

CIRCULAR :-

A reference is invited to the Ordinances, Regulations and syllabi relating to the Master of Arts (M.A.) degree examination and Master of Science (M.Sc.) degree examination vide pamphlet No.157 and 175 respectively and to this office Circular No.UG/99 of 2002 dated 22nd February,2002 and the Head, University Department of Statistics, and the Principals of the affiliated colleges in Arts and Science, the Heads of the recognized Institutions concerned and Professor-cum-Director, Institute of Distance Education are hereby informed that the recommendation made by the Board of Studies in Statistics at its meeting held on 12th March,2008 has been accepted by the Academic Council at its meeting held on 15th April,2008 vide item No.4.13 and that, in accordance therewith, the syllabus in the subject of Statistics at the M.A./M.Sc.(Part-II) course are revised as per Appendix and that the same has been brought into force with effect from the academic year 2008-2009.

MUMBAI-400 032
10th October, 2008

PRIN.K VENKATARAMANI
REGISTRAR

To, The Head, University Department of Statistics, the Principals of the affiliated colleges in Arts and Science, the Heads of the recognized Institutions concerned and Professor-cum-Director, Institute of Distance Education.

A.C./4.13/15.04.2008

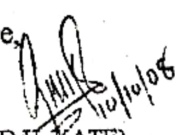
No.UG/ 447 - A of 2008,

MUMBAI-400 032

10th October,2008.

Copy forwarded with compliments for information to :-

- 1) The Deans, Faculties of Arts and Science
- 2) The Chairman, Board of Studies in Statistics
- 3) The Controller of Examinations,
- 4) The Co-Ordinator, University Computerization Centre.


(D.H. KATE)
DEPUTY REGISTRAR
(U.G./P.G SECTION)

Copy to :-

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information.

The Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute of Distance Education, (10 copies) the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registrar, (PRO) the Assistant Registrar, Academic Authorities Unit (2 copies) and the Assistant Registrar, Executive Authorities Unit (2 copies). They are requested to treat this as action taken report of the concerned resolution adopted by the Academic Council referred to in the above Circular and that, no separate Action Taken Report will be sent in this connection. the Assistant Registrar Constituent Colleges Unit (2 copies), BUCT (1 copy), the Deputy Account, Unit V (1 copy), the In-charge Director, Centralize Computing Facility (1 copy), the Receptionist (1 copy), the Telephone Operator (1 copy), the Secretary MUASA (1 copy), the Superintendent Post-Graduate Section (2 copies), the Superintendent, Thesis Section (2 copies)

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UNIVERSITY OF MUMBAI



Revised Syllabus For M.A./M.Sc.(Part-II) in Statistics

(With effect from the academic year 2008-2009)

The following will be the scheme of M.A./ M.Sc. Part -II examination for the branch of Statistics with effect from 2008-2009 :

M.A./ M.SC. PART -II EXAMINATION

Scheme of Examination : -

Paper VI - Multivariate Analysis

For M.Sc. (Part-II) (One Paper – 3 hours – 100 marks)

For M.A. (Part-II) (One Paper – 3 hours – 75 marks)

Paper VII - Testing of Hypothesis

For M.Sc. (Part-II) (One Paper – 3 hours – 100 marks)

For M.A. (Part-II) (One Paper – 3 hours – 75 marks)

Paper VIII - Optional Paper – Any two to be selected from the following electives:

For M.Sc. (Part-II) (One Paper – 3 hours – 100 marks)

For M.A. (Part-II) (One Paper – 3 hours – 75 marks)

1. Bayesian Analysis
2. Bio informatics
3. Biostatistics
4. Clinical research
5. Contingencies
6. Data Mining
7. Financial Mathematics
8. Genetics
9. Non Parametric Inference
10. Operations Research

Paper IX - Optional Paper- Any two to be Selected from the following electives:

For M.Sc. (Part-II) (One Paper – 3 hours – 100 marks)

For M.A. (Part-II) (One Paper – 3 hours – 75 marks)

1. Advanced theory of designs
2. Categorical Data Analysis
3. Econometrics
4. Financial Statistical Economics
5. Measure Theory
6. Risk Analysis
7. Statistical Decision Theory
8. Statistical process control
9. Stochastic Processes
10. Survival Analysis

Distribution of marks : -

- All Questions in the theory Paper are compulsory and Appropriate weightage should be given to each topic in the syllabus.

Paper X-Practical based on paper VI to IX and project work/dissertation
For M.Sc. (Part-II) (One Paper – 6 hours – 100 marks)
For M.A. (Part-II) (One Paper – 6 hours – 100 marks)

Distribution of marks for paper X:-

- 70 marks for practical examination consisting of two sessions each of 3 hours duration .
- 10 marks for journal and viva-vocce.
- 20 marks for project work.

Teaching Hours:-

- The syllabus of each Theory paper should be covered in 120 hours in one academic year i.e. 60 hours per term, Consisting of 4 hours per week for each paper.
- There will be one seminar of one -hour duration per paper per week.
- Eight hours of practical consisting of two practical session of 4 hours per week per batch.
- Each batch for practical consists of ten students.
- Two hours of practical session of teaching of Statistical Software per week per batch.

