AC 27/2/13

Item no. 4.125

UNIVERSITY OF MUMBAI

Syllabus for SEM III & IV
Program: M.A./M.Sc.
Course : Statistics

(Credit Based Semester and Grading System with effect from the academic year 2013–2014)

M.A./ M.Sc.
Sem III and IV
Statistics
Credit Based Semester and Grading System
To be implemented from the Academic year 2013-2014

Table showing the proposed courses to be covered in the Second year in two semesters.

Semester III	PSST301	PSST302	PSST303	PSST304	PSSTP3A & PSSTP3B
	MULTIVARIATE ANALYSIS I	TESTING OF HYPOTHESIS I	OPTIONAL PAPER I (A) ANY TWO ELECTIVES TO BE SELECTED FROM GROUP A	OPTIONAL PAPER I (B) ANY TWO ELECTIVES TO BE SELECTED FROM GROUP B	PRACTICALS BASED ON PSST 301 TO PSST 304
Semester IV	PSST401	PSST402	PSST403	PSST404	PSSTP4A & PSSTP4B
	MULTIVARIATE ANALYSIS II	TESTING OF HYPOTHESIS II	OPTIONAL PAPER II (A) SAME ELECTIVES AS SEMESTER III TO BE SELECTED FROM GROUP A	OPTIONAL PAPER II (B) SAME ELECTIVES AS SEMESTER III TO BE SELECTED FROM GROUP B	PRACTICALS BASED ON PSST401 TO PSST404

Each batch of practicals consists of 10 students

Students will have to select same electives for semester III and semester IV

SEMESTER III

Page numbers given below indicate depth and scope of syllabus

Total No. of Classroom Teaching 60 hours +60 notional Hours =120 hours= 4 credits

Course Code	UNIT	MULTIVARIATE ANALYSIS I	Books & Page Numbers
PSST301	I	i) Multivariate data and Multivariate graphical display. ii) Multivariate distributions, marginal and conditional distribution, some multivariate generalizations of univariate distributions, simulation.	Johnson-Wichern 1-157 Anderson 6-65 Johnson-Wichern 252-275 Kshirsagar 23-46
	II	Multivariate normal distribution, Wishart distribution.	Flury 23-184 Kshirsagar 47-81 Anderson 115-169
	III	Principal Component Analysis.	Johnson-Wichern 458-512
	IV	Factor Analysis Cluster Analysis Multidimensional Scaling	Johnson-Wichern 514-565

Reference Books :

1. Johnson Richard A and Wichern D.W.(1998) : Applied Multivariate Statistical Analysis (4th Edition)
2. Anderson T.W.(1958) : An Introduction to Multivariate Statistical Analysis.John Wiley & Sons

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 ,Marcel Dekker Inc. New York.
6. Hardle Wolfgang & Hlavka : Multivarite Statistics : Exercise & Solutions

Total No. of Classroom Teaching 60 hours +60 notional Hours =120 hours= 4 credits

Prerequisites : Joint and marginal distribution of order statistics, distribution of median and range

Course Code	UNIT	TESTING OF HYPOTHESIS I	Books & Page Numbers
PSST302	I	Some fundamental notions of hypothesis testing ,N P Lemma (Necessary part, Sufficiency, Existence) MP, UMP tests	Rohatgi & Saleh 455-464 Lehmann & Romano 56-107 Rohatgi & Saleh 464-472
	II	Families with Monotone Likelihood Ratio, Tests based on Monotone Likelihood Ratio	Rohatgi & Saleh 472-479 Lehmann & Romano 56-107 Rohatgi & Saleh 479-486
	III	Confidence-interval estimation of population quantiles	Gibbons & Chakrabarti 48-54
		The empirical distribution function	54-60
		Test based on runs, Test based on total number of runs, lengths of the longest run, runs up and down	Gibbons & Chakrabarti 68-88
	IV	Goodness of fit tests : Chi-square goodness of fit test, The Kolmogorov-Smirnov one statistic test , Applications	Gibbons & Chakrabarti 94-124
		Sign test, Wilcoxon Signed-rank test	Gibbons & Chakrabarti 139-177

		General two sample problem Wald Wolfowitz run test Kolmogorov-Smirnov two sample test	Gibbons & Chakrabarti 184-206
		Mann-Whitney U-test	212-223
		Wilcoxon Rank-Sum test	239-246

Reference Books :

1. Vijay K. Rohatgi, A. K. M. D. Ehsanes Saleh: An introduction to probability and statistics. John Wiley and Sons:- (2nd Edition)
2. J. D. Gibbons & S. Chakrabarti : Nonparametric Statistical Inference. (3rd Edition, Revised and Expanded).
3. Lehmann, E.L. & Romano Joseph P. (2005) : Testing Statistical Hypotheses (3rd Edition):- Springer Text
4. A.Wald :- Sequential Analysis.

Recommended Books

1. Fergusson: Mathematical Statistics: A Decision Theoretic Approach
2. Zacks Samuel: Theory of Statistical Inference
3. Conover W.J. : Practical Nonparametric Statistics.
4. Jun Shao (2005): Mathematical Statistics.
5. Hollander and Wolf : Nonparametric Statistics.

Course code 303

Group A Electives for optional paper I (A) : Any two electives to be selected from the following electives

GROUP A ELECTIVES

A. BAYESIAN ANALYSIS
B. BIO INFORMATICS
C. BIOSTATISTICS
D. CLINICAL RESEARCH
E. CONTINGENCIES
F. DATA MINING
G. FINANCIAL MATHEMATICS
H. STATISTICAL PROCESS CONTROL
I. NONPARAMETRIC INFERENCE
J. OPERATIONS RESEARCH

Total No. of Classroom Teaching 60 hours +60 notional Hours =120 hours= 4 credits for two selected electives together.

Course Code	UNIT	BAYESIAN ANALYSIS I	Books & Page Numbers
PSSTAA303	I	Utility & Non Function Prior Informatics & Subjective Probability	Berger 46-73 Berger 74-117 Lee 33-120
	II	Bayesian Analysis	Berger 118-307

Reference Books :

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

Course Code	UNIT	BIOINFORMATICS I	Books & Page Numbers
PSSTAB303	I	Poisson Process and Markov Chains, Analysis of One and Multiple DNA Sequences	Ewens & Grant 129-218
	II	Random Walks, Classical Estimation and Testing, BLAST	Ewens & Grant 219-302

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.

