

UNIVERSITY OF MUMBAI
No.UG / 153 of 2009

CIRCULAR:-

A reference is invited to the Ordinances, Regulations and syllabi relating to the B.Sc. degree course vide this office Circular No.UG/428 of 2003 dated 3rd September, 2003 and the Principals of the affiliated colleges in Science are hereby informed that the recommendation made by the Board of Studies in Statistics at its meeting held on 23rd January, 2009 has been accepted by the Academic Council at its meeting held on 13th February, 2009 vide item No.4.31 and that, in accordance therewith, the syllabus in the subject of Statistics at the S. V. B.Sc. is revised as per Appendix and that the same has been brought into force with effect from the academic year 2009-2010.

MUMBAI-400 032
12th May, 2009

PRIN K VENKATARAMANT
REGISTRAR

To,

The Principals of the affiliated colleges in Science.

A.C./4.31/13.02.2009

No.UG/ 153- A of 2009, MUMBAI-400 032 12th May, 2009

Copy forwarded with compliments for information to: -

1. The Dean, Faculty of 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), Professor -cum Director, Institute of Distance Education, (10 copies) the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar, (PRO) . the Assistant Registrar, Academic Authorities Unit (2 copies)



UNIVERSITY OF MUMBAI



Syllabus
at the S.Y.B.Sc. (Paper I, II & III)
in the Subject of
Statistics

(With effect from the academic year 2009-2010)

**DRAFT OF SYLLABUS
IN STATISTICS**

AT

S.Y.B.Sc.

WITH EFFECT FROM

2009-2010

PROBABILITY AND SAMPLING DISTRIBUTIONS

- Unit 1 Univariate random variables (Discrete and Continuous): 15L
 Moment Generating Function, Cumulant generating Function.
 Their important properties.
 Relationship between moments and cumulants and their Uses.
 Characteristic Function. Its properties (without proof).
 Transformation of random variable.
- Unit 2 Standard Discrete Probability Distributions: 15L
 Uniform Distribution, Bernoulli's Distribution, Binomial Distribution, Poisson Distribution, Geometric Distribution, Negative Binomial Distribution, Hypergeometric distribution. The following aspects to be discussed wherever applicable to the above stated distributions
 Mode; Median; Derivation of M.G.F., C.G.F.; Moments upto second order; Additive property; Recurrence relation of central moments; Skewness and Kurtosis.
 Limiting distribution (without proof) and Fitting of Distribution.
 Truncated Binomial and Truncated Poisson Distribution with suitable illustrations; p.m.f. and mean.
- Unit 3 Bivariate Probability Distributions: 15L
 Discrete Joint Probability mass function, Continuous Joint probability density Function.
 Their properties; Marginal and Conditional Distributions; Independence of Random Variables; Conditional Expectation and variance; Regression function; Coefficient of Correlation; Transformation of random variables and Jacobian of transformation (Simple illustrations).
- Unit 4 Standard Continuous Probability Distributions: 15L
 Rectangular Distribution; Triangular Distribution; Exponential Distribution; Cauchy's Distribution (with single and double parameter); Gamma distribution (with single and double parameter); Beta distribution (Type I and Type II). The following aspects to be discussed wherever applicable to the above stated distributions
 Derivation of M.G.F., C.G.F., Moments up to second order,

Asymptotic property.
Confidence interval for ratio of variances of two Normal populations. Test of significance of equality of variances of two Normal populations.
Interrelationships of F distribution with a) t-distribution b) Chi-Square distribution and c) Normal distribution.

TOPICS FOR PRACTICALS:

1. Distribution of random variables: M.G.F., C.G.F.
2. Standard discrete distributions.
3. Fitting of Standard discrete distributions.
4. Bivariate Probability Distribution
5. Transformation of discrete and continuous variables.
6. Standard continuous distributions
7. Normal Distribution, Central Limit Theorem
8. Chi-square distribution
9. t- distribution
10. F- distribution.