COMPULSORY PAPER: PAPER VI: MULTIVARIATE ANALYSIS
MODULE I

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Multivariate data and Multivariate graphical display.	Johnson-Wichern	1-157
2.	Multivariate distributions, marginal and conditional distribution, some multivariate generalizations of univariate distributions, simulation, multivariate normal distribution, Wishart distribution.	Anderson Johnson-Wichern Kshirsagar Flury	6-65 252-272 23-184

Unit 2 – (15 Lectures)

		Books	Pg.No.
3.	Hotelling T^2 and its applications.	Anderson	170-206
4.	Regression and correlation coefficients among several variables and their testing.	Anderson	115-169

Unit 3 – (15 Lectures)

		Books	Pg.No.
5.	Likelihood Ratio Tests	Anderson Giri	291-380 175-288

Unit 4 – (15 Lectures)

		Books	Pg.No.
6.	Multivariate Analysis of variance	Johnson, Wichern	290-375

MODULE II

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Discriminant analysis, classification of the observations into one of the two populations. Extension to more than two populations.	Johnson-Wichern Dillon-Goldstein	629-723 360-392

Unit 2 – (15 Lectures)

		Books	Pg.No.
2.	Principal Component Analysis.	Johnson-Wichern	458-512
3.	Factor Analysis	Johnson-Wichern	

Unit 3 – (15 Lectures)

		Books	Pg.No.
4.	Canonical Correlations and Variates.	Johnson-Wichern Dillon-Goldstein	587-627 337-359

Unit 4 – (15 Lectures)

		Books	Pg.No.
5.	Cluster Analysis.	Johnson-Wichern	726-798
6.	Multidimensional Scaling.	Dillon -Goldstein	157-206

Reference Books:

1. Johnson Richard A(1998) :Applied Multivariate Statistical Analysis(4th Edition).
2. Anderson Theodore W. (2003) : An Introduction to Multivariate Statistical Analysis.
3. Dillon William R & Goldstein Mathew (1984): Multivariate Analysis :Methods and Applications.
4. Giri Narayan C.(1995): Multivariate Statistical Analysis.
5. Kshirsagar A.M.(1979):Multivariate Analysis.
6. Hardle Wolfgang & Hlavka :Multivariate Statistics: Exercise & Solutions

COMPULSORY PAPER: PAPER VII: TESTING OF HYPOTHESIS

MODULE I

Unit 1 - (15 Lectures)

		Books	Pg.No
1.	Some fundamental notations of hypothesis testing	Rohatgi	455-464
2.	N P Lemma (Necessary part, Sufficiency, Existence) MP, UMP tests	Lehmann Rohatgi	72-75 464-472
3.	Families with Monotone Likelihood Ratio	Rohatgi	472-479

Unit 2- (15 Lectures)

		Books	Pg.No
4.	Unbiased and similar tests	Lehmann	135-144
5.	Invariant tests	Rohatgi	479-486
6.	Locally most powerful tests	Rohatgi	486-489

Unit 3 - (15 Lectures)

		Books	Pg.No
7.	Neyman structure test	Lehman	144-156
8.	UMA, UMAU confidence sets	Rohatgi	

Unit 4- (15 Lectures)

		Books	Pg.No
9.	Likelihood ratio tests	Rohatgi	490-500
10.	SPRT	Wald	

Module II

Unit 1 - (15 Lectures)

		Books	Pg.No
1.	Order Statistics, Joint distribution, marginal distribution of order statistics, distribution of median and range	Gibbons &Chakrabarti	25-35
2.	Confidence-interval estimation of population quantiles	Gibbons &Chakrabarti	45-54
3.	The empirical distribution function	Gibbons &Chakrabarti	54-60
4.	Test based on runs, Test based on total number of runs, lengths of the longest run, runs up and down	Gibbons &Chakrabarti	65-88

Unit 2 - (15 Lectures)

		Books	Pg.No
5.	Tests of goodness of fit, Chi-square goodness of fit test, The kolmogorov-Smirnov one sample statistics, Applications	Gibbons &Chakrabarti	94-124
6.	Sign test, Wilcoxon Signed-rank test	Gibbons &Chakrabarti	139-177
7.	General two sample problem, Wald Wolfowitz run test Kolmogorov-Smirnov two sample test	Gibbons &Chakrabarti	184-206
8.	Mann-Whitney U-test		212-223
9.	Wilcoxon Rank-Sum test	Gibbons &Chakrabarti	239-246

Unit 3 - (15 Lectures)

		Books	Pg.No
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15.	samples The Kruskal-Wallis one way ANOVA test	&Chakrabarti	288-307
16.	Friedman's test		386-396
17.	Unit 4 - (15 Lectures) Measures of association for bivariate Samples, Kendall's Tau coefficient Spearman's coefficient of rank correlation, Measure of association	Books Gibbons &Chakrabarti	Pg. No 399-445

Reference Books:

1. Rohatgi Vijay K., Ehsanes Saleh A. K. M. D. (2001):- An introduction to probability theory and mathematical statistics.
2. Gibbons J. D. & S. Chakrabarti (2007):- Non parametric Statistical Inference. (Revised & Expanded)
3. Lehmann E. L. (1959):- Testing Statistical Hypothesis 2nd Edition
4. Wald A. (2004):- Sequential Analysis.

Recommended Books

1. Fergusson T. S. (1967): Mathematical Statistics a decision theoretic approach
2. Zacks S. Chelemyahu (1994):- Theory of Statistical Inference
3. Conover W. J. (1971):- Practical Non Parametric Statistics.
4. Shao Jun (2005): Mathematical Statistics.
5. Hollander Myles and Wolf Douglas A (2006):- Non Parametric Statistical method. 2nd edition.

