

B.Sc. Semester – IV

Subject: STATISTICS
Discipline Specific Course (DSC)

The course **STATISTICS** in IV semester has two papers (Theory Paper –I for 04 credits & Practical paper-II for 2 credits) for 06 credits: Both the papers are compulsory. Details of the courses are as under.

Year	II	Course Code: 21BSC4C2STS2L	Credits	04
Sem.	IV	Course Title: STATISTICAL INFERENCE-I	Hours	56
Course Pre-requisites, if any		NA		
Formative Assessment Marks: 40		Summative Assessment Marks: 60	Duration of ESA:.02 hrs.	

Course Outcome (CO):

After completion of course (Theory), students will be able to:

CO 1 Carryout statistical analysis by identifying families of distributions and the use of order statistics.

CO 2 To find estimators using different methods of estimation and compare estimators.

CO 3 To carryout statistical inference using different tests of hypotheses under different scenarios.

Syllabus- Course 4 (Theory): 21BSC4C2STS2L : Title- STATISTICAL INFERENCE-I	Total Hrs: 56
Unit-I Point Estimation-I	16 hrs
Families of distributions- location and scale families. Single parameter exponential family. Concept of order statistics, Distribution of maximum and minimum order statistics (with proof) and rth order statistic (without proof). Concepts of estimator and estimate. Criteria for estimators: Unbiasedness, Consistency. Invariance property of consistent estimators. Efficiency and relative efficiency. Mean squared error as a criterion for comparing estimators. Sufficient statistics. Statement of Neyman-Factorization theorem.	
Unit-II : Point Estimation-II	12 hrs
Fisher information function. Statement of Cramer–Rao inequality and its applications. Minimum Variance Unbiased Estimator and Minimum Variance Bound Estimator. Maximum likelihood and method of moment estimation; Properties of MLE and moment estimators and examples. Method of Scoring, Rao-Blackwell theorem and examples.	

Unit-III Testing of Hypotheses	18 hrs
Statistical hypotheses - null and alternative, Simple and composite hypotheses. Type-I and Type-II errors, test functions. Randomized and non-randomized tests. Size, level of significance, Power function, power of tests. Critical region, p- value and its interpretation. Most Powerful (MP) and UMP test. Statement of Neyman-Pearson Lemma and its applications. Likelihood ratio tests. Large and small samples tests of significance. Tests for single mean, equality of two means, single variance and equality of two variances for normal populations. Tests for proportions.	
Unit-IV Interval Estimation	10 hrs
Confidence interval, confidence coefficient, shortest confidence interval. Methods of constructing confidence intervals using pivotal quantities. Construction of confidence intervals for mean, difference of two means, variance and ratio of variances, proportions, difference of two proportions and correlation coefficient.	

Books recommended.

1. Gupta S.C. and V.K. Kapoor (2020), Fundamental of Mathematical Statistics, Sultan Chand and Co. 12th Edition.
2. Hogg, R. V. McKean J. W. and Craig, A. T. (2012), Introduction to Mathematical Statistics, Pearson 7th Edition.
3. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009), Probability and Statistical Inference, 10th Edition, Pearson Education, New Delhi.
4. Kale, B.K. (1999). A First Course on Parametric Inference, New Delhi, Narosa Publishing House.
5. Kendall, M.G., et. al., (1996). An Introduction to the Theory of Statistics, Universal Book Stall.
6. Rohatgi, V.K. and A.K. Md. Ehsanes Saleh. (2002). An Introduction to Probability Theory and Mathematical Statistics, New York, John Wiley.
7. Ross, S.M. (2014), Introduction to Probability and Statistics for Engineers and Scientists, 5th Edition, Academic Press.

B.Sc. Semester – IV

Subject: STATISTICS
Discipline Specific Course (DSC)

Course No.-4 (Practical) : 21BSC4C2STS2P

Year	II	Course Code: 21BSC4C2STS2P	Credits	02
Sem.	IV		Hours	52
Course Pre-requisites, if any		NA		
Formative Assessment Marks: 25		Summative Assessment Marks: 25	Duration of ESA:.03 hrs.	

Course Outcome (CO):

After completion of course (Practical), students will be able to gain :

- CO 1 Practical knowledge of computing the estimates and test statistics using R.
- CO 2 Practical knowledge of carrying out statistical inference with different tests of hypotheses.
- CO 3 Practical knowledge on carrying out MP and UMP tests using R.

List of the Experiments for 52 hrs / Semesters

Note: The first practical assignment is on R-programming and R packages. Practical assignments 2 to 10 have to be first solved manually (using scientific calculators) and executed using R-programming.