Course Code	UNIT	BIOSTATISTICS I	Books & Page Numbers
PSSTAC303	I	The Evaluation of Screening Tests	Fleiss, Levin & Paik 1-15
		Comparative Studies: Cross-Sectional, Naturalistic, or Multinomial Sampling	Fleiss, Levin & Paik 95-140
		Comparative Studies: Prospective and Retrospective Sampling	Fleiss, Levin & Paik 144-157
	II	The Analysis of Data from Matched Samples	Fleiss, Levin & Paik 373-403
		Direct Assays	Finney 21-57
		Quantitative Dose-Response Relationships	Finney 58-75
		Parallel Line Assays	Finney 99-117

Reference Books :

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

Course Code	UNIT	CLINICAL RESEARCH I	Books & Page Numbers
PSSTAD303	I	Background and Basic Concepts, Phase I and II Clinical Trials	Fieller 7-20 Zhang 18-48
		Basic Trial Analysis Phase III Clinical Trials	Fieller 21-38 Zhang 35-48
		Randomization	Fieller 39-54 Zhang 49-73
	II	Protocol Deviations Some Additional Issues in Phase III Clinical Trials	Fieller 55-62 Zhang 74-80
		Size of the Trial Sample Size Calculations	Fieller 63-78 Zhang 81-95

Reference Books :

1. Dr. Fieller Nick(2007): Medical Statistics: Clinical Trials .
2. Zhang Daowen (2007): Statistical Principles of Clinical Trials (Lecture Notes)
3. Stephen Piantadosi : Statistical Methods for clinical Trials .

Recommended Books :

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

4. Marilyn Mulay (2000) : A Step-By-Step Guide to Clinical Trials Jones & Bartlett
5. Walker, Glenn A. (2002) :Common Statistical Methods for Clinical Research: With SAS Examples Sas Inst.
6. Cleophas, Ton J.M. (2006):Statistics Applied to Clinical Trials, 3rd Edition), Springer Verlag.
7. Shein-Chung Chow, Jen-Pei Liu (2004):
8. Design and Analysis of Clinical Trials: Concepts and Methodologies (Wiley Series in Probability and Statistics. John Wiley & Sons, Inc.
9. Shein-Chung Chow, Jun Shao, Hansheng Wang. (2003): Sample Size Calculations in Clinical Research. Mercel Dekker, Inc.
10. Anne Whitehead (2003) : Meta-Analysis of Controlled Clinical Trials.Wiley
11. Leandro, Gioacchino (2005) :Meta-analysis In Medical Research: The Handbook for the Understanding and Practice of Meta-Analysis .Blackwell Publication.
12. Byron Jones. (2003): Design and Analysis of Cross-Over Trials, Second Edition, CRC PRESS.
13. Patterson, Scott(2005): Bioequivalence And Statistics in Clinical Pharmacology. Chapman & Hall.
14. Dmitrienko, Alex; Molenberghs, Geert; Chuang-Stein, Christy; Offen, Walter. (2005): Analysis of Clinical Trials Using Sas : A Practical Guide[Sas Inst]
15. Kimko, Hui C(2002): Simulation for Designing Clinical Trials: A Pharmacokinetic-Pharmacodynamic Modeling Perspective. Informa Healthc.
16. Ron Cody (2007): Learning SAS by Example: A Programmer's Guide SAS Publishing.

Course Code	UNIT	CONTINGENCIES I	Books & Page Numbers
PSSTAE303	I	The Mathematics of Compound Interest	Gerber 1-14
		The Future Lifetime	Gerber 15-22
		Life Insurance	Gerber 23-34
		Life Annuities	Gerber 35-48
	II	Net Premiums	Gerber 49-58
		Net Premium Reserves	Gerber 59-74

Reference Books :

1. Gerber Hans U. (1997): Life Insurance Mathematics. Third Edition
2. Neill Alistair (1977): Life contingencies . Heinemann

Recommended Books :

1. Booth, P.M. et al. (1999) Modern actuarial theory and practice, Chapman & Hall,.
2. CT-5 Lecture Notes: UK Institute Actuaries Core Reading for Subject CT5 Contingencies.
3. Promislow S.David (2006) Fundamentals of actuarial Mathematics.

Course Code	UNIT	DATA MINING I	Books & Page Numbers
PSSTAF303	I	**1. Introduction to Database:** Overview of database management system, Entity Relation model: entity, attributes, keys, relations, ER diagram, Introduction to relational schema, integrity constraints over relations, Functional dependency. Relational algebra (No question is to be ask from this) **2. Data Mining Techniques :** **(i) Introduction to Data Mining:** Definition, Data mining and Knowledge Discovery in Databases, Data mining models: Descriptive and Predictive. KDD process, Visual data mining. **(ii) Introduction to Text Mining:** Information Retrieval, Typical Information Retrieval Process, Data Mining on Text, Text Mining definition, Text Mining Process. **(iii) Data mining and Machine Learning**: Input to Data Mining Algorithms, Data types: Nominal; Ordinal; Interval; Ratio.	Dunham 1-12 Witten & Eibe 1- 35 Han & Kamber 1-36 Baeza & Yates 1- 9 Raghu & Johannes 25-45
	II	**Data Pre-processing and Introduction to Data warehousing:** **(i) Data Pre-processing:** Cleaning: Missing Values; Noisy Values; Noisy values; Inconsistent values; Redundant values. Outliers, Discretization: Equal Width Binning; Equal Depth Binning, Normalization, Smoothing. **(ii) Introduction to Data warehousing:** Definition, Data marts, Need for data warehousing, data warehouse architecture. **(iii)Data Design and Data Representation:**	Dunham 21-41 Witten & Eibe 41-60 Han & Kamber 105-218

		Principles of dimensional modeling, OLAP and OLTP, Data cubes, Data cube operations, data cube schemas, data extraction, transformation and loading.	Inmon 29-134

Reference Books:-

(1) Dunham, Margaret H, Data Mining: Introductory and Advanced Topics, Prentice Hall.

(2) Witten, Ian and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Morgan Kaufmann.

(3) Han and Kamber (2006), Data Mining: Concepts and Techniques, Second Edition, Morgan Kaufmann.

(4) Baeza and Yates, Modern Information Retrieval, Addison Wesley.

(5) Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw – Hill.

(6) Inmon (1993), Building the Data Warehouse, Wiley.

Recommanded Books:-

(1) Berry and Browne(2006), Lecture Notes in Data Mining, World Scientific.

(2) Berry and Linoff (2004), Data Mining Techniques, Second Edition, Wiley.

(4) Konchady(2006), Text Mining Application Programming, Thomson.

(5) Weiss et al. (2005), Text Mining: Predictive Methods for Analyzing Unstructured information, Springer.

(6) Webb, Malvern (2002), Statistical pattern Recognition, Wiley & Sons Ltd.

(7) Cios, K.J., Pedrycz, W., Swiniarski, R.W., Kurgan, L.A (1998), Data Mining: A Knowledge Discovery Approach, Springer .

(8) D. J. Hand, Heikki Mannila, Padhraic Smyth(2001), Principles of data mining, The MIT press.

(9) Trevor Hastie, Robert Tibshirani, Jerome H. Friedman(2001), The elements of statistical learning: data mining, inference, and prediction, Springer.

(10) R. Kimpall, The Data Warehouse Toolkit, John Wiley.

(11) E.G. Mallach, Decision Support and Data Warehouse systems", TMH.