OPTIONAL PAPERS: PAPER VIII : (1) BAYESIAN ANALYSIS

Unit 1 - (15 Lectures)

1. Utility & Non Function
2. Prior Informatics & Subjective Probability

Books	Pg.No.
Berger	46-73
Berger	74-117
Lee	33-120

Unit 2 - (15 Lectures)

3. Bayesian Analysis

Books	Pg.No
Berger	118-307

Unit 3 - (15 Lectures)

4. Minimax Analysis
5. Hypothesis-Testing

Books	Pg.No
Berger	308-387
Lee	123-167

Unit 4 - (15 Lectures)

6. Preposterior & Sequential Analysis

Books	Pg.No
Berger	432-512

Reference Books:

1. Berger James O (1980): Statistical Decision Theory & Bayesian Analysis.
Spring-verlag.
2. Lee Peter M (1989) : Bayesian Statistics : An Introduction; Oxford University Press

OPTIONAL PAPER: PAPER VIII: (2) BIOINFORMATICS

Unit 1 – (15 Lectures)

- | | Books | Pg.No. |
|--|---------------|---------------|
| 1. Poisson Process and Markov Chains, Analysis of One and Multiple DNA Sequences | Ewens & Grant | 129-218 |

Unit 2 – (15 Lectures)

- | | Books | Pg.No |
|--|---------------|--------------|
| 2. Random Walks, Classical Estimation and Testing, BLAST | Ewens & Grant | 219-302 |

Unit 3 – (15 Lectures)

- | | Books | Pg.No |
|--|---------------|--------------|
| 3. M.C.'s with No Absorbing States, Higher-Order Markov Dependence, Markov Chain Monte Carlo, M.C. with Absorbing States, Continuous-Time M.C., Hidden Markov Models | Ewens & Grant | 303-348 |

Unit 4 – (15 Lectures)

- | | Books | Pg.No |
|--|---------------|--------------|
| 4. Computationally Intensive Methods, Evolutionary Models, Phylogenetic Tree Estimation. | Ewens & Grant | 349-422 |

Reference Books:

1. Ewens Warren J. & Grant Gregory R.(2004): Statistical Methods in Bioinformatics An Introduction

Recommended Books:

1. Simon Richard M (2003) :- Design and analysis of DNA Micro array Investigations.
2. Mount David W.(2004): Bioinformatics Sequence and genome analysis.
3. Durbin Richard (1998):- Biological sequence analysis. Probabilistic models of proteins and Nucleic Acids.

OPTIONAL PAPER: PAPER VIII: (3) BIOSTATISTICS

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	The Evaluation of Screening Tests	Fleiss, Levin & Paik	1-15
2.	Comparative Studies: Cross-Sectional, Naturalistic, or Multinomial Sampling	Fleiss, Levin & Paik	95-140
3.	Comparative Studies: Prospective and Retrospective Sampling	Fleiss, Levin & Paik	144-157

Unit 2 – (15 Lectures)

		Books	Pg.No
4.	The Analysis of Data from Matched Samples	Fleiss, Levin & Paik	373-403
5.	Direct Assays	Finney	21-57
6.	Quantitative Dose- Response Relationships	Finney	58-75
7.	Parallel Line Assays	Finney	99-117

Unit 3 – (15 Lectures)

		Books	Pg.No
8.	Efficiency, Reliability and Sensitivity	Finney	164-186
9.	Slope Ration Assays	Finney	187-213
10.	Repeated Measures, Introduction	Davis	1-12
11.	Univariate Methods	Davis	15-28

Unit 4 – (15 Lectures)

		Books	Pg.No
12.	Normal Theory Methods: Unstructured Multivariate Approach	Davis	45-54
13.	Normal-Theory Methods: Multivariate Analysis Variance	Davis	73-82
14.	Normal-Theory Methods : Repeated Measures ANOVA	Davis	103-109

Reference Books:

1. Davis Charles S.(2002): Statistical Methods for the Analysis of Repeated Measurements.
2. Finney D.J. (1971): Statistical Method in Biological Assays.
3. Fleiss Joseph L., Levin Bruce & Paik Myunghee Cho (2003): Statistical Methods for Rates and Proportions

OPTIONAL PAPER: PAPER VIII: (4) CLINICAL RESEARCH

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Background and Basic Concepts, Phase I and II Clinical Trials	Fieller	7-20
		Zhang	18-48
2.	Basic Trial Analysis Phase III Clinical Trials	Fieller	21-33
		Zhang	35-48
3.	Randomization	Fieller	39-54
		Zhang	49-73

Unit 2 – (15 Lectures)

		Books	Pg.No.
4.	Protocol Deviations Some Additional Issues in Phase III Clinical Trials	Fieller	55-62
		Zhang	74-80
5.	Size of the Trial Sample Size Calculations	Fieller	63-78
		Zhang	81-95

Unit 3 – (15 Lectures)

		Books	Pg.No.
6.	Multiplicity and Interim Analysis Comparing More Than Two Treatments	Fieller	79-112
		Zhang	96-117
7.	Crossover Trials Causality, Non—compliance and Intent-to-treat	Fieller	113-132
		Zhang	118-130
8.	Combining Trials Survival Analysis in Phase III Clinical Trials	Fieller	133-146
		Zhang	131-163

Unit 4 – (15 Lectures)

		Books	Pg.No.
9.	Binary Response Data Early stopping of Clinical Trials	Fieller	147-166
		Zhang	164-193
10.	Comparing Methods of Measurements	Fieller	167-175

Reference Books:

1. Dr. Fieller Nick(2007): Medical Statistics: Clinical Trials
2. Zhang Daowen (2007): Statistical Principles of Clinical Trials (Lecture Notes)

Recommended Books:

1. Wang Duolao, Bakhai Ameet: Clinical Trials - A Practical Guide to Design, Analysis, and Reporting: .
2. Good Phillip I. (2006):- A Manager's Guide to the Design and Conduct of Clinical Trials.
3. Friedman Lawrence M., Furberg Curt D., DeMets David L.(1998) Fundamentals of Clinical Trials

4. Mulay Marilyn (2001): A Step-By-Step Guide to Clinical Trials.
5. Walker, Glenn A. (2002): Common Statistical Methods for Clinical Research: with SAS Examples
6. Cleophas, Ton J.M. (2006): Statistics Applied to Clinical Trials 3rd Edition]
7. Chow Shein-Chung, Liu Jen-Pei (2004): Design and Analysis of Clinical Trials: Concepts and Methodologies.]
8. Chow Shein-Chung, Shao Jun, Wang Hansheng (2003): Sample Size Calculations in Clinical Research
9. Whitehead Anne (2003): Meta-Analysis of Controlled Clinical Trials
10. Leandro, Gioacchino (2005): Meta-analysis In Medical Research: The Handbook for the Understanding and Practice of Meta-Analysis
11. Jones Byron (2003): Design and Analysis of Cross-Over Trials.]
12. Patterson, Scott, Jones Byron (2005): Bioequivalence And Statistics in Clinical Pharmacology
13. Analysis of Clinical Trials Using Sas: A Practical Guide: Dmitrienko, Alex; Molenberghs, Geert; Chuang-Stein, Christy; Offen, Walter. [2005, Sas Inst]
14. Kimko, Hui C, Duffull Stephen B. (2002): Simulation for Designing Clinical Trials: A Pharmacokinetic-Pharmacodynamic Modeling Perspective
15. Cody Ron (2007): Learning SAS by Example: A Programmer's Guide.

OPTIONAL PAPER: PAPER VIII: (5) CONTINGENCIES

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	The Mathematics of Compound Interest	Gerber	1-14
2.	The Future Lifetime of a Life Aged	Gerber	15-22
3.	Life Insurance	Gerber	23-34
	Life Annuities	Gerber	35-48
	Unit 2 – (15 Lectures)	Books	Pg.No
4.	Net Premiums	Gerber	49-58
5.	Net Premium Reserves	Gerber	59-74
	Unit 3 – (15 Lectures)	Books	Pg.No
6.	Multiple Decrements	Gerber	75-82
7.	Multiple Life Insurance	Gerber	83-92
8.	The Total Claim Amount in a Portfolio	Gerber	93-102
	Unit 4 – (15 Lectures)	Books	Pg.No
9.	Expense Loading	Gerber	103-108
10.	Estimating Probabilities of Death	Gerber	109-118

Reference Books:

1. Gerber Hans U. (1997) Third Edition: Life Insurance Mathematics.

Recommended Books:

1. Booth Philip, Chadburn, Robert, Haberman Steven, James Devi, Khorasane Zaki, Plumb Robert H., Rickay Zen Ben (2004) :- Modern actuarial theory and practice 2nd edition
2. CT-5 Lecture Notes: UK Institute Actuaries Core Reading for Subject CT5 Contingencies.
3. Promislow S. David (2006) Fundamentals of actuarial mathematics.

OPTIONAL PAPER: PAPER VIII: (6) DATA MINING

Unit 1 – (15 Lectures)

1. Data Preprocessing ,Databases, Data Warehouses, and OLAP, Feature Extraction and selection Methods, Discretization Methods,

Books

Cios, Pedeycz,
Swiniarski
&Kurgan

Pg.No.
93-254

Unit 2 – (15 Lectures)

2. Methods for constructing Data Models : Unsupervised learning – Clustering, Association Rules, Statistical Methods, Decision Trees, Rules Algorithms, and Their Hybrids, Neural Networks, Text mining

Books

Cios, Pedeycz,
Swiniarski
&Kurgan

Pg.No
255-467

Unit 3 – (15 Lectures)

3. Data Model Assessment .

Books

Cios, Pedeycz,
Swiniarski
&Kurgan

Pg.No
467-486

Unit 4 – (15 Lectures)

4. Data security and Privacy Issues

Books

Cios, Pedeycz,
Swiniarski
&Kurgan

Pg.No
487-501

Reference Books:

1. Cios Krzysztof J., Pedeycz Witold, Swiniarski Roman W. and Kurgan Lukasz A. (2007): Data mining : A knowledge Discovery Approach.

Recommended Books:

1. Berson, A. and Smith, S.J. (1997):- Data Warehousing, Data Mining, and OLAP.
2. Breiman, L., Friedman, J.H., Olshen, R.A. and Stone, C.J. (1984):- Classification and Regression Trees.
3. Han, J. and Kamber, M. (2000):- Data Mining; Concepts and Techniques.
4. Mitchell, T.M. (1997). Machine Learning.

