

**Choice Based Credit System (CBCS) Syllabus for M.A./M.Sc.3rd Semester Statistics wef
2017 and onwards BOSPG held on 08/08/2017**

General Instructions for the Candidates

1. The two years (**4 semester**) 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 III			
Course Type	Course Code	Title of the Course	No. of Credits
Core (CR)	ST17301CR	Statistical Inference-I	04
	ST17302CR	Multivariate Analysis	04
	ST17303CR	Survey Project	04
Discipline Centric Elective (DCE)	ST17304DCE	Demography	04
	ST17305DCE	Inventory and Queuing Theory	02
	ST17306DCE	Non-Parametric Methods	02
	ST17307DCE	Practical based on ST17301CR & ST17302CR	02
	ST17308DCE	Practical based on ST17304DCE	02
Generic Elective (GE)	ST17309GE	Data Analysis Using Statistical Software	02
	ST17310GE	Standard Probability Distributions-I	02
Open Elective (OE)	ST17311OE	Statistical Quality Control	02

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STATISTICAL INFERENCE – I

COURSE NO: ST17301CR

No. of Credits-4

UNIT-I

Statistical Inference: Problems of estimation and Point Estimation, the general statistical decision problem, Example (Point estimation, Interval estimation etc.). Criteria of unbiasedness, consistency and efficiency. Chapman Robin's Inequality, Cramer-Rao Inequality. Minimum variance unbiased (MVU) estimation, UMVU Estimation, Asymptotic relative efficiency, Invariance of consistent estimator under continuous transformation.

UNIT-II

Sufficient and Complete Statistics: Sufficiency, Minimal sufficient statistic, Factorization theorem, Fisher–Neyman criterion. Characterization of distributions. Admitting Sufficient Statistics. Exponential families and Pitman families, Invariance property of sufficiency under one to one transformation of sample space. Fisher information for one and several parameter models. Rao-Blackwell theorem. Completeness and Lehman–Scheffle theorem.

UNIT-III

Methods of estimation: Moments Method, Method of maximum likelihood (MLE). Optimum properties of MLE. Maximum Consistent Asymptotic Normal estimators (CAN) obtained by MLE method in one parameter exponential family. Other methods of estimation: Minimum Chi –square, modified minimum Chi –square and least square estimate.

UNIT-IV

Interval Estimation: Determination of confidence interval based on small and large samples. Relation between confidence estimation and hypothesis testing.

TEXT BOOKS:

- Kale, B.K. (1999): A first course on Parametric Inference, Narosa Publishing House.
- Rohatgi, V. (1988): An Introduction to Probability and Mathematical Statistics. Wiley Eastern Ltd. New Delhi (Student Edition)

REFERENCES:

- Lehman, E.L. (1986): Theory of Point Estimation (Student Edition)
- Lehman, E.L. (1986): Testing Statistical Hypothesis (Student Edition)
- Rao, C.R. (1973): Linear Statistical Inference
- Dudewicz, E.J. and Mishap, S.N. (1988): Modern Mathematical Statistics. Wiley Series in Prob. Math. Stat., John Wiley and Sons, New York (International Student Edition)
- Ferguson, T.S. (1967): Mathematical Statistics, Academic.
- Zacks, S (1971). Theory of Statistical Inference, John Wiley and Sons, New York.

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MULTIVARIATE ANALYSIS

COURSE NO: ST17302CR

No. of Credits -4

UNIT-I

Multivariate Normal Distribution Theory: Marginal and conditional distribution, Joint distribution, Linear function of correlated normal variate. Characteristics function of multivariate normal distribution, Maximum likelihood estimation of the mean vector and co-variance matrix and their independence. Distribution of sample mean vector. Large sample behavior of mean vector and co-variance matrix. Distribution of non-central chi-square.

UNIT-II

Quadratic form and its distribution. Multiple and partial correlation co-efficient and their sampling distribution. Simple regression model, regression co-efficient and distribution of sample regression co-efficient. Test of linear hypothesis about regression co-efficients and interval estimation.