Course Code	UNIT	FINANCIAL MATHEMATICS I	Books & Page Numbers
PSSTAG303	I	Theory of interest rates, Basic Compound Interest function, Nomial rates of interest : annuities payable p^{th} ly.	McCutcheon and Scott 10-85
	II	Discounted cash flow, capital redemption policies	McCutcheon and Scott 86-144

Reference Books:

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

2. CT-1 Lecture Notes: UK Institute Actuaries Core Reading for Subject CT1 Contingencies

Course Code	UNIT	STATISTICAL PROCESS CONTROL I	Books & Page Numbers
PSSTAH303	I	Process and Measurement System Capability Analysis	Montgomery 349-402
		Cumulative sum and Exponentially Weighted Moving Average Control Charts	Montgomery 405-442
	II	Other Univariate Statistical Process Monitoring and Control Techniques.	Montgomery 443-506
		Multivariate Process Monitoring Control.	Montgomery 507-545

Reference Books :

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

Recommended Books:

1. Bowker & Goode: Sampling Inspection by variables.
2. Burr, I.: Quality Control Methods.
3. Duncan: Quality Control and Industrial Statistics.
4. Grant,E.L. and Leaven Worth: Statistical Quality Control.
5. Johnson and Leone: Statistics and Experimental Design in Engineering and Phusical Science.
6. Oakland John, S. & Followel Roy, F.: Statistical Process Control-A Practical Guide.
7. Taguchi, G. : Introduction to Quality Engineering.

Course Code	UNIT	NONPARAMETRIC INFERENCE I	Books & Page Numbers
PSSTAI303	I	Linear rank statistics and the general two sample problem	Gibbons 281-295
		Linear rank tests for location problems	Gibbons 296-318
	II	Linear rank tests for scale problem	Gibbons 319-352
		Tests of equality of independent samples	Gibbons 353-398 Hollander and Wolfe 189-269

Reference Books :

1. Gibbons J.D.(2007): Nonparametric Statistical Inference
2. Hollander Myles(1999): Nonparametric Statistical Methods
3. Wolfe Douglas A.(1999): Nonparametric Statistical Methods

Recommended Books :

1. W.W. Daniel (1990):, Applied Nonparametric Statistics, Boston: PWS-KENT,2nd ed.,
2. J.K.Ghosh and R.V. Ramamoorthi(2003):, Bayesian Nonparametric Springer Verlag, NY.
3. M. Hollandor, and D.A. Wolf(1973): e Non-parametric Statistical Inference. McGraw-Hill.
4. E. L. Lehman(1975), Nonparametric Statistical Methods Based on Ranks, McGraw-Hill.
5. R. H. Randles and D. A. Wolfe,(1979): Introduction to the Theory of Nonparametric Statistics Wiley, New York.

6. P.Sprent(1989):, Applied Nonparametric Statistical Methods. Chapman and Hall, London .

Prerequisite: Linear programming : Model building, Graphical method, Simplex method.

Course Code	UNIT	OPERATIONS RESEARCH I	Books & Page Numbers
PSSTAJ303	I	Goal Programming.	Winston[1] & Winston[2]
		Sensitivity analysis in LP and its use .	Winston[1] : section 5.1,6.3,6.4
		Dual of LP: Forming dual of LP and its relation with primal LP, Economic interpretation of dual.	Winston[1] : sections 6.5,6.7 Winston[1]: sections 6.6,6.8,6.9
	II	Data Envelopment Analysis (DEA): Meaning and use of DEA	Winston[1] : sections 6.12
		Transportation problem: Formulation of transportation problem its solution	Winston[1] : sections 7.1 to 7.3 Winston[2] : ections 5.2 Winston[1] : sections 7.4

Reference Books :

1. Winston Wayne L, - Operations Research applications and algorithms
2. Practical Management Science – Winston, Albright, Broadie
3. Introduction to Management Science with Spreadsheets – Stevenson, Ozgur
4. Introduction to Management Science – F.S. Hillier and M.S. Hillier

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

Course code 304

Group **B** Electives for optional paper I (B) : Any two electives to be selected from the following electives

GROUP B ELECTIVES :

A. ADVANCED THEORY OF DESIGNS
B. CATEGORICAL DATA ANALYSIS
C. ECONOMETRICS
D. FINANCIAL STATISTICAL ECONOMICS
E. MEASURE THEORY
F. RISK ANALYSIS
G. STATISTICAL DECISION THEORY
H. GENETICS
I. STOCHASTIC PROCESSES
J. SURVIVAL ANALYSIS

Total No. of Classroom Teaching 60 hours +60 notional Hours =120 hours= 4 credits for two selected electives together.

Course Code	UNIT	ADVANCED THEORY OF DESIGNS I	Books & Page Numbers
PSSTBA 304	I	Optimality of Block Designs	Shah & Sinha 17-61
		Optimality of Weighing Designs	Shah & Sinha 141-160
	II	Two-Level Fractional Factorial Designs	Myers & Montgomery 134-182
		Process Improvement with Steepest Ascent	Myers & Montgomery 183-207
		Analysis of Response Surfaces	Myers & Montgomery 208-278

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 Bikas K. (1989): Lecture Notes in Statistics. Theory of Optimal Designs.

Recommended Books:

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

Course Code	UNIT	CATEGORICAL DATA ANALYSIS I	Books & Page Numbers
PSSTBB304	I	Models For Binary Response Variables, Log Linear Models, Fitting Log linear and Logit Models	Alan Agresti 79-200
	II	Building and Applying Log Linear Models, LogLinear-Logit Models for Ordinal Variables.	Alan Agresti 210-297

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.

Course Code	UNIT	ECONOMETRICS I	Books & Page Numbers
PSSTBC304	I	Linear Regression Model	Gujarati 246-282
		Multicollinearity	Gujarati 283-315
		Heteroscedasticity	Gujarati 316-352
	II	Autocorrelation	Gujarati 353-392
		Model Specification	Gujarati 398-430

Reference Books:

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

Recommended Books:

1. Brian Snowdon, Howard R. Vane,. *Modern Macroeconomics: Its Origins, Development And Current State*. Edward Elgar Publishing.
2. Bade, Robin; and Michael Parkin. (2001) *Foundations of Microeconomics*. Addison Wesley Paperback 1st Edition.
3. Eaton, B. Curtis; Eaton, Diane F.; and Douglas W. Allen. : (2002) *Microeconomics*. Prentice Hall, 5th Edition.
4. Amemiya, T. (1985):Advanced Econometrics. Cambridge, MA: Harvard University Press.
5. Berndt, E. R. (1991):The Practice of Econometrics. Reading, MA: Addison-Wesley.
6. Card, D., and A. Krueger. (1995) : Myth and Measurement: The New Economics of the Minimum Wage. Princeton, NJ: Princeton University Press.
7. DeGroot, M. H., and M. J. Schervish. (2002) Probability and Statistics. 3rd ed. Boston: Addison-Wesley.
8. Goldberger, A. S.(1991):A Course in Econometrics. Cambridge, MA: Harvard University Press.
9. Wooldridge, J. M. (2003) :Introductory Econometrics. 2nd ed. Cincinnati, OH: South-Western College. (Wooldridge is the basic text. The material in Goldberger is

more advanced and optional. DeGroot and Schervish is a recommended text for statistics review.)
10. Griliches, Z., and Intriligator, M. (1983):Handbook of Econometrics. Vol. 1-3. Amsterdam, Holland; New York, NY: North-Holland,
11. Koopmans, T. C. (1957): Three Essays on the State of Economic Science. New York, NY: McGraw-Hill.
12. Greene, W. H. (2002): Econometric Analysis. 5th ed. Upper Saddle River, NJ: Prentice Hall.

