

Choice Based Credit System (CBCS) Syllabus for M.A./M.Sc. 2nd Semester Statistics wef 2017 and onwards BOSPG held on 08/08/2017

General Instructions for the Candidates

1. The two years (**4 semesters**) PG Programmes is of 96 credit weightage i.e. **24** credits/semester (**24×4 = 96**).
2. Out of **24** credits in a semester a candidate has to obtain **12** credits compulsorily from the **Core Courses**, while the remaining **12** credits can be obtained from the **Electives(DCE, GE &OE)** in the following manner:
 - A candidate can obtain a maximum of **8** credits within his /her own Department out of specialization offered by the Department as **Discipline Centric Electives**.
 - **4** credits shall be obtained by the candidate from the **Electives(GE , OE)** offered by the Department other than his/her own. The candidate shall be free to obtain these **4** credits from the **General** or **Open Elective** or **A Combination of Both**.

SEMESTER II			
Course Type	Course Code	Title of the Course	No. of Credits
Core (CR)	ST17201CR	Probability and Distribution Theory - II	04
	ST17202CR	Linear Models and Regression Analysis	04
	ST17203CR	Advanced Statistical Computing	04
Discipline Centric Elective (DCE)	ST17204DCE	Operations Research-I	04
	ST17205DCE	Advanced Sampling Techniques	02
	ST17206DCE	Practical based on ST17201CR and ST17202CR	04
	ST17207DCE	Practical based on ST17203CR	02
	ST17208DCE	Practical based on ST17204DCE	02
Generic Elective (GE)	ST17209GE	Sampling Theory	02
	ST17210GE	Testing of Hypothesis-II(Non-Parametric)	02
Open Elective (OE)	ST17211OE	Basic Design of Experiments	02

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PROBABILITY AND DISTRIBUTION THEORY-II

COURSENO: ST17201CR

No. of Credits-4

UNIT-I

Sampling distributions: Chi-square and F distributions and their properties and applications, Non-central F and Chi-square distribution. Test of significance of F and Chi-square.

UNIT-II

Sampling distributions: t distribution and its properties and applications, Non-central t- distribution. Test of significance of t.

Bivariate distributions: Bivariate normal distribution, exponential and multinomial distributions and their properties , marginal and conditional distributions. Expectations and conditional expectations, covariance.

UNIT-III

Bivariate discrete distributions: Power series distributions and Generalized power series distribution and its properties, relations and applications.

Order Statistics: Distribution and properties. Joint and marginal distributions of order statistics. Distribution of median and range. Discrete order statistics and their joint pmf. Limiting distribution of nth order statistics. Extreme value laws and their properties. Correlation between extremes.

UNIT-IV

Convergence: Convergence of a sequence of random variables, convergence in probability, almost sure, Convergence of a sequence of pair of random variables. Convergence of moments. Chebyshev's and Kintchine's weak law of large numbers (WLLNs): Condition for the WLLNs. Strong law of large number and Kalmogrov's theorems and examples.

CLT: Introduction of CLT. Lindberg Levy , Liapunov forms and De-Movier's central limit theorems (CLT) and examples.

TEXT BOOKS:

- Dudewicz, E.J. and Mishra, S.N. (1988): Modern Mathematical Statistics, Willy, Int'l Students edition
- Rohatgi, V.K. (1994): An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
- Rao, R.C. (1973): Linear Statistical Inference and its Applications, 2/e, Wiley Eastern
- Ash, Robert. (1972): Real Analysis and Probability, Academic Process
- Dudley, R.M. (1989): Real Analysis and Probability, Wads worth and Brooks /Cole

REFERENCES:

- Pitman, J. (1993): Probability, Narosa Publishing House.
- Johnson, S. and Kotz, (1972): Distributions in Statistics, vol. III, Houghton and I, II And Miffin.
- Johnson, Kotz and Kemp (1992): Univariate discrete distribution, John Willy

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LINEAR MODELS & REGRESSION ANALYSIS

COURSE NO: ST17202CR

No. of Credits-4

UNIT-I:

Linear models; Gauss Markov set up, Model classification, Normal equations and least squares estimates, Error and estimation space, Variance and covariance of least square estimates, Estimation of error variance, estimation with correlated observations, least square estimates with restriction on parameters.

UNIT-II

Test of hypotheses for one and more than one linear parametric functions, Tests of linear hypotheses, estimable linear hypotheses, confidence intervals and prediction intervals, Generalized F test, Generalized t test.