OPTIONAL PAPER: PAPER VIII: (7) FINANCIAL MATHEMATICS

Unit 1 – (15 Lectures)

1. Theory of interest rates, Basic Compound Interest function, Nomial rates of interest :annuities payable p^{th} ly,

Books

McCutcheon and Scott

Pg.No.
10-85

Unit 2 – (15 Lectures)

2. Discounted cash flow, capital redemption policies

Books

McCutcheon and Scott

Pg.No
86-144

Unit 3 – (15 Lectures)

3. The valuation of securities, Capital gains tax, Cumulative sinking funds

Books

McCutcheon and Scott

Pg.No
145-229

Unit 4 – (15 Lectures)

4. Yield curves, discounted mean terms, matching and immunization, Consumer credit, an introduction to stochastic interest rate models

Books

McCutcheon and Scott

Pg.No
230-298

Reference Books:

1. McCUTCHEON J. J and Scott W.F.(2005): An Introduction to the Mathematics of Finance.

Recommended Books:

1. CT-1 Lecture Notes: UK Institute Actuaries Core Reading for Subject CT1 Contingencies.
2. Chan Wai-Sum, Tse Yius-Kiren: Financial and Actuarial mathematics
3. Mc-cuttheon J. J. and Scott W. F.: Introduction to math Finance Cases (step by step).

OPTIONAL PAPER: PAPER VIII: (8) GENETICS

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Basic Terms and Definitions in Genetics and Concepts	Elandt-Johnson	1-9,33-
2.	Equilibrium Laws in Panmictic Populations	Elandt-Johnson	35,39-52 57-75

Unit 2 – (15 Lectures)

		Books	Pg.No
3.	Genotype Distributions for Relatives in Randomly Mating Populations	Elandt-Johnson	122-149
4.	Inbreeding and Nonrandom Mating	Elandt-Johnson	196-234
5.	Natural Selection and Mutation	Elandt-Johnson	240-275

Unit 3 – (15 Lectures)

		Books	Pg.No
6.	Human Blood Groups	Elandt-Johnson	391-415
7.	Autosomal Linkage in Experimental Populations	Elandt-Johnson	421-435
8.	Statistically Equivalent Models of Inheritance.	Elandt-Johnson	439-453

Unit 4 – (15 Lectures)

		Books	Pg.No
9.	Segregation Ratios in Families.	Elandt-Johnson	458-492
10.	Simple Modes of Inheritance	B. L. Agarwal	22-42
11.	Path Analysis	S. P. Agarwal	43-83
	Heritability and Repeatability	B. L. Agarwal	
		S. P. Agarwal	

Reference Books:

1. Elandt-Johnson Regina C. (1971): Probability Models and Statistical Methods in Genetics.
2. Agarwal B. L. and Agarwal S. P. (2007): Statistical Analysis of Quantitative Genetics.

Recommended Books:

1. Kempthorne, O. (1957): An Introduction to Genetic Statistics.
2. Li, C. C., (1955): Population Genetics, Chicago University Press.
3. Ewens, W.J. (1979) Mathematical Population Genetics .
4. Nagilaki, T. (1992) Introduction to Theoretical Population Genetics
5. Durbin, R., Eddy, S.R., Krogh, A. and Mitchison, G. (1998) Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids.

OPTIONAL PAPER: PAPER VIII: (9) NON-PARAMETRIC INFERENCE

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Linear rank statistics and the general two sample problem	Gibbons	281-295
2.	Linear rank tests for location problems	Gibbons	296-318

Unit 2 – (15 Lectures)

		Books	Pg.No
3.	Linear rank tests for scale problem	Gibbons	319-352
4.	Tests of equality of independent samples	Gibbons Hollander and Wolfe	353-398 189-269

Unit 3 – (15 Lectures)

		Books	Pg.No
5.	Measure of association in Multiple - Classification	Gibbons	450-493
6.	Asymptotic relative efficiency	Gibbons	494-519

Unit 4 – (15 Lectures)

		Books	Pg.No
7.	Analysis of Count data	Gibbons	520-551
8.	Regression Problem	Hollander and Wolfe	415-457

Reference Books:

1. Gibbons J.D., Chakrabarti S. (2007): Nonparametric Statistical Inference. 4th edition
2. Hollander Myles (1999): Nonparametric Statistical Methods
3. Wolfe Douglas A. (1999): Nonparametric Statistical Methods

Recommended Books:

1. Daniel W. W. (1990): Applied Nonparametric Statistics, 2nd ed.
2. Ghosh J. K. and Ramamoorthi R. V. (2003): Bayesian Nonparametric
3. Hollander M. and Wolfe D. A. (1973): Non-parametric Statistical Inference.
4. Lehman E. L. (1975): Nonparametric Statistical Methods Based on Ranks
5. Randles R. H. and Wolfe D. A. (1979): Introduction to the Theory of Nonparametric Statistics
6. Sprent P. (1989): Applied Nonparametric Statistical Methods.

OPTIONAL PAPER: PAPER VIII: (10) OPERATIONS RESEARCH

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Linear programming : Model building, Graphical method (To be studied by students), Simplex method, Goal Programming.	Winston ² Albright	
2.	Sensitivity analysis in LP: Use of sensitivity analysis	Winston ¹	Section 5.1 6.3, 6.4
3.	Dual of LP: Forming dual of LP and its relation with primal LP, Economic interpretation of dual	Winston ¹ Winston ¹	Sections 6.5, 6.7 Sections 6.6, 6.8, 6.9

Unit 2 – (15 Lectures)

		Books	Pg.No
4.	Data envelopment analysis (DEA): Meaning and use of DEA	Winston ¹ :	Section 6.12
5.	Transportation problem: Formulation of transportation problem and obtaining solution	Winston ¹ & Albright Winston ² : Winston ¹ :	sections 7.1 to 7.3 section 5.2 section 7.4