REFERENCE BOOKS

1. Introduction to the theory of statistics: A.M. Mood , F.A. Graybill, D.C. Boyes; Third edition; McGraw-Hill Book Company
2. Introduction to Mathematical Statistics: R.V. Hogg, A.T. Craig; Fourth edition; Collier McMillan Publishers
3. Probability and Statistical Inference: R.V. Hogg, E.A. Tanis; Third edition; McMillan Publishing Company
4. John E. Freund's Mathematical Statistics: I. Miller, M. Miller; Sixth edition; Pearson Education Inc.
5. Introduction to Mathematical Statistics: P.G. Hoel; Fourth edition; John Wiley & Sons Inc.
6. Fundamentals of Mathematical Statistics: S.C. Gupta, V.K. Kapoor; Eighth edition; Sultan Chand & Sons
7. Mathematical Statistics: J.N. Kapur, H.C. Saxena; Fifteenth edition; S. Chand & Company Ltd.
8. Statistical Methods: An Introductory Text: J. Medhi; Second Edition, Wiley Eastern Ltd.
9. An outline of Statistical Theory Vol. 1: A.M. Goon, M.K. Gupta, B. Dasgupta; Third edition; The World Press Pvt. Ltd.

Median, Mode, Additive property, Skewness & Kurtosis (without proof), Limiting distribution, Fitting of Distribution and Interrelation.

Unit 5 Normal distribution:

15L

Derivation of its Median; Mode; M.G.F.; C.G.F.; Moments upto fourth order; Mean Absolute Deviation; Recurrence relation of central moments; skewness & kurtosis; Distribution of linear function of Independent Normal variables.
Fitting of Normal Distribution.
Central Limit Theorem with proof for i.i.d.r.v.s. using M.G.F.
Log Normal distribution: Derivation of mean and variance.

Unit 6 Exact Sampling Distributions:

15L

Chi- Square Distribution: Concept of degrees of freedom; Derivation of Mode; Moments up to second order; Additive Property; Asymptotic Property and Distribution of Sum of Squares of Standard Normal variables .
Sampling Distributions of Sample Mean and Sample Variance and their independence for a sample drawn from Normal population (without proof);
Confidence interval for population variance of Normal population; Test of significance for specified value of variance of Normal population.
Test for Independence of attributes, Test for Goodness of fit using Chi-square distribution. Yates' correction.
t- distribution: Derivation of Mode; Moments up to second order; Distribution of $U/\sqrt{(V/n)}$ where U is a standard Normal variate and V is an independent Chi-square variate with n degrees of freedom; Asymptotic property.
Definition of Student's t-statistic;
Confidence intervals for
i) one Normal population mean
ii) difference between two Normal population means (assuming equal population variances and based on independent samples)
Tests of significance using one or two samples of small size for comparison with given value of:
i) for specified value of One Normal population mean
ii) Difference between two Normal population means
a. With equal variances with independent samples.
b. Based on paired observations.
F- distribution: Derivation of Mode; Moments up to second order; Distribution of reciprocal of F-variate; Distribution of $(U/m)/(V/n)$ where U and V are independent Chi-Square variables with m and n degrees of freedom respectively.

THEORY OF SAMPLING AND DESIGNS OF EXPERIMENTS

UNIT-1 Concepts:

15 L

Population, population unit, sample, sample size, parameter, statistic, estimator, unbiasedness, bias, mean square error (M.S.E.) and standard error.

Census and Sample Surveys:

Steps in conducting sample survey with examples on designing of Questionnaire. Concepts of Sampling and Non-sampling errors. NSSO, CSO and their functions.

Concepts of Probability and Non-Probability Sampling:

Sampling with and without replacement: (WR / WOR)

Drawing Simple random sample by

(a) Lottery Method and

(b) Use of Random numbers

Simple Random sampling:

Simple Random sampling (SRS) for Variables: Estimation of Population Mean and Total. Expectation and Variance of Estimators. Unbiased estimators of Variance of these estimators.[Using SRSWR and SRSWOR]

SRS for Attributes: Estimation of population proportion and Variance of the estimators. Unbiased estimator of Variance of these estimators.[Using SRSWR and SRSWOR]

Estimation of sample size based on desired accuracy in case of variables and attributes.