UNIT-III

Experimental Design models; Introduction, Point estimation, Re-parameterization, Variance and Covariance of estimable function, testing of hypotheses, Regression models.

UNIT-1V

Simple linear regression fit of polynomials, Residual and their plot as tests for departure from assumption such as fitness of model, normality, and homogeneity of variances and detection of outliers, Analysis of covariance, estimation and testing ,one way model with one covariance, two way model with two covariance

TEXT BOOKS:

- Cookers.and Weisberg, S (1982). Residual and Influence in Regression. Chapman and Hall
- Draper,N.R. and Smith, R.L. (1998). Applied Regression Analysis.3rd Ed. Wiley.
- Gunst, R.F. and Mason, R.L. (1980). Regression Analysis and its Applications- A Data Oriented Approach. Marcel and Decker.
- Roa, C.R. (1973). Linear Statistical Inference and its Applications.Wiley Eastern.
- Weisberg, S. (1985).Applied Linear Regression.Wiley.
- Rencher,A.C And Schaalje,G.B(2007),Linear Model in Statistics, John Wiely and Sons.

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ADVANCED STATISTICAL COMPUTING

COURSE NO.: ST17203CR

No. of Credits-4

UNIT-I

R Software: Introduction, Types of functions: Data functions, Summary functions, Elementary functions and graphical functions. Commands/Statements in R for descriptive Statistics, representation of Multivariate data.

UNIT-II

Using R Software's: Correlation & Regression analysis: simple and multiple. Tests of significance, Test of significance of large samples, Test of single proportion, Test of significance of difference of proportions.

UNIT-III

Using R Software's: Difference of mean & proportion, Chi-Square test for independence of attributes and Contingency table, t-test, Paired t-test, Test for correlation in sampling from normal population, F-test, testing of two variance of two univariate normal population.

UNIT-IV

Using R Software's: Simulation Studies, random number generation of various probability distributions. Codes for different programmes in R-Software. Estimation of parameters of different probability functions by using R.

TEXT BOOKS:

- S.C. Gupta & V.K. Kapoor (2012), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
- Dudewicz, E.J. and Mishra, S.N. (1988): Modern Mathematical Statistics, Willy, Int'l Students edition.
- R Development Core Team (2011), "R: A language and environment for statistical computing," R Foundation for Statistical Computing, Vienna, Austria.
- The R Development Core Team (2011), "R: A language and environment for statistical computing, Reference Index." Version 2.13.0 (2011-04-13).

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OPERATIONS RESEARCH- I

Course No: ST17204DCE

No. of Credits-4

UNIT I

Definition and scope of Operational research, Necessity of Operations Research in Industry; phases in Operations Research. LP problems: Simplex method and Extreme point theorems; Revised Simplex Method, Transportation and Assignment Problems with their methods of solution.

UNIT II

Duality in LPP, Symmetric and asymmetric dual problems, duality theorems, Primal-Dual Relations, Complementary Slackness Theorem and Complementary Slackness conditions, Dual Simplex Method, Sensitivity Analysis.

UNIT III

Decision Making in the face of competition, two-person, Zero sum games, Games with mixed strategies, existence of solution and uniqueness of value in zero-sum games, finding solutions in 2x2, 2xm and mxn games, Equivalence between game theory and linear programming problem.

UNIT IV

Sequencing and scheduling problems: 2 machine n-job; 3 machine n-job problems with identical machine sequence for all jobs; 2-job n-machine problem with different routings. Project management; PERT and CPM; Probability of project completion.

TEXT BOOKS:

- Taha H.A. (1982) Operational Research: An introduction; Macmillan.
- Philips D.T., Ravindran A. and Solberg J. Operation Research, Principles and Practice.
- Kanti Swarup, P.K. and Singh, M.M.. (1985) Operation Research; Sultan Chand & Sons.

REFERENCES:

- Hillier F.S. and Lieberman G.J. (1962) Introduction to Operation Research; HoldenDay.
- Saaty T.L. (1961) Elements of Queuing Theory with Applications; McGraw Hill.
- Churchman C.W, Ackoff R.L. and Arnoff E.L. (1957) Introduction to Operations Research
- R. Panneerselvam(2002): Operations Research: Prentice Hall

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ADVANCED SAMPLING TECHNIQUES

Course No: STM17205DCE

No. of Credits-2

UNIT I

Double Sampling: Double Sampling for Stratification including estimation of variance. Variance of ratio and regression estimates in double sampling. Double sampling for pps estimation. Sampling on successive occasions: Sampling on two occasions, estimation of current population mean.