Canonical Correlation and Canonical variables: Definition, uses, estimation and statistical inference. Distribution of characteristic roots and vectors: The distribution of canonical Correlation.

UNIT-III

Distribution of sample co-variance matrix and the sample generalized variance; Wishart matrix and its distribution. Some important properties of the Wishart distribution. Characteristic function of Wishart distribution.

Generalized T^2 statistics: The general T^2 statistics, Derivation of the generalized T^2 statistics and its distribution. Some important properties of T^2 statistics and its uses. Two-sample problem with unequal co-variance matrices. Likelihood criterion for testing independence of set of variate and its moments. Walk's lambda criterion and its distribution. Mahalanobis D^2 statistics and its distribution.

UNIT-IV

Classification and discrimination: Classification and discrimination procedure for discrimination between two multivariate normal populations. Sample discriminant function, tests associated with discriminate function, standards of good classification, probability of misclassification and their estimation, classification into two and more than two multivariate normal population

Principal Component: Definition of principal components, uses, estimation and computation, Statistical inference on principal components.

Factor Analysis: Definition of factor analysis and uses, linear factor models, estimation of factor loading, Factor rotation, estimation of factor scores.

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TEXT BOOKS:

- Anderson, T.W (1983): An Introduction to Multivariate Statistical analysis, 2nd ed., John Wiley Johnson,
- R.A. and Wichen, D.W. (1992): Applied Multivariate Statistical Analysis, 2nd ed. Prentice Hall.
- Giri, N.C. (1977): Multivariate Statistical Inference, Academic press.
- Kshirsagar, A. M (1972): Multivariate Analysis, Marcel Decker.
- Morrison, D. F. (1976): Multivariate Statistical Methods, 2nd Ed, and McGraw Hill.
- Sharma, S. (1996): Applied multivariate technique, Wiley
- Muirhead, R. J. (1982): Aspects of multivariate statistical theory, John Wiley.
- Seber, G.A.F.(1984): Multivariate observations, Wiley.
- Srivastava, M.S.and Khatri, C.G. (1979): An introduction to multivariate statistics. North Holland. Carter and Srivastava: Multivariate Analysis, North Holland.

COURSE NO.: ST17303CR No. of credits -4

SURVEY PROJECT

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DEMOGRAPHY

COURSE NO: ST17304DCE

No. of Credits-4

UNIT I

Introduction and definition of vital Statistics, coverage and content errors in demographic data, use of balancing equations, Chanderasekharan-Deming formula to check completeness of registration data. Accuracy of age data on sex and age: Whipple's and Myer's indices. Dependency ratio.

UNIT II

Measure of fertility; relationship between CBR, GFR and TFR. Mathematical models on fertility and human reproduction process, Dandekar's modified binomial and Poisson models. Distributions of time to first birth, William Brass Model, Singh's model and Singh's modified model, inter-live birth intervals and of number of births, estimation of parity progression ratios from open birth interval data.

Unit III

Mortality: concepts and rates; measures of infant mortality rate. Force of mortality. Life table and its construction: Complete and abridged. Greville's and Reed-Merrels methods. Relationship between life table functions and their estimation. Relationship between abridged life table functions.

Unit IV

Population projection: Methods for population projection. Use of Leslie matrix. Frejka's component method. Logistic Model for population growth and their fitting to population data. Migration: concepts and rates. Uses of place of birth and duration of residence data.

TEXT BOOKS:

- Bartholomew, D.J. (1982). Stochastic Models for Social Processes, John Wiley.
- Benjamin, B. (1969). Demographic Analysis, George, Allen and Unwin.
- Ching, C. L. (1968). Introduction to Stochastic process in Biostatistics, John Wiley.
- Cox. P. R. (1970). Demography, Cambridge University Press
- Keyfitz, N. (1977). Applied Mathematical Demography, Springer Verlag.
- Spiegelman, M. (1969). Introduction to Demographic Analysis; Harvard University Press.