UNIT-2 Stratified Random Sampling:

15 L

Concepts of Stratified population and Stratified sample.

Estimation of population mean and total based on stratified sample. Expectation and variance of unbiased estimator of population mean and total assuming SRSWOR within strata.

Unbiased estimators of Variances of these estimators.

Proportional allocation; Optimum allocation with and without varying costs. Comparison of simple random sampling and stratified random sampling with proportional and optimum allocation.

Ratio and Regression Estimators under SRSWOR:

15 L

Ratio estimators for population mean, ratio and total. Expectation and M.S.E. of Estimators. Estimators of M.S.E.
Uses of Ratio estimators.

Regression estimation of population mean and total. Expectation. Variance and Minimum Variance.

Uses of Regression estimators.

Comparison of ratio estimator, Regression estimator and Mean per unit estimator.

Introduction only : Systematic sampling, Cluster sampling, Two stage sampling.

Analysis of Variance:

15 L

One way classification with equal and unequal observations per class.

Mathematical Model and its Assumptions. Cochran's theorem (Statement only). Expectation of various sums of squares.

Estimation of parameters by least squares method. Variance of the estimators. Estimation of treatment contrast and confidence limits for the elementary treatment contrasts.

Two way classification (with one observation per cell)

Mathematical Model and its Assumptions. Expectation of various sums of squares. Estimation of parameters by least squares method. Variance of the estimators. Estimation of treatment contrast and confidence limits for the elementary treatment contrasts.

Design of Experiments:

15 L

Concepts of Experiments, Experimental unit, Treatment, Replicate, Block, Experimental error and Precision.

Principles of design of experiment: Replication, Randomization and Local Control.

Efficiency of a design D_1 with respect to design D_2 .

Choice of size, shape of plots and block in different agriculture and non-agriculture experiment.

Standard Designs of Experiments:

Completely randomized design (CRD) and Randomized block design (RBD), Mathematical Model and its Assumptions.

Expectation of various sums of squares. Estimation of parameters by least squares method. Standard errors of treatment differences. Comparison of their efficiencies.

Latin square design. Mathematical Model and its Assumptions. Expectation of various sums of squares. Estimation of parameters by least squares method. Standard errors of treatment differences. Comparison of the efficiency with CRD and RBD.

15 L

Missing Plot Technique for one missing observation in case of CRD and RBD.

Factorial Experiments: Purpose and advantage.

2^2 , 2^3 experiments, Calculation of main effects and interactions.
Yates method. Analysis of data from 2^2 , 2^3 factorial experiments

TOPICS OF PRACTICALS

1. Designing of Questionnaire and conduct of sample survey.
2. Simple random sampling for variables.
3. Simple random sampling for attributes.
4. Estimation of sample size in case of simple random sampling.
5. Stratified Random Sampling.
6. Ratio and Regression methods of Estimations.
7. One way and two way classification models of ANOVA.
8. CRD, RBD
9. LSD
10. Missing plot technique (one observation).
11. Factorial experiments.

Reference Books:

1. W. G. Cochran, Sampling Techniques, 3rd Edition., Wiley (1978).
2. M. N. Murthy, Sampling Theory and Methods, Statistical Publishing Society (1967).
3. Des Raj, Sampling Theory, McGraw-Hill Series in Probability and Statistics (1968).
4. P. V. Sukhatme and B. V. Sukhatme, Sampling Theory of Surveys with Applications, 3rd Edition, Iowa State University Press (1984).
5. S. C. Gupta and V. K. Kapoor, Fundamentals of Applied Statistics, 3rd Edition, Sultan Chand and Sons (2001)
6. M. N. Das and N. C. Giri, Design and Analysis of Experiments, 2nd Edition, New Age International (P) Limited, Publishers (1986).
7. D. C. Montgomery, Designs and Analysis of Experiments, 6th Edition, Wiley (2004).
8. N. K. Malhotra, Marketing Research, 5th Edition, Prentice Hall of India Pvt. Ltd., (2007).