13. White, H. (1984): Asymptotic Theory for Econometricians. Orlando, FL: Academic Press.
14. Wooldridge, J. M. (2001): Econometric Analysis of Cross Section and Panel Data. Cambridge, MA: MIT Press.
15. Ruud, P, (2000): An Introduction to Classical Econometric Theory. New York, NY: Oxford University Press.
16. Novice SAS users may find The Little SAS Book helpful.

Course Code	UNIT	FINANCIAL STATISTICAL ECONOMICS I	Books & Page Numbers
PSSTBD304	I	Mechanics of Future Market & Hedging Strategies.	John C. Hull 21-73
		Interest Rate	John C. Hull 75-128
		Determination of Forward and Future Prices	John C. Hull
	II	Interest Rate Futures, Swaps	John C. Hull 129-148
		Mechanics of Options Markets	John C. Hull 149-202

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

Course Code	UNIT	MEASURE THEORY I	Books & Page Numbers
PSSTBE304	I	Operation On Sets	Doob 7-16 Halmos 9-15
		Classes Of Subjects of a Spaces Set-functions	Doob 11-36 Halmos 16-29
	II	Measure Spaces	Doob 37-52 Halmos 30-48

Reference Books :

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

Course Code	UNIT	RISK ANALYSIS I	Books & Page Numbers
PSSTBF304	I	Claim Number Process	Beard, Pentikainen & Pesonen 1-46
		Compound Poisson Process	Beard, Pentikainen & Pesonen 47-125
	II	Application related one year time and variance as a measure of stability	Beard, Pentikainen & Pesonen 126-182
		Risk Process with a time span of several	Beard, Pentikainen

		years	& Pesonen 186-257

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

Course Code	UNIT	STATISTICAL DECISION THEORY I	Books & Page Numbers
PSSTBG304	I	Decision Problem	DeGroot 121-154
		Conjugate Families of Distributions	DeGroot 155-189
	II	Limiting Posterior Distributions	DeGroot 190-225

Reference Books:

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

Recommended Books:

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

Course Code	UNIT	GENETICS I	Books & Page Numbers
PSSTBH304	I	Basic Terms and Definitions in Genetics and Concepts	Elandt-Johnson 1-9, 33-35, 39-52
		Equilibrium Laws in Panimictic Populations	Elandt-Johnson 57-75

	II	Genotype Distributions for Relatives in Randomly Mating Populations	Elandt-Johnson 122-149
		Inbreeding and Nonrandom Mating	Elandt-Johnson 196-234
		Natural Selection and Mutation	Elandt-Johnson 240-275

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. Kempthome, 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 ,Springer Verlag.

4. Nagilaki, T. (1992) :Introduction to Theoretical Population Genetics ,Springer Verlag.

5. Durbin, R., Eddy, S.R., Krogh, A. and Mitchison,G. (1998) :Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge Univ. Press.

Course Code	UNIT	STOCHASTIC PROCESSES I	Books & Page Numbers
PSSTBI304	I	Stochastic Process : Basic Concepts	Medhi 56-68
		Markov Process with Discrete State Space	Medhi 157-192

	II	Simulation Advanced topics	Ross 590-600
		Variance Reduction Technique	Ross 624-650

Reference Books :

1.Medhi J. (1994) : Stochastic Processes Second edition,Wiley Eastern.

2.Ross S. M. (1993) : Introduction to Probability Models.

3. Durrett R. (1999) : Essentials of Stochastic Process.

4. Bhatt Narayan C. : Elements of Applied Stochastic Processes

Recommended Books:

1.Cox D. R. and Miller H. D. (1965): The Theory of Stochastic Processes.

2.Karlin S. and Taylor H. M. (1975): First Course in Stochastic Processes second edition.

ourse Code	**UNIT**	**SURVIVAL ANALYSIS I**	**Books & Page Numbers**
PSSTBJ304	**I**	Survival distribution	Smith 1-17
		Hazard models	Smith 19-36
		Data Plots	Smith 55-72
	II	Reliability of the system	Ross 499-548

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.
7. Lawless J.F.(1982): Statistical models and methods for life time data
8. Mann N.R., Schlafer R.E. and Singpurwalla N.D.(1974) : Methods of Statistical analysis of reliability data.

PRACTICALS

At the end of Third Semester there will be a practical examination based on Theory papers PSST301, PSST302, PSST303 and PSST304

<table>
<tr><td rowspan="3">PSSTP3A</td><td>BASED ON PSST301</td><td rowspan="3">4</td><td rowspan="6">Total
8
Credits</td></tr>
<tr><td>BASED ON PSST302</td></tr>
<tr><td>BASED ON SPSS AND MINITAB</td></tr>
<tr><td rowspan="3">PSSTP3B</td><td>BASED ON ANY TWO ELECTIVES CHOSEN FROM GROUP A</td><td rowspan="3">4</td></tr>
<tr><td>BASED ON ANY TWO ELECTIVES CHOSEN FROM GROUP B</td></tr>
<tr><td>BASED ON VIVA AND JOURNAL</td></tr>
</table>

Contents of PSSTP3A and PSSTP3B to be covered with the help of Statistical Software like SAS, SPSS, MINITAB, ' R' Software etc. As a part of PSSTP3A students will have to give a test on SPSS of 10 marks and MINITAB of 10 marks. As a part of PSSTP3B students will have to give Viva of 10 marks and 10 marks are assigned to the journal. Test on SPSS and MINITAB will be based on all the syllabus of M. Sc Semester 1,2 and 3.

6 hours practical per week
2 hours software per week
Therefore Practicals + Software = 8 hours per week
Hence 120 Teaching hours + 120 Notional
= 240 hours
= 8 credits

Total number of Credits for Third Semester

Theory 16 + Practicals 8 = 24

Reference Books : **Statistical Software**

1. Carver R.H. & Others Data analysis with SPSS.
2. Cody R.P. & Smith J.H. Applied Statistics and the SAS programming language.
3. Darren Georage and Paul Mallery SPSS for windows.
4. Spencer N.H.(2004) SAS Programming, the one day course.
5. Practical Statistical for experimental biologists.
6. Random A and Everitt R.S. : A handbook of statistical analysis using

7. Nom o' Rowke, Larry Hatcher, Edward J. Stepansk : A Step by step approach using SAS for univariate and multivariate Statistics (2nd Edition)
8. Nom O' Rourke, Larry Hatcher Edward J. Stepansk. A step by Approach
9. using SAS for unvariate and multivariate Statistics-2nd Edition SAS Institution. Inc. Wily.
10. Donald L. Harmell, James F.Horrell.Data. Statistics and Decision Models with Excel