Unit 3 – (15 Lectures)

		Books	Pg.No
6.	Assignment problem: Formulation of assignment problem and obtaining solution	Winston ¹ Winston ²	section 7.5 section 5.4
7.	Network models: Shortest path problem, Maximum flow problem, PERT and CPM, Minimum cost network flow problem, Minimum spanning tree problem	Winston ¹ Winston ²	section 8.2 section 5.4

Unit 4 – (15 Lectures)

		Books	Pg.No
8.	Advanced methods in LP: Revised simplex method, Column generation to solve large scale LPs, Dantzig-Wolfe decomposition method, Simplex method for upper bounded variables, Dr. Karmarkar's method	Winston ¹	
9.	Simulation: Discrete event simulation, Monte Carlo simulation, Simulation with continuous random variables, Stochastic simulation	Winston ¹	

Reference Books:

1. Winston Wayne L. (1997) - Operations Research applications and algorithms
2. Winston Wayne L., Albright, Christian S. (2006): Practical Management Science
3. Stevenson, Ozgur :Introduction to Management Science with Spreadsheets
4. Hillier F. S. and Hillier M. S.:Introduction to Management Science

Software:

1. Microsoft solver for topics 1 to 7
2. LINDO (Linear Interactive and Discrete Optimizer), LINGO for topics 1 to 7
3. Microsoft project for PERT and CPM
4. Crystal Ball for simulation

OPTIONAL PAPER: PAPER IX: (1) ADVANCED THEORY OF DESIGNS

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Optimality of Block Designs	Shah & Sinha	17-61
2.	Optimality of Weighing Designs	Shah & Sinha	141-160
Unit 2 – (15 Lectures)			
3.	Two-Level Fractional Factorial Designs	Myers & Montgomery	134-182
4.	Process Improvement with Steepest Ascent	Myers & Montgomery	183-207
5.	Analysis of Response Surfaces	Myers & Montgomery	208-278
Unit 3 – (15 Lectures)			
6.	Experiment Designs for fitting Response Surfaces	Myers & Montgomery	279-400
7.	Response Surface Methods and Taguchi's Robust Parameter Designs	Myers & Montgomery	460-534
Unit 4 – (15 Lectures)			
8.	Experiments With Mixtures	Myers & Montgomery	535-623
9.	Analysis of Mixture Data	Cornell	228-289

Reference Books:

1. Cornell John A.(1990): Experiments with Mixtures. Designs, Models and the Analysis of Mixture Data
2. Myers Raymond H. & Montgomery Douglas C. (1995): Response Surface Methodology. Process and Product Optimization Using Designed Experiments.
3. Shah Kirti R. & Sinha Bika K.(1989): Lecture Notes in Statistics. Theory of Optimal Designs.

Recommended Books. "

1. Chakrabarti, M. C.: Mathematics of Design and Analysis of Experiments
2. Raghav Rao, D.: Construction and Combinatorial Problems in Design of Experiments.

OPTIONAL PAPER: PAPER IX: (2) CATEGORICAL DATA ANALYSIS

Unit 1 – (15 Lectures)

1. Models For Binary Response Variables, Log Linear Models, Fitting Log linear and Logic Models

Books

Alan Agresti

Pg.No.

79-200

Unit 2 – (15 Lectures)

2. Building and Applying Log Linear Models, LogLinear-Logit Models for Ordinal Variables,

Books

Alan Agresti

Pg.No.

210-297

Unit 3 – (15 Lectures)

3. Multinomial Reponse Models, Models for Matched Pairs

Books

Alan Agresti

Pg.No.

306-375

Unit 4 – (15 Lectures)

4. Analyzing Repeated Categorical Response Data, Asymptotic Theory for Parametric Models, Estimation Theory for Parametric Models

Books

Alan Agresti

Pg.No.

386-477

Reference Books:

1. Agresti Alan(1990): Categorical Data Analysis.

Recommended Books:

1. Hosmer D. W. and Lemeshow S. (1989) :Applied Logistic Regression.
2. Cox D. R. (1970): The Analysis of Binary Data.
3. Gokhale, D. V. and S. Kullback(1978): The Information in Contingency Tables.

OPTIONAL PAPER: PAPER IX: (3) ECONOMETRICS

Unit 1 – (15 Lectures)

		Books	Pg.No
1.	Linear Regression Model	Gujarati	246-282
2.	Multicollinearity	Gujarati	283-315
3.	Heteroscedasticity	Gujarati	316-352
	Unit 2 – (15 Lectures)		
4.	Autocorrelation	Gujarati	353-392
5.	Model Specification	Gujarati	398-430
	Unit 3 – (15 Lectures)		
6.	Regression on Dummy Variables	Gujarati	431-466
7.	Regression on Dummy Dependent Variable: The LPM, Logit, and Probit Models	Gujarati	467-504
8.	Autoregressive and Distributed Lag Models	Gujarati	505-554
	Unit 4 – (15 Lectures)		
9.	Simultaneous-Equation Models	Gujarati	555-620
10.	Endogeneity in Nonparametric Regression Models, Weakly Dependent Data	Li and Racine	521-573

Reference Books:

1. Gujarati Damodar N.(1988): Basic Econometrics Second Edition
2. Qi Li and Jeffrey Scott Racine (2007). Nonparametric Econometrics

Recommended Books:

1. Snowdon Brian, Vane Howard R.: Modern Macroeconomics: Its Origins, Development And Current State.
2. Bade, Robin; and Michael Parkin (2001): Foundations of Microeconomics. Addison Wesley Paperback.
3. Eaton, B. Curtis; Eaton, Diane F.; and Douglas W. Allen. (2002): *Microeconomics*.
4. Amemiya, T.(1985): Advanced Econometrics.
5. Berndt, E. R.(1991):The Practice of Econometrics.
6. Card, D., and A. Krueger.(1995): Myth and Measurement: The New Economics of the Minimum Wage.
7. DeGroot, M. H., and M. J. Schervish.(2002): Probability and Statistics..
8. Goldberger, A. S.(1991): A Course in Econometrics.
9. Wooldridge, J. M.(2003): Introductory Econometrics.
10. Griliches, Z., and Intriligator, M.(1983): Handbook of Econometrics. Vol I-3.
11. Koopmans, T. C.(1957): Three Essays on the State of Economic Science.)
12. Greene, W. H.(1984): Econometric Analysis. 5th ed.
13. White, H.(1984): Asymptotic Theory for Econometricians.
14. Wooldridge, J. M.(2001): Econometric Analysis of Cross Section and Panel Data.
15. Ruud, P.(2000): An Introduction to Classical Econometric Theory.

Unit 1 - (15 Lectures)

		Books	Pg.No.
1.	Mechanics of Future Market & Hedging Strategies.	John C. Hull	21 -73
2.	Interest Rate	John C. Hull	75-128
3.	Determination of Forward and Future Prices	John C. Hull	

Unit 2 - (15 Lectures)

		Books	Pg.No
4.	Interest Rate Futures, Swaps	John C. Hull	129-148
5.	Mechanics of Options Markets	John C. Hull	149-202

Unit 3 - (15 Lectures)

		Books	Pg.No
6.	Properties of Stock Options, Trading Strategies involving Options	John C. Hull	205-239
7.	Binomial Trees, Wiener Procedures and Ito's Lemma	John C. Hull	241-279

Unit 4 - (15 Lectures)

		Books	Pg.No
8.	The Black-Scholes-Merton Model	John C. Hull	281-310
9.	Basic Numerical Procedures, Credit Risk	John C. Hull	391-432
10.	Martingales and Measures, Interest Rate Derivatives: the standard market models	John C. Hull	481-505 589-632

Reference Books:

1. Hull John C. (2006): Options , Futures and Other Derivatives 6th Edition.
2. Elton Edwin J. and Gruber Martin J (1997): Modern Portfolio Theory and Investment Analysis 5th Edition.
3. Panjer Hary H. (1998): Financial Economics

OPTIONAL PAPER: PAPER IX: (5) MEASURE THEORY

Unit 1 – (15 Lectures)

	Operation On Sets	Books	Pg.No.
1.		Doob	7-15
		Halmos	9-15
2.	Classes Of Subjects of a Spaces Set- functions	Doob	11-36
		Halmos	16-29
	Unit 2 – (15 Lectures)	Books	Pg.No
	Measure Spaces	Doob	37-52
3.		Halmos	30-48
	Unit 3 – (15 Lectures)	Books	Pg.No
4.	Extension Of Measures	Halmos	49-72
5.	Measurable Functions	Doob	53-72
		Halmos	73-94
	Unit 4 – (15 Lectures)	Books	Pg.No
6.	Integrations	Doob	73-102
		Halmos	95-136

Reference Books:

1. Doob. J.L.(1994) : Measure Theory, Spring-Verlag
2. Halmos Paul R (1950) : Measure Theory : Spring-Verlag

OPTIONAL PAPER: PAPER IX: (6) RISK ANALYSIS

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Claim Number Process	Beard, Pentikainen & Pesonen	1-46
2.	Compound Poisson Process	Beard, Pentikainen & Pesonen	47-125

Unit 2 – (15 Lectures)

		Books	Pg.No
3.	Application related one year time and variance as a measure of stability	Beard, Pentikainen & Pesonen	126-182
4.	Risk Process with a time span of several years	Beard, Pentikainen & Pesonen	186-257

Unit 3 – (15 Lectures)

		Books	Pg.No
5.	Parametric estimation for Non-censored and censored data	Willian & Briggs	11-42
6.	Cost effective analysis	Willian & Briggs	43-92

Unit 4 – (15 Lectures)

		Books	Pg.No
7.	Power and Sample Size determination	Willian & Briggs	93-116
8.	Covariate adjustment and Subgroup Analysis	Willian & Briggs	117-144

Reference Books:

1. Willan Andrew R. & Briggs Andrew H.(2006): Statistical Analysis of cost effectiveness data.
2. Beard R. E., Pentikainen T. & Pesonen E.(1984): Risk Theory The Stochastic Basis of Insurance Third Edition

OPTIONAL PAPER: PAPER IX: (7) STATISTICAL DECISION THEORY

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Decision Problem	DeGroot	121-154
2.	Conjugate Families of Distributions	DeGroot	155-189

Unit 2 – (15 Lectures)

		Books	Pg.No
3.	Limiting Posterior Distributions	DeGroot	190-225

Unit 3 – (15 Lectures)

		Books	Pg.No
4.	Sequential Sampling	DeGroot	267-323
5.	Optimal Stopping	DeGroot	324-384

Unit 4 – (15 Lectures)

		Books	Pg.No
6.	Sequential Choice of Experiments	DeGroot	385-439

Reference Books:

1. DeGroot Morris H.(1970): Optimal Statistical Decisions

Recommended Books:

1. Berjer,J(1993): Statistical Decision Theory and Bayesian Analysis.
2. Ghosh (1991): Sequential Tests of Statistical Hypothesis
3. Savage, L.J.(1972): Foundations of Statistics.