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INVENTORY AND QUEING THEORY

Course No.: ST17305DCE

No. ofCredit-2

UNIT I

Analytical structure of inventory problems; ABC Analysis: EOQ problem with and without shortages with (a) production is instantaneous (b) Finite Constant rate (c) shortages permitted random models where the demand follows uniform distributing, multistage inventory subject to constraints,

UNIT II

Queuing models-specifications and effectiveness measures.Littles formula, Steady-state solutions M/M/1 and M/M/C models with associated distributions of queue-length and waiting time.M/G/1 queue.Steady-state solutions of M/Ek/1.Transient solution of M/M/1 queue.

TEXT BOOKS:

- Taha H.A. (1982) Operational Research: An introduction; Macmillan.

REFERENCE BOOKS:

- KantiSwarup, P.K. and Singh,M.M.. (1985) Operation Research; Sultan Chand & Sons.
- Hadley G. and Whitin T.M. (1963) Analysis of Inventory Systems; Prentice Hall.
- Hillier F.S. and Lieberman G.J. (1962) Introduction to Operation Research; Holden Day.
- Kleinrock L. (1975) Queuing Systems Theory Vol.1, John Wiley.
- Saaty T.L.(1961) Elements of Queuing Theory with Applications; McGraw Hill.

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NON- PARAMETRIC METHODS

Course No: ST17306DCE

No. ofCredits-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 –Wilfritz run test, ARE.

UNIT-II

Empirical distributions, 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.

COURSE NO.: ST17307DCE No. of credits -2

PRACTICAL BASED ON COURSES ST17301CR & ST17302CR

COURSE NO.: ST17308DCE No. of credits -2

PRACTICAL BASED ON COURSE ST17304DCE

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DATA ANALYSIS USING STATISTICAL SOFTWARE

COURSE NO: ST17309GE

No. of Credits-2

UNIT-I

Statistical Software's: MINITAB reading and manipulation of data, descriptive statistics. Commands/ Statements in MINITAB, Working with Software Package MINITAB for graphics (Histogram, Plot, Box plot, Pi-chart, QQ plot, density plot, Stem and Leaf). Matrix processing (Basic operations, Eigen Values and inversion of Matrices etc.) .

UNIT-II

Using MINITAB: Correlation and Regression analysis: simple and multiple. Simple hypothesis tests (t, χ^2 and F) and analysis of variance.

TEXT BOOKS:

- B. Ryan and B.L. Joiner (2001). MINITAB Handbook, Fourth edition, Duxbury.
- R.A. Thisted (1988): Elements of Statistical Computing, Chapman and Hall.
- 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, Wiley, Int'l Students edition.

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STANDARD PROBABILITY DISTRIBUTIONS-I

COURSE NO: ST17310GE

No. Of Credits-2

UNIT-I

Discrete Random variable, Distribution function, Probability mass function, Mathematical expectation and its properties.

UNIT-II

Important Statistical Discrete distributions: Uniform, Bernoulli, Binomial, Poisson, geometric and their mean and variances, moments and moment generating function.

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

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STATISTICAL QUALITY CONTROL

Course No: STM173110E

No. of Credits-2

UNIT-I:

Meaning and scope of SQC, Applications of SQC, Stewarts control chart, Statistical basis of a control chart, control chart for variables (X bar, R, & S) charts.

UNIT-II:

Control charts for attributes (np, p & C) charts. Operating Characteristic function (OC) and Average Run length (ARL) of X-bar chart. Moving average charts.

TEXT BOOKS:

- Biswas, S.(1996). Statistical Quality Control, Sampling Inspection and Reliability; New Age International Publishers.
- Montgomery, D.C. (1985) Introduction to Statistical Quality Control; Wiley.
- Phadke, M.S. (1989) Quality Engineering through Robust Design; Prentice Hall.