OPERATIONS RESEARCH

AND

INDUSTRIAL STATISTICS

- UNIT-1 Assignment problem: 15 L
Concept. Solution by Complete Enumeration Method and Hungarian Method. Adjustments when problem is of Maximization type, Unbalanced type.
Traveling salesman Problem
Sequencing:
Processing n Jobs through 2 and 3 Machines and 2 jobs through m Machines.
- UNIT-2 Transportation problem: 15 L
Concept, Mathematical Formulation. Concepts of Solution, Feasible Solution. Initial Basic Feasible Solution by North-West Corner rule, Matrix Minima Method, Vogel's Approximation Method. Optimal Solution by MODI Method : (Optimality Test, Improvement Procedure.)
Adjustments when problem is of Maximization type, Unbalanced type.
- UNIT-3 Linear Programming Problem (L.P.P.): 15 L
Mathematical Formulation:-Maximisation and Minimisation, Concepts of Solution, Feasible Solution, Basic Feasible Solution, Optimal Solution.
Graphical Solution for Problem with two variables.
Simplex method of solving L.P.P.
Big M Method. Concept of Duality. Its use in solving LPP.
Relationship between optimum solutions to Primal and Dual;
Economic Interpretation of Dual.
- UNIT-4 CPM and PERT: 15 L
Objective and Outline of the techniques. [CONCEPT OF A PROJECT AS AN ORGANIZED EFFORT].
Diagrammatic representation of activities in a project : Bar Diagram and Network Diagram.
Slack time and Float times. Determination of Critical path.
Probability consideration in project scheduling.
Project cost analysis.

Control Charts :

15 L

Principles of control. Process quality control of attributes and variables $\bar{X}$, R, p, c, np charts, their uses.
p charts with variable sample size is also expected.
Problems involving setting up standards for future use are expected.

Acceptance Sampling :

15 L

Lot Acceptance Sampling Plans by Attributes.
Single Sampling plan, OC function and OC curve. AQL, LTPD, ASN, ATI, AOQ, Consumer's risk, Producer's risk.
Double Sampling Plan, OC function and OC curve.
Introduction to Six sigma limits.

TOPICS FOR PRACTICALS

1. Assignment Problem.
2. Transportation Problem.
3. L.P.P. : Formulation of Mathematical Model and Graphical Method.
4. L.P.P. : Simplex Method, Duality.
5. Sequencing Problem
6. CPM-PERT : Construction of Network based on events and activity relationship.
7. CPM-PERT: Finding Critical Path. Computation of Probability of Projects completion.
8. CPM-PERT : Cost -- Time Analysis.
9. Control Charts.
10. Acceptance Sampling Plan.

Reference Books :

1. Statistical Quality Control : E.L.Grant . Second Edition, Mcgraw Hill , 1988
2. Quality Control and Industrial Statistics : Duncan , D.B.Taraporwala Sons & Co., Third Edition.
3. Quality Control : Theory and Applications : Bertrand Hamen.
4. PERT and CPM, Principles and Applications : Srinath, Second Edition, East-west Press Pvt. Ltd.
5. Operations Research : Kantiswaroop, P.K.Gupta and Manmohan, Fourth Edition, Sultan Chand & Sons
6. Operations Research : Methods and Problems : Sasieni, Yaspan and Friedman, Wiley Eastern Ltd.
7. Mathematical Method in O.R. : H.M.Wagner, John Wiley & sons.
8. Operations Research : S.D.Sharma, Eleventh Edition, Kedar Nath Ram Nath & co.
9. Operations Research : H.A.Taha, Sixth Edition, Prentice Hall of India.

10. Operations Research Techniques : B.Banerjee, Second Edition, Mumbai Business Books
11. Operations Research : G.V. Shenoy, Second Edition, Wiley Eastern Ltd.
12. Operations Research : Philipos, John Wiley & sons, 1976.
13. Operations Research : N.P.Loomba
14. Schaum Series book in Operations Research : Richard Broson, Second Edition, Tata McGraw-Hill Publishing Co.Ltd.
15. Quality Control : L.V. Burr, Mardekkar New York , 1976.