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)

Case studies :

1. A.C Rosander : Case Studies in Sample Design
2. Business research methods – Zikund (http://website, swlearning.com)

3. C. Ralph Buncher 21 and Jia-Yeong Tsay : Statistical in the Pharmaceutical Industry
4. Contempory Marketing research – carl McDaniel, Roges Gates. (McDaniel, swcollege.com)

5. Edward J Wegmes g. Smith : Statistical Methods for Cancer Studies
6. Eugene K. Harris and Adelin Albert : Survivorship Analysis for Clinical Studies
7. Marketing research – Zikmund (http://website.swlearing.com)

8. Marketing research – Naresh Malhotra (http://www.prenhall.com /malhotra)

9. http://des.maharashtra.gov.in (government of maharashtra data)
10. Richard G. Cornell :Statistical Methods for Cancer Studies
11. Stanley H. Shapiro and Thomas H.Louis Clinical Trials
12. William J. Kennedy, Jr. and James E. Gentle. Statistical Completing
13. Case Studies in Bayesion Statistics vol. VI
Lecture notes in Bayesion Statistics number 167 (2002)

Constantine, Gatsonis Alicia, Carriquary Andrew, Gelman

14. Wardlow A.C (2005) Practical Statistical for Experimental bilogoists (2nd Edition)

Total number of Credits for Third Semester

Theory 16 + Practicals 8 = 24

Exam Pattern for Theory and Practical

Internal Exam 40 Marks

Semester End Exam 60 Marks of 3 hours duration

At the end of third Semester there will be a practical examination based on Theory papers Based on PSST301, PSST302, PSST303 and PSST304.

SEMESTER IV

Page numbers given below indicate depth and scope of syllabus

Total No. of Classroom Teaching 60 hours +60 notional Hours =120 hours= 4 credits

Course Code	UNIT	MULTIVARIATE ANALYSIS II	Books & Page Numbers
PSST401	I	Hotelling' s T^2 and its applications.	Anderson 170-206
		Regression and correlation coefficients among several variables and their testing.	Anderson 115-169
	II	Likelihood Ratio Tests	Anderson 291-380 Giri 175-288
		Multivariate Analysis of variance	Johnson-Wichern 290-375

	III	Canonical Correlations and Variates	Johnson-Wichern 587-627
	IV	Discriminant analysis, classification of the observations into one of the two populations. Extension to more than two populations.	Johnson-Wichern 629-723 Dillon-Goldstein 360-392

Reference Books :

1. Johnson Richard A and Wichern D.W. (1998) : Applied Multivariate Statistical Analysis (4th Edition)
2. Anderson T.W.(1958) : 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

Recommended Books :

1. Khatri C G : Multivariate Analysis.

2. Mardia K V : Multivariate Analysis **.**

Total No. of Classroom Teaching 60 hours +60 notional Hours =120 hours= 4 credits

Course Code	UNIT	TESTING OF HYPOTHESIS II	Books & Page Numbers
PSST402	**I**	Unbiased Test, LMP & LMPU Test,	Lehman & Romano 110-276 Rohatgi & Saleh 486-489.
	II	Similar Test , Neyman structure test, Invariant Test Likelihood ratio tests UMA,UMAU confidence sets	Lehman & Romano 392-414 Rohatgi & Saleh 490-500 Rohatgi & Saleh 466-494
	III	Test for equality of k independent samples	Gibbons & Chakrabarti

		The Kruskal-Wallis one way ANOVA test	Gibbons & Chakrabarti 288-307
		Friedman's test	Gibbons & Chakrabarti 386-396
	IV	Measures of association for bivariate Samples	Gibbons & Chakrabarti
		Kendall's Tau coefficient Spearman's coefficient of rank correlation Measure of association	Gibbons & Chakrabarti 399-445
		SPRT	Wald

Reference Books :

1. Vijay K. Rohatgi, A. K. M. D. Ehsanes Saleh: An introduction to probability and statistics. John Wiley and Sons:- (2nd Edition)
2. J. D. Gibbons & S. Chakrabarti : Nonparametric Statistical Inference. (3rd Edition, Revised and Expanded).
3. Lehmann, E.L. & Romano Joseph P. (2005) : Testing Statistical Hypotheses (3rd Edition):- Springer Text
4. A.Wald :- Sequential Analysis.

Recommended Books:

1.Fergusson: Mathematical Statistics: A Decision Theoretic Approach
2.Zacks Samuel: Theory of Statistical Inference
3.Conover W.J. : Practical Nonparametric Statistics.
4.Jun Shao (2005): Mathematical Statistics.
5.Hollander and Wolf : Nonparametric Statistics.

Course code PSST403 and PSST404

Electives for PSST403 II(A) will be same as Electives for PSST303 I(A)

Electives for PSST404 II(B) will be same as Electives for PSST304 I(B)

Course Code	**UNIT**	**BAYESIAN ANALYSIS II**	**Books & Page Numbers**
PSSTAA403	**I**	Minimax Analysis	Berger 308-387
		Hypothesis-Testing	Lee 123-167

	II	Preposterior & Sequential Analysis	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.

Course Code	**UNIT**	**BIOINFORMATICS II**	**Books & Page Numbers**
PSSTAB403	**I**	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
	II	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 (19998) :- Biological sequence analysis. Probabilistic models of Proteins and Nucleic Acids.

Course Code	UNIT	BIOSTATISTICS II	Books & Page Numbers
PSSTAC403	I	Efficiency, Reliability and Sensitivity	Finney 164-186
		Slope Ratio Assays	Finney 187-213
		Repeated Measures, Introduction	Davis 1-12
		Univariate Methods	Davis 15-28
	II	Normal Theory Methods: Unstructured Multivariate Approach	Davis 45-54
		Normal-Theory Methods : Multivariate Analysis of Variance	Davis 73-82
		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: Statistical Methods in Biological Assays.

3. Fleiss Joseph L.,Levin Bruce & Paik Myunghee Cho (2003): Statistical Methods for Rates and Proportions

Course Code	UNIT	CLINICAL RESEARCH II	Books & Page Numbers
PSSTAD403	I	Multiplicity and Interim Analysis Comparing More Than Two Treatments	Fieller 79-112 Zhang 96-117
		Crossover Trials Causality, Non—compliance and Intent-to-treat	Fieller 113-132 Zhang 118-130
		Combining Trials Survival Analysis in Phase III Clinical Trials	Fieller 133-146 Zhang 131-163
	II	Binary Response Data Early stopping of Clinical Trials	Fieller 147-166 Zhang 164-193
		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. Duolao Wang, Ameet Bakhai.Clinical Trials - A Practical Guide to Design, Analysis, and Reporting
2. Phillip I. Good (2006): A Manager's Guide to the Design and Conduct of Clinical Trials (Manager's Guide Series): John Wiley & Sons, Inc.
3. Lawrence M. Friedman, Curt D.Furberg, David L .DeMets: Fundamentals