UNIT II

Two-stage sampling: (a) Equal first stage unit; estimation of population mean and its variance and estimates of variance. Comparison with one stage sampling

(b) Unequal first stage unit; estimation of population mean. Expected values and variance of different estimates including the case of probability proportional to size

TEXT BOOKS:

- Cochran, W. G: Sampling Techniques, 3rd edition, Wiley.
- Mukhopadhyay, P. (2000): Theory and Methods of Survey Sampling, Prentice Hall of India, Private limited, New Delhi
- Des Raj & Chandak (1998): Sampling Theory, Narosa.
- Murthy, M. N. (1977): Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
- Skate teal (1984): Sampling Theory of Surveys with Applications, Iowa University Press, & IARS.
- Singh, D and Chuddar, F. S. (1986): Theory and Analysis of Sample Survey Design, New Age International Publisher.

COURSE NO: ST17206DCE

No. of credits -4

PRACTICAL BASED ON ST17201CR & ST17202CR

COURSE NO: ST17207DCE

No. of credits -2

PRACTICAL BASED ON ST17203CR

COURSE NO: ST17208DCE

No. of credits -2

PRACTICAL BASED ON ST17204DCE

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SAMPLING THEORY

COURSE NO: ST17209GE

No. of Credits-2

UNIT-I

Basic concepts of sampling from a finite population; sampling versus complete enumeration; simple random sampling with replacement and without replacement, Concept of sampling design, expected value and sampling variance of the sample mean, expected value of the sample mean square and estimation of the variance.

UNIT-II

Stratified random Sampling: Estimation of the population mean/total and its variance, choice of sample sizes in different strata, variance under different allocations. Comparison with un-stratified sampling. Estimation of the gain in precision due to stratification, construction of strata.

Text Books:

- Cochran, W. G: Sampling Techniques, 3rd edition, Wiley.
- Mukhopadhyay, P. (2000): Theory and Methods of Survey Sampling, Prentice Hall of India, Private limited, New Delhi
- Des Raj & Chandak (1998): Sampling Theory, Narosa.
- S.C. Gupta & V.K Kapoor (2010), Fundamentals of Applied Statistics, Sultan Chand & Sons,

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Testing of hypothesis -II (Non-Parametric)

Course No: ST17210GE

No. of Credits-2

UNIT-I

Non- Parametric Inference: Introduction, Advantages and disadvantages of non- parametric tests. Sign Test-one sample and two samples, Wilcoxon-Signed rank test- one sample and two samples, Wilcoxon –Mann Whitney test ,test of randomness based on total number of runs,Wald –Wilfowitz run test, ARE.

UNIT-II

Empirical distribution functions,Kolmogrov-Smirnov- one sample and two samples test (for samples of equal size), Median test. Mood Test, Ansari – Bradley Test, ARE, Linear rank statistics, distribution properties of the linear rank statistics.

REFERENCES:

- Mukhopadhyay, P.;Mathematical Statistics.
- Gibbons,J.D and Chakraborty,(2003):Nonparametric Statistical Inference,4th edition Marcel Dekker,CRC.

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DESIGN & ANALYSIS OF EXPERIMENTS

Course No: ST172110E

No. of Credits-2

UNIT-I

Design of experiments, Principles of Design of experiments (randomization, replication, local control) Assumptions, layout and Analysis of Completely Randomized Design (CRD), Randomized Block Design (RBD), One missing observation in RBD.

UNIT-II

Factorial experiments: General factorial experiments, factorial effects; Main effects and Interactions. Best estimates and testing the significance of factorial effects; study of 2 and 3 factorial experiments in randomized blocks; Yates method for computing different factorial effects.

Text Books:

- S.C. Gupta & V.K Kapoor (2010), Fundamentals of Applied Statistics, Sultan Chand & Sons,
- Alokdey (1986): Theory of Block Designs, Willey Eastern
- Angela Dean Daniel Voss (1999): Design and Analysis of Experiments, Springer.
- Das, M.N and Giri, N. (1979): Design and Analysis of Experiments, Willey Eastern
- Giri, N (1986): Analysis of Variance, South Asia Publishers
- John, P.W.M. (1971): Statistical Design and Analysis of Experiments,
- McmillainJoshi.D.D. (1987): Linear estimation and Design of Experiments Willey Eastern
- R. Rangaswamy (2005): A Text book of Agricultural Statistics. New Age International (P) Limited.