OPTIONAL PAPER: PAPER IX: (8) STATISTICAL PROCESS CONTROL

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Process and Measurement System Capability Analysis	Montgomery	349-402
2.	Cumulative sum and Exponentially Weighted Moving Average Control Charts	Montgomery	405-442

Unit 2 – (15 Lectures)

		Books	Pg.No
3.	Other Univariate Statistical Process Monitoring and Control Techniques.	Montgomery	443-506
4.	Multivariate Process Monitoring and Control	Montgomery	507-545

Unit 3 – (15 Lectures)

		Books	Pg.No
5.	Engineering Process Control	Montgomery	546-568
6.	Process Design and Improvement with Designed Experiments	Montgomery	569-638

Unit 4 – (15 Lectures)

		Books	Pg.No
7.	Process Optimization with Designed Experiments	Montgomery	639-672
8.	Robust Design and Signal to Noise Ratios	Phadke	67-128

Reference Books:

1. Montgomery Douglas C.(2004) Fourth Edition: Introduction to Statistical Quality Control
2. Phadke Madhav S.(1989): Quality Engineering Using Robust Design

Recommended Books:

1. Bowker & Goode (1952): Sampling Inspection by variables.
2. Burr, I.(1976): Quality Control Methods.
3. Duncan(1974): Quality Control and Industrial Statistics.
4. Grant, E.L. and Leavenworth (1996): Statistical Quality Control.
5. Johnson and Leone (1977): Statistics and Experimental Design in Engineering and Physical Science.
6. Madhav Phadake(1986): Quality Engineering using Robust Design.
7. Oakland John, S. & Followe Roy, F.(1986): Statistical Process Control-A Practical Guide.
8. Taguchi, G.(1986) : Introduction to Quality Engineering.

OPTIONAL PAPER: PAPER IX: (9) STOCHASTIC PROCESS

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Stochastic Process some notation.	Medhi	56-68
2.	Marker Process with Discrete State Space	Medhi	157-192

Unit 2 – (15 Lectures)

		Books	Pg.No
3.	Marker Process- Continuous Time	Medhi	192-213
4.	Marco Chains		
4.	Marco Process With Continuous State Space	Medhi	221-237

Unit 3 – (15 Lectures)

		Books	Pg.No
5.	Renewal Process- Renewal Process in Continuous Time	Medhi	249-272
6.	Time Series	Ross	549-569
6.		Medhi	340-347

Unit 4 – (15 Lectures)

		Books	Pg.No
7.	Martingales	Durrett	100-120
8.	Stimulation of Stochastic Process	Ross	613-624
9.	Variance Reduction Technique	Ross	624-640

Reference Books:

1. Medhi J. (1994) : Stochastic Process Second edition
2. Ross S. M. (1993) : Introduction to Probability Models.
3. Durrett R. (1999) : Essentials of Stochastic Process.

Recommended Books:

1. Cox D. R. and Miller H. D. (1965): The Theory of Stochastic Process.
2. Karlin S. and Taylor H. M. (1975): First Course in Stochastic Processes second edition.

OPTIONAL PAPER: PAPER IX : (10) SURVIVAL ANALYSIS

Unit 1 – (15 Lectures)

		Books	Pg.No.
1.	Survival distribution Hazard models	Smith	1-36
		Barlow & Proschan	52-79
2.	Reliability Theory	Ross	499-516
		Barlow & Proschan	1-51

Unit 2 – (15 Lectures)

		Books	Pg.No
3.	Data Plots	Smith	54-72
4.	Censoring and life tables	Smith	74-118

Unit 3 – (15 Lectures)

		Books	Pg.No
5.	Parametric Survival models under consuming and fitting Parametric Regression Models.	Bain	98-408

Unit 4 – (15 Lectures)

		Books	Pg.No
6.	Renewal processes	Medhi	243-268
7.	Optimum Maintenance Policies	Barlow & Proschan	85-117

Reference Books:

1. Barlow R.E. and Proschan F (1965): Mathematical theory of reliability
2. Barlow R.E. and Proschan F(1975): Statistical theory of reliability and life testing
3. Ross S. M.(1993): Introduction to Probability Models
4. Smith P.J. (2002): Analysis of Failure and Survival data
5. Medhi J.(1994): Stochastic Processes (second edition)
6. Bain L.J. (1978): Statistical Analysis of Reliability and life testing models.

PAPER -X

Practical - Section -I

Based on Paper VI and Paper VII

Contents of this Section to be covered as given in the Data site and case studies with help of Statistical Software like SAS, SPSS, MINITAB etc.

Practical - Section -II

Based on Paper VIII and Paper IX

Contents of this Section to be covered as given in the Data site and case studies with help of Statistical Software like SAS, SPSS, MINITAB etc.

Practical - Section -III

Student should do a project/ dissertation

Data Site :

~~<http://www.cmie.com/>~~ - time-series-data-(paid-site).
www.mospi.nic.in / websitensso.htm (national sample survey site)
www.mospi.nic.in / cso_test.htm (central statistical organization)
www.cenrusindia.net (cenrus of India)
~~www.indiastat.com~~ (paid site on India statistics).
www.maharashtra.gov.in /index.php (Maharashtra govt.site)
www.mospi.gov.in (government of India)
www.rbi.org

Software: SAS / SPSS / MINITAB