of Clinical Trials,
4. Marilyn Mulay (2000): A Step-By-Step Guide to Clinical Trials. Jones & Bartlett.
5 Walker Glenn A. (2002): Common Statistical Methods for Clinical Research: With SAS Examples: Sas Inst.
6. Cleophas, Ton J.M. (2006):Statistics Applied to Clinical Trials: Edition: 3rd: Springer Verlag.
7. Shein-Chung Chow, Jen-Pei Liu (2004): Design and Analysis of Clinical Trials: Concepts and Methodologies Wiley Series in Probability and Statistics John Wiley & Sons, Inc.
8. Shein-Chung Chow, Jun Shao, Hansheng Wang.(2003): Sample Size Calculations in Clinical Research. Mercel Dekker, Inc.
9. Anne Whitehead(2003):Meta-Analysis of Controlled Clinical Trials, WILEY.
10. Leandro, Gioacchino (2005):Meta-analysis In Medical Research: The Handbook for the Understanding and Practice of Meta-Analysis:, Blackwell Pub
11. Byron Jones. (2003): Design and Analysis of Cross-Over Trials, Second Edition: CRC PRESS.
12. Patterson, Scott(2005):Bioequivalence And Statistics in Clinical Pharmacology. Chapman & Hall.
13. Dmitrienko, Alex; Molenberghs, Geert; Chuang-Stein, Christy; Offen, Walter. (2005):Analysis of Clinical Trials Using Sas: A Practical Guide:, Sas Inst.
14. Kimko, Hui C (2002):Simulation for Designing Clinical Trials: A Pharmacokinetic-Pharmacodynamic Modeling Perspective. Informa Healthc.
15. Ron Cody (2007): Learning SAS by Example: A Programmer's Guide. SAS Publishing.

Course Code	UNIT	CONTINGENCIES II	Books & Page Numbers
PSSTAE403	I	Multiple Decrements	Gerber 75-82
		Multiple Life Insurance	Gerber 83-92
		The Total Claim Amount in a Portfolio	Gerber 93-102
	II	Expense Loading	Gerber 103-108
		Estimating Probabilities of Death	Gerber 109-118

Reference Books :

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

Recommended Books :

1. Booth, P.M. et al.(1999): Modern actuarial theory and practice, Chapman & Hall, CT-5 Lecture Notes: UK Institute Actuaries Core Reading for Subject CT5 Contingencies.
2. Promislow S. David (2006): Fundamentals of Actuarial Mathematics.
3. Neill Alister: Life Contingencies

Course Code	UNIT	DATA MINING II	Books & Page Numbers
PSSTAF403	**I**	**Classification and Clustering :** **(i)** Challenges, Fraud detection, Distance based Algorithm: K nearest Neighbours and kD-Trees. **(ii) Rules-Based Classifiers:** Rule Sets, Rule Lists, Constructing Rules-based Classifiers: 1R; PRISM; RIPPER. **(iii) Trees Classifiers:** Tree Learning Algorithm, Attribute Splitting Decisions: Random, Purity Count, Entropy (ID3), Information Gain Ratio, Pruning: Pre and Post-Pruning; Chi-square Test; Sub-tree Replacement; Sub-tree Raising, C4.5's error estimation, From Trees to Rules. **(iv) Statistical based classifiers:** Bayesian classification, Document classification, Bayesian Networks. **(v) Regression/model trees:** CHAID (Chi Squared Automatic Interaction Detector). CART (Classification And Regression Tree). **(vi)Clustering:** Distance/Similarity, Partitioning Algorithm: K-Means; K-Medoids,	Dunham 75-116, 125-154. Witten & Eibe 61-68, 136-139, 189- 213, 254- 266, 271- 276. Han & Kamber 285-322, 347-351, 383- 418.

		Partitioning Algorithm for large data set: CLARA; CLARANS, Hierarchical Algorithms: Agglomerative (AGNES); Divisive (DIANA), Density based clustering: DBSCAN.	
	II	**Association Rule Mining and Graph Mining:** **(i) Association Rule Mining (ARM):** Market basket analysis, Buying patterns ,General Issues: Support; Confidence; Lift; Conviction, Frequent Item sets: A Priori Algorithm; Issues with A Priori Algorithm, Data structures: Hash tree and FP tree. **(ii) Graph Mining**: Graphs, Types of Graph Mining, including PageRank, AGM, gSPAN. **(iii) Rough Sets Approach:** Information System, Discerning Objects: Discernibility Matrix, Discernibility Functions, Rough Membership Function. **(iv) Introduction to Support Vectors and Neural Networks:** Linear, Nonlinear separable data, Maximum Margin Hyper plane. **(v) Evaluation:** Confusion Matrix, Costs, Lift Curves, ROC Curves.	Dunham 75-116, 164 -173, 195-218. Witten & Eibe 112- 118, 214-223, 351- 356. Han & Kamber 227-248, 327-342, 535-565.

Reference Books:-

(1) Dunham, Margaret H, Data Mining: Introductory and Advanced Topics, Prentice Hall.

(2) Witten, Ian and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Morgan Kaufmann.

(3) Han and Kamber (2006), Data Mining: Concepts and Techniques, Second Edition, Morgan Kaufmann.

(4) Baeza and Yates, Modern Information Retrieval, Addison Wesley.

(5) Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw – Hill.

(6) Inmon(1993), Building the Data Warehouse, Wiley.

Recommended books:-

(1) Berry, Browne(2006), Lecture Notes in Data Mining, World Scientific.

(2) Berry and Linoff (2004), Data Mining Techniques, Second Edition, Wiley.

(4) Konchady (2006), Text Mining Application Programming, Thomson.

(5) Weiss et al. (2005) , Text Mining: Predictive Methods for Analyzing Unstructured information, Springer.

(6) Webb, Malvern(2002), Statistical pattern Recognition, Wiley & Sons Ltd.

(7) Cios, K.J., Pedrycz, W., Swiniarski, R.W., Kurgan, L.A (1998), Data Mining: A Knowledge Discovery Approach, Springer .

(8) D. J. Hand, Heikki Mannila, Padhraic Smyth(2001), Principles of data mining, The MIT press .

(9) Trevor Hastie, Robert Tibshirani, Jerome H. Friedman(2001), The elements of statistical learning: data mining, inference, and prediction, Springer.

(10) R. Kimpall, The Data Warehouse Toolkit, John Wiley.

(11) E.G. Mallach, Decision Support and Data Warehouse systems", TMH.

Course Code	UNIT	FINANCIAL MATHEMATICS II	Books & Page Numbers
PSSTAG403	I	The valuation of securities, Capital gains tax, Cumulative sinking funds	McCutcheon and Scott 145-229
	II	Yield curves, discounted mean terms, matching and immunization, Consumer credit,an introduction to stochastic interest rate models	McCutcheon and Scott 230-298

Reference Books :

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

2 CT-1 Lecture Notes: UK Institute Actuaries Core Reading for Subject CT1 Contingencies

Course Code	UNIT	STATISTICAL PROCESS CONTROL II	Books & Page Numbers
PSSTAH403	I	Engineering Process Control	Montgomery 546-568
		Process Design and Improvement with Designed Experiments	Montgomery 569-638
	II	Process Optimization with Designed Experiments	Montgomery 639-672
		Robust Deign 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: Sampling Inspection by variables.

