equation – simple problems- Random walk – orientation with numerical problems

UNIT 3

Classification of states of Markov chain – Simple problems - Basic limit theorem of Markov chain (statement only) - stationary and limiting distribution for a Markov Chain – Existence of limiting distribution

UNIT 4

Stationary Process: Poisson Processes – Postulates and its distribution – properties of Poisson Process: Addition and difference of Poisson Process and its connection with Binomial and Exponential distribution – Birth and Death Process (Concept only) – Yule-Furry process

UNIT 5

Characteristics of queuing models– Simple queuing models M/M/1–M/M/S - Simple problems

Books for Study

1. Medhi, J. (2017): Stochastic processes, New Age International (p) Ltd.

Books for Study and Reference:

1. Karlin, S. and Taylor, H.M. (1975): A first course in Stochastic processes, Academic press.
2. Adke, S.R. and Manjunath, S.M. (1984): An introduction to Finite Markov Processes, Wiley Eastern.
3. Ross, S.M. (1983): Stochastic processes, John Wiley.

DSE

STAT 363: OPERATIONS RESEARCH

Course Objectives: To learn about decision theory and optimization techniques
To learn game theory and network analysis

Course Outcomes: Students will gain knowledge to allocate resources in an optimal manner and also plan the time-line of projects.

UNIT 1

Introduction to Operations Research – Principal Components of Decision problem – Phases of Operations Research – Various models in Operations Research

UNIT 2

Linear Programming – Graphical Solution – Simplex method - Big M-Method and two-Phase methods – Principle of Duality – Conversion of primal to dual

UNIT 3

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

UNIT 4

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

UNIT 5

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.

Books for study:

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

Books for Reference:

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.

DSE**STAT 364: PSYCHOLOGY AND EDUCATIONAL STATISTICS**

Course Objectives: To learn the applications of statistics in psychology and education and different scoring, Scaling techniques, measuring intelligent quotient, similar concepts.

Course Outcomes: Statistical skills related to psychology and educational research will be enhanced.

UNIT 1

Introduction-scaling procedures- Z or σ scores-standard scores-Normalized scores-T-scores- Percentile score-Scaling of rankings in terms of Normal Probability curve-scaling of ratings in terms of Normal Probability curve

UNIT 2

Reliability of test scores- definition of reliability- index of reliability- Parallel tests-Methods for determining test reliability- the test-retest method- Alternate or parallel forms method-split half method- effect of test length on the reliability of the test- effect of different ranges on the reliability of the test

UNIT 3

Estimation of validity- types of validity- validity and test length- comparison between reliability and validity- Intelligence tests- Mental age- Intelligence quotient

UNIT 4

Biserial correlation- correlation from fourfold tables- the contingency coefficient-curvilinear relationship

UNIT 5

Correlation ratio- intra-class correlation- partial and multiple correlation- definition-formula for three variables- limitations- simple problems

BOOKS FOR STUDY

1. S.C.Gupta and V.K.Kapoor(2014) : Fundamentals of Applied Statistics, Sultan Chand and Sons
2. H.E.Garrett(2005) : Statistics in Psychology and Education ,International Book Bureau

Books for Reference:

1. George Ferguson and Yoshio Takane (1989), Statistical Analysis In Psychology and Education (The McGraw-Hill series in psychology)

DSE-3B
STAT 365: PROJECT WORK

Course Objectives: To provide a mechanism to plan and execute a real-time project independently

Course Outcomes: Students will come to know the real-time application of various statistical techniques as applied in research and industry.

Guidelines for the Project work:

1. A project work shall be normally offered in the third year (sixth semester).
2. A project work shall be assessed for a maximum of 100 marks. The assessment will be based on the project report, presentation and viva-voce.
3. A project may be undertaken by a group of students and the maximum number of students in a team shall not exceed five. However, the project report shall be submitted by each member of the team separately.
4. A project work shall be supervised by a faculty member assigned by the Head of the Department.
5. There shall be an internal examiner and External Examiner for the evaluation of the project work.
6. A project work should encourage a student to be able to interact with the end user.
7. A project work should be chosen such that there is enough scope to apply and demonstrate the statistical techniques learnt in the course.
8. A project work report shall clearly state the problem addressed, the methodology adopted, the assumptions and the hypotheses formulated, any previous references to the study undertaken, statistical analyses performed and the broad conclusion drawn.

GE-2**STAT 366:TOTAL QUALITY MANAGEMENT**

Course Objectives: To learn the concept of Total quality Management in production, Service in different industries.

Course Outcomes: On completion of the course, students will be able to implement TQM techniques in industries.

Unit 1:

Total Quality Management (TQM) – Excellence in TQM : Need for excellence - Excellence through change – Key to excellence – Definition of Quality and Total Quality - Fundamentals of TQM – Major process components of TQM – Elements of TQM – Eight components model.

Unit 2:

Cost of Quality : Types of quality costs – Reducing the cost of quality (COQ) - Problem solving : Types of problems – Quality Control (QC) Tools – Problem solving process – Seven basic QC tools - Kaizen : Continuous improvement – Kaizen practice – 5S Kaizen movement - Quality Circles : Differences between quality circles and quality teams.

Unit 3:

Statistical Process Control: Concept – Statistical control charts - Just-in-Time (JIT) : Definition – Objectives of JIT – JIT and problems - Teamwork : Elements of effective teamwork – Stages of team development - Total Employee Involvement – Empowerment.

Unit 4:

Customer Satisfaction : Internal-External customers – Benchmarking : Definition and Concept – Benefits of benchmarking – Process of benchmarking (briefly) – Types of benchmarking – Leadership : Five roles of leaders.

Unit 5:

Acceptance Sampling: Definition – Lot Acceptance Sampling Plans (LASPs) - Six Sigma : Implementation and its Infrastructure - ISO 9000: 2000: Introduction to EMS

Books for Study :

1. Sharma, D. D (2004), **Total Quality Management – Principles, Practice and Cases**, 2nd edition, Sultan Chand and Sons, New Delhi (Chapter 1 to 3, 6 to 16, 29 to 33).
2. Jayakumar (2005), **Total Quality Management**, Lakshmi Publication, Chennai.

Books for Reference:

1. Logothetis, N (1992) **Managing Total Quality**, Prentice Hall of India, New Delhi.
2. Montgomery, D. C (1985) **Statistical Process Control**, John Wiley and Sons, USA.
3. Oakland, J. S (1989) **Total Quality Management**, Butterworth-Heinemann, England.