1. Demonstration of R-functions for estimation and testing of hypotheses.
2. Point estimation of parameters and obtaining estimate of standard errors and mean square error.
3. Computing maximum likelihood estimates.
4. Computing moment estimates.
5. Interval estimation: Construction of confidence interval (large and small samples)
6. Evaluation of Probabilities of Type – I and Type – II errors and power of tests.
7. Small sample tests: Tests for mean, equality of means under normality when variance is (i) known (ii) unknown, P-values.
8. Small sample tests: single proportion and equality of two proportions, variance and equality of two variances under normality.P-values for the above tests.
9. Large sample tests: Tests for mean, equality of means when variance is (i) known (ii) unknown, under normality, variance and equality of two variances under normality. P-values for the above tests.

10. MP and UMP tests for parameters of binomial, Poisson distributions, normal and Exponential(scale parameter only) distributions and power curve.

General instructions:

Computation of all the practicals manually and using R

Scheme of Practical Examination (distribution of marks): 25 marks for Semester end examination

Students have to attempt 3 practical questions out of four practical questions given, each carrying 7 marks.

- 1. 7 Marks**
- 2. 7 Marks**
- 3. 7 Marks**
- 4. Viva 2 Marks**
- 5. Journal 2 Marks**

Total 25 marks

Note: Same Scheme may be used for IA(Formative Assessment) examination

Books recommended.

1. Gupta S.C. and V.K. Kapoor (2020), Fundamental of Mathematical Statistics, Sultan Chand and Co. 12th Edition.
2. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009), Probability and Statistical Inference, 10th Edition, Pearson Education, New Delhi.
3. Ross, S.M. (2014), Introduction to Probability and Statistics for Engineers and Scientists, 5th Edition, Academic Press.
4. R for beginners by Emmanuel Paradis (freely available at https://cran.r-project.org/doc/contrib/ParadiseRdebut_en.pdf)

B.Sc. Semester – IV

Subject: STATISTICS
Open Elective Course (OEC-4): 21BSC403STS4
(OEC for other students)

Year	II	Course Code: 21BSC403STS4	Credits	03
Sem.	IV	Course Title: BASICS OF OPERATIONS RESEARCH	Hours	42
Course Pre-requisites, if any		NA		
Formative Assessment Marks: 40		Summative Assessment Marks: 60	Duration of ESA:.02 hrs.	

Course Outcomes (CO):

Students will be able to

CO1- Generate mathematical models of business environment.

CO2-Analyze the business situations.

CO3-Use different solution procedures through OR models.

Syllabus- OEC: 21BSC403STS4: Title- Basics of Operations Research	Total Hrs: 42
Unit-I Introduction to Operations Research(OR) and LPP	14 hrs
Origin and growth of OR, importance of OR in managerial decision making, scope and applications of OR, models and modelling in OR. Linear programming problems(LPP): Formulation of the problem, feasible & infeasible, basic feasible solution, optimal, unbounded and multiple optimal solutions of LPP, solution by graphical method. Slack, Surplus and Artificial variables. Duality in LPP, Importance of Duality Concepts, Formulation of Dual Problem, Economic Interpretation of Duality.	
Unit-II Allocation Problems	14 hrs
Transportation problems: Formulation, methods of finding initial solution (North West Corner Rule, Least Cost Method and Vogel's Approximation Method), unbalanced transportation problems, maximization transportation problem. Assignment problems: Formulation, methods of solution, Hungarian method, multiple optimal solutions, unbalanced problems, maximization problems.	
Unit-III Decision theory	14 hrs
Game theory: Basic concepts. Two – Person Zero Sum Game. Pure and Mixed Strategies. Maximin– Minimax principle, Games with and without saddle points. Principle of dominance.	

Concepts of decision making, decision making environments, Decision making under uncertainty - Decision making under risk, decision tree analysis. Case discussion. Concepts of network analysis, project network models, Critical Path Method, PERT.	
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Books recommended.

1. Hillier, F S, et al. Introduction to Operations Research (9/e). Tata McGraw Hill, 2011.
2. Ravindran, A and Don T Phillips. Operations Research: Principles and Practice. John Wiley & Sons, 1987.
3. Sharma, J K. Operations Research: Theory and Applications (5/e). New Delhi: Laxmi Publications, 2013.
4. Taha, Hamdy A. Operations Research: An Introduction (9/e). Prentice Hall, 2010.
5. Vohra, N D. Quantitative Techniques for Management. Tata McGraw Hill Education, 2015.
6. KantiSwarup, Gupta, P.K. and Man Mohan: Operations Research, Sultan Chand & Sons, New Delhi.
7. Kapoor, V.K: Operations Research, Sultan Chand & Sons, New Delhi.
8. Kapoor, V.K.: Operations Research Problems & Solutions, Sultan Chand & Sons, New Delhi.

Details of Formative assessment (IA) for DSCC theory/OEC: 40% weight age for total marks

Type of Assessment	Weight age	Duration	Commencement
Written test-1	10%	1 hr	8 th Week
Written test-2	10%	1 hr	12 th Week
Seminar	10%	10 minutes	--
Case study / Assignment / Field work / Project work/ Activity	10%	-----	--
Total	40% of the maximum marks allotted for the paper		