2 Burr, I.: Quality Control Methods.

3.Duncan: Quality Control and Industrial Statistics.

4.Grant,E.L. and Leaven Worth: Statistical Quality Control.

5.Johnson and Leone: Statistics and Experimental Design in Engineering and Physical Science.

6.Oakland John, S. & Followel Roy, F.: Statistical Process Control-A Practical Guide.

7.Taguchi, G. : Introduction to Quality Engineering.

Course Code	UNIT	NONPARAMETRIC INFERENCE II	Books & Page Numbers
PSSTAI403	I	Measure of association in Multiple Classification	Gibbons 450-493
		Asymptotic relative efficiency	Gibbons 494-519
	II	Analysis of Count data	Gibbons 520-551
		Regression Problem	Hollander and Wolfe 415-457

Reference Books :

1. Gibbons J.D.(2007): Nonparametric Statistical Inference
2. Hollander Myles(1999): Nonparametric Statistical Methods
3. Wolfe Douglas A.(1999): Nonparametric Statistical Methods

Recommended Books:

1. W.W. Daniel (1990):, Applied Nonparametric Statistics, 2nd ed., Boston: PWS-KENT
2. J.K.Ghosh and R.V. Ramamoorthi (2003):, Bayesian Nonparametric, Springer Verlag, NY .
3. M. Hollandor, and D.A. Wolf(1973): e Non-parametric Statistical Inference. McGraw-Hill.
4. E. L. Lehman(1975), Nonparametric Statistical Methods Based on Ranks, McGraw-Hill.
5. R. H. Randles and D. A. Wolfe,(1979): Introduction to the Theory of Nonparametric Statistics Wiley, New York.
6. P.Sprent(1989): Applied Nonparametric Statistical Methods. Chapman and Hall, London .

Course Code	UNIT	OPERATIONS RESEARCH II	Books & Page Numbers
PSSTAJ403	I	Assignment problem : Formulation of assignment problem and obtaining solution	Winston[1] : sections 7.5 Winston[2]: sections 5.4
		Network models: Shortest path problem, Maximum flow problem, PERT and CPM, Minimum cost network flow problem, Minimum spanning tree problem	Winston[1] : sections 8.2 Winston[2]: sections 5.4
	II	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]
		Simulation: Discrete event simulation, Monte Carlo simulation, Simulation with continuous random variables, Stochastic simulation	Winston[1]

Reference Books:

1. Winston Wayne L, - Operations Research applications and algorithms
2. Winston, Albright, Broadie.Practical Management Science Introduction to Management Science with Spreadsheets – Stevenson, Ozgur
3. F.S. Hillier and M.S. Hillier ,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

Course Code	UNIT	ADVANCED THEORY OF DESIGNS II	Books & Page Numbers
PSSTBA404	I	Experimental Designs for fitting Response Surfaces	Myers & Montgomery 279-400
		Response Surface Methods and Taguchi's Robust Parameter Designs	Myers & Montgomery 460-534
	II	Experiments With Mixtures	Myers & Montgomery 535-623
		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 Bikas K.(1989): Lecture Notes in Statistics. Theory of Optimal Designs.

Recommended Books:

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

Course Code	UNIT	CATEGORICAL DATA ANALYSIS II	Books & Page Numbers
PSSTBB404	I	Multinomial Response Models, Models for Matched Pairs	Alan Agresti 306-375
	II	Analyzing Repeated Categorical Response Data, Asymptotic Theory for Parametric Models, Estimation Theory for Parametric Models	Alan Agresti 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.

Course Code	UNIT	ECONOMETRICS II	Books & Page Numbers
PSSTBC404	I	Regression on Dummy Variables	Gujrati 431-466
		Regression on Dummy Dependent Variable: The LPM, Logit, and Probit Models	Gujrati 467-504
		Autoregressive and Distributed Lag Models	Gujrati 505-554
	II	Simultaneous-Equation Models Endogeneity in Nonparametric Regression Models, Weakly Dependent Data	Gujrati 555-620 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. Brian Snowdon, Howard R. Vane,. *Modern Macroeconomics: Its Origins, Development And Current State*. Edward Elgar Publishing.
2. Bade, Robin; and Michael Parkin. (2001) :*Foundations of Microeconomics.* Addison Wesley Paperback 1st Edition.
3. Eaton, B. Curtis; Eaton, Diane F.; and Douglas W. Allen. : (2002) *Microeconomics*. Prentice Hall, 5th Edition.
4. Amemiya, T. (1985):Advanced Econometrics. Cambridge, MA: Harvard University Press.
5. Berndt, E. R. (1991):The Practice of Econometrics. Reading, MA: Addison-Wesley.
6. Card, D., and A. Krueger. (1995) : Myth and Measurement: The New Economics of the Minimum Wage. Princeton, NJ: Princeton University Press.

7. DeGroot, M. H., and M. J. Schervish. (2002) :Probability and Statistics. 3rd ed. Boston: Addison-Wesley.
8. Goldberger, A. S.(1991):A Course in Econometrics. Cambridge, MA: Harvard University Press.
9. Wooldridge, J. M. (2003): Introductory Econometrics. 2nd ed. Cincinnati, OH: South-Western College. (Wooldridge is the basic text. The material in Goldberger is more advanced and optional. DeGroot and Schervish is a recommended text for statistics review.)

10. Griliches, Z., and Intriligator, M. (1983):Handbook of Econometrics. Vol. 1-3. Amsterdam, Holland; New York, NY: North-Holland,
11. Koopmans, T. C. (1957): Three Essays on the State of Economic Science. New York, NY: McGraw-Hill.
12. Greene, W. H. (2002): Econometric Analysis. 5th ed. Upper Saddle River, NJ: Prentice Hall.
13. White, H. (1984): Asymptotic Theory for Econometricians. Orlando, FL: Academic Press.
14. Wooldridge, J. M. , (2001) :Econometric Analysis of Cross Section and Panel Data. Cambridge, MA: MIT Press.
15. Ruud, P, (2000): An Introduction to Classical Econometric Theory. New York, NY: Oxford University Press.
16. Novice SAS users may find The Little SAS Book helpful.

Course Code	UNIT	FINANCIAL STATISTICAL ECONOMICS II	Books & Page Numbers
PSSTBD404	I	Properties of Stock Options, Trading Strategies involving Options	John C. Hull 205-239
		Binomial Trees, Wiener Procedures and Ito's Lemma	John C. Hull 241-279
	II	The Black-Scholes-Metron Model	John C. Hull 281-310
		Basic Numerical Procedures,Credit Risk	John C. Hull 391-432 481-505
		Martingales and Measures, Interest Rate Derivatives: the standard market models	John C. Hull 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.

Course Code	UNIT	MEASURE THEORY II	Books & Page Numbers
PSSTBE404	I	Extension Of Measures	Halmos 49-72
		Measurable Functions	Doob 53-72 Halmos 73-94
	II	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

Course Code	UNIT	RISK ANALYSIS II	Books & Page Numbers
PSSTBF404	I	Parametric estimation for Non-censored and censored data	Willian & Briggs 11-42
		Cost effective analysis	Willian & Briggs 43-92
	II	Power and Sample Size determination	Willian & Briggs 93-116
		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.

Course Code	UNIT	STATISTICAL DECISION THEORY II	Books & Page Numbers
PSSTBG404	I	Sequential Sampling	DeGroot 267-323
		Optimal Stopping	DeGroot 324-384
	II	Sequential Choice of Experiments	DeGroot 385-439

Reference Books:

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

Recommended Books:

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

Course Code	UNIT	GENETICS II	Books & Page Numbers
PSSTBH404	I	Human Blood Groups	Elandt Johnson 391-415
		Autosomal Linkage in Experimental Populations	Elandt Johnson 421-435
		Statistically Equivalent Models of Inheritance.	Elandt Johnson 439-453
	II	Segregation Ratios in Families. Simple Modes of Inheritance	Elandt-Johnson 458-492
		Path Analysis	B. L. Agarwal 22-42 S. P. Agarwal
		Heritability and Repeatability	B. L. Agarwal 43-83 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. Kempthome, 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 (Springer Verlag)
4. Nagilaki, T. (1992) Introduction to Theoretical Population Genetics (Springer Verlag)
5. Durbin, R., Eddy, S.R., Krogh, A. and Mitchison,G. (1998) Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. (Cambridge Univ. Press)

Course Code	UNIT	STOCHASTIC PROCESSES II	Books & Page Numbers
PSSTBI404	I	Martingales	Durrett 100-120
		Markov Process with continuous State space	Medhi 221-237
	II	Renewal Process- Renewal Process in Continuous Time	Medhi 249-272 Ross 549-569
		Time Series	Medhi 340-347

Reference Books :

1.Medhi J. (1994) : Stochastic Processes Second edition

2.Ross S. M. (1993) : Introduction to Probability Models.

3. Durrett R. (1999) : Essentials of Stochastic Process.

4. Bhatt Narayan C. : Elements of Applied Stochastic Processes

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.

Course Code	UNIT	SURVIVAL ANALYSIS II	Books & Page Numbers
PSSTBJ404	I	Product –Limit estimator	Smith 95-118
		Parametric models under censoring	Smith 119-141
	II	Fitting parametric regression models	Smith 143-165
		Cox Proportional Hazards	Smith 167-186

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.
7. Lawless J.F.(1982) Statistical models and methods for life time data
8. Man N. R., Schlafer R.E. and Singpurwalla N.D.(1974) Methods of Statistical analysis of reliability data.

Two Electives to be selected from group B and each elective will carry two units. Therefore four units for optional paper II(B) PSST 404

PRACTICALS

At the end of Fourth Semester there will be a practical examination based on Theory papers PSST401, PSST402, PSST403 and PSST404.

<table>
<tr><td rowspan="3">PSSTP4A</td><td>BASED ON PSST401</td><td rowspan="3">4</td><td rowspan="6">Total
8
Credits</td></tr>
<tr><td>BASED ON PSST402</td></tr>
<tr><td>BASED ON SAS AND VIVA/JOURNAL</td></tr>
<tr><td rowspan="3">PSSTP4B</td><td>BASED ON THE TWO ELECTIVES CHOSEN FROM GROUP A</td><td rowspan="3">4</td></tr>
<tr><td>BASED ON THE TWO ELECTIVES CHOSEN FROM GROUP B</td></tr>
<tr><td>BASED ON PROJECT</td></tr>
</table>

Contents of PSSTP4A and PSSTP4B to be covered with the help of Statistical Software like SAS, SPSS, MINITAB, ' R' Software etc. As a part of PSST4A students will have to give a test on SAS of 10 marks and viva and journal of 10 marks. As a part of PSSTP4B the students will have to do a project on Data Analysis which will carry 20 marks. Test on SAS will be based on all the syllabus of M. Sc Semester 1,2, 3 and 4.

6 hours practical per week
2 hours software per week
Therefore Practicals + Software = 8 hours per week

Hence 120 Teaching hours + 120 Notional hours
= 240 hours
= 8 credits

Reference Books : **Statistical Software**

1. Carver R.H. & Others Data analysis with SPSS.
2. Cody R.P. & Smith J.H. Applied Statistics and the SAS programming language.
3. Darren Georage and Paul Mallery SPSS for windows.
4. Spencer N.H.(2004) :SAS Programming, the one day course.
5. Practical Statistical for experimental biologists.
6. Random A and Everitt R.S. : A handbook of statistical analysis using
7. Nom o' Rowke, Larry Hatcher, Edward J. Stepansk : A Step by step approach using SAS for univariate and multivariate Statistics (2nd Edition)
8. Nom O' Rourke, Larry Hatcher Edward J. Stepansk. A step by Approach
9. using SAS for univariate and multivariate Statistics-2nd Edition SAS Institution. Inc. Wiley.
10. Donald L. Harmell, James F.Horrell.Data. Statistics and Decision Models with Excel

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)

Case studies :

1. A.C Rosander : Case Studies in Sample Design
2. Business research methods – Zikund
   (http://website, swlearning.com)

3. C. Ralph Buncher 21 and Jia-Yeong Tsay : Statistical in the Pharmaceutical Industry
4. Contempory Marketing research – carl McDaniel, Roges Gates.
   (McDaniel, swcollege.com)

5. Edward J Wegmes g. Smith : Statistical Methods for Cancer Studies
6. Eugene K. Harris and Adelin Albert : Survivorship Analysis for Clinical Studies
7. Marketing research – Zikmund
   (http://website.swlearing.com)

8. Marketing research – Naresh Malhotra
(http://www.prenhall.com /malhotra)

9. http://des.maharashtra.gov.in (government of maharashtra data)

10. Richard G. Cornell :Statistical Methods for Cancer Studies
11. Stanley H. Shapiro and Thomas H.Louis Clinical Trials
12. William J. Kennedy, Jr. and James E. Gentle. Statistical Completing
13. Case Studies in Bayesion Statistics vol. VI
Lecture notes in Bayesion Statistics number 167 (2002)

Constantine, Gatsonis Alicia, Carriquary Andrew, Gelman

14. Wardlow A.C (2005) Practical Statistical for Experimental bilogoists
(2nd Edition)

Total number of Credits for Fourth Semester

Theory 16 + Practicals 8 = 24

Exam Pattern for Semester III & Semester IV

Internal Exam 40 Marks

Semester End Exam 60 Marks of 3 hours duration

There will be 6 Questions . Student will have to attempt 4 Questions with 2 Questions from Question No.1, 2, 3 and 2 Questions from Question no. 4,5,6.

Semester III	Theory	4 x 4=16
	Practicals	8
	Seminar	---
		24 credits
Semester IV	Theory	4 x 4=16
	Practicals	8
	Seminar	----
		24 credits