

Sri Dev Suman Uttarakhand University
Badshahithaul, Tehri Garhwal
M.A./ M.Sc. Statistics Syllabus-2018

Courses in the M.A./M.Sc. Programme at a Glance

First Semester

Course Code	Title of the Paper
STAT/C-101	Mathematical Analysis
STAT/C-102	Linear Algebra
STAT/C-103	Probability Theory
STAT/C-104	Statistical Inference and Non-Parametric Tests
STAT/P-105	Practical/ Statistical Laboratory

Second Semester

Course Code	Title of the Paper
STAT/C-201	Survey Sampling
STAT/C-202	Linear Models and Regression
STAT/C-203	Design of Experiments
STAT/C-204	Distribution Theory
STAT/P-205	Practical/ Statistical Laboratory

Third Semester

Course Code	Title of the Paper
STAT/C-301	Statistical Processes
STAT/C-302	Multivariate Analysis
STAT/C-303	Advanced Operations Research
STAT/E-304	Choose any One out of the Paper No. STAT/E-304.1 and STAT/E-304.2
STAT/E-304.1	Computational Statistics
STAT/E-304.1	Reliability Theory & Maintenance
STAT/P-305	Practical/ Statistical Laboratory

Fourth Semester

Course Code	Title of the Paper
STAT/C-401	Research Methodology
STAT/C-402	Applied Statistics
STAT/C-403	Official Statistics
STAT/E-404	Choose any One out of the Paper No. STAT/E-404.1 and STAT/E-404.2
STAT/E-404.1	Econometrics
STAT/E-404.2	Project Work & Viva Voce
STAT/P-405	Practical/ Statistical Laboratory

M.A./ M.Sc. I Semester

Course Code: STAT/C-101

Title: Mathematical Analysis

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Real Analysis: Continuity and discontinuity of functions, Differentiability, Roll's theorem, Mean Value theorem, Non differentiable functions, Riemann integration, Fundamental theorem of integral calculus, convergence of integrals and uniform convergence.

Complex Analysis: Analytic functions, Conformal representation, complex integration, Cauchy's Theorem, Morea's Theorem, Taylor's and Laurentts Series, Zero's and Poles of Functions, theory of Residues and Its application to Contour integration.

Fourier series and elementary properties.

Books Recommended

1. H. Anton, I. Birens and S. Davis: Calculus, John Wiley and Sons, Inc.
2. G.B. Thomas and R.L. Finney: Calculus, Pearson Education
3. W. Rudin: Principle of Mathematical Analysis
4. Royden: Mathematical Analysis
5. James Ward Brown and Ruel V. Churchn: Complex Variables and Applications, 8th Ed. McGraw Hill International Edition 2009

Course Code: STAT/C-102

Title: Linear Algebra

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Vector Spaces, subspaces, linear dependence and independence, basis and dimension of vector space, finite dimensional vector spaces. Example of vector spaces over real and complex variables.

Vector spaces with an inner product, Gram-Schmidt orthogonalization process, orthonormal projection of a vector

Linear transformations, algebra of matrices, row and column spaces of a matrix, elementary matrices, determinant, rank and inverse of a matrix, partitioned matrices.

Canonical form, Hermite canonical form, diagonal form, triangular form, Jordan form, quadratic form, generalized inverse, Moore-Penrose generalized inverse, idempotent matrices.

Characteristic roots and vectors, algebraic multiplicity of a characteristic roots, Cayley-Hamilton theorem, spectral decomposition of a real symmetric matrix.

Books Recommended

1. Shanti Narayan: A Text Book on matrices, S. Chan & Co.
2. Perlis : Theory of Matrices, Addison - Wesley
3. Gray bill: Introduction to linear statistical models. Vol. I, McGraw Hill
4. Gilbert Strang: Linear Algebra and its Applications, Thomson, 2007

Course Code: STAT/C-103

Title: Probability Theory

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Probability Spaces, random variables, Schwartz Inequality, Jensen Inequality, Markov Inequality and Tchebyshev's Inequality.

Classes of sets, field, sigma fields, minimal sigma fields, Borel sigma fields. Measure, Probability measure, properties of measure, Lebesgue-Steljes measures, measurable functions.

Law of large numbers: Weak law of large numbers, Strong law of large numbers for i.i.d. sequence, strong law of large numbers, Kolmogorov's strong law of large numbers, Borel –Cantelli Lemma, Kolmogorov 0-1 law.

Convergence in probability (distribution and in mean). Central limit theorem for a sequence of independent random variables under Lindberg's condition, Liapounov's CLT (only statement).

Books Recommended

1. Goon, Gupta and Dasgupta: An outline of Statistical theory Vol. 1, World Press Calcutta.
2. Cramer, H: Mathematical methods of statistics, Asia pub. House, Bombay
3. Gnedenko B.V.: Theory of probability, Chariles
4. Parzen E.: Modern Probability Theory and Applications, John Wiley
5. Mood. A.M & Graybill: Mathematical Statistics

Course Code: STAT/C-104

Title: Statistical Inference and Non-Parametric Tests

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Problem of point estimation: Unbiasedness, Consistency, Sufficiency, Efficiency, Factorization theorem, minimal sufficient statistics.

Methods of estimations: maximum likelihood method, method of moments, minimum chi-square method, Minimum variance unbiased estimators, Cramer-Rao lower bound approach.

Interval estimation: Confidence Interval, Confidence Regions, best confidence intervals, shortest confidence intervals, General method of finding confidence interval. Method of obtaining confidence intervals based on small and large samples. Relationship with the testing of hypothesis.

One sample and two sample U statistics, Rank test, sign test, signed rank test, Kolmogorov- Smirnov tests. Wilcoxon- Mann Whitney test, Kruskal- Wallis k sample tests.

Books Recommended

1. Wald. A.: Sequential analysis, John Wiley
2. Mood, Urayabill and Boes: introduction of the Theory of Statistics, McGraw Hill
3. Wilks, S.S: Mathematical Statistics, John Wiley
4. Kendall & Stuart: Advanced Theory of Statistics Vol. II
5. Goon, Gupta & Das Gupta: An outline Statistical Theory Vol.II

Course Code: STAT/P-105

Title: Practical/ Statistical Laboratory

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment : 20

Practical based on papers 102 and 103.

Practical will be of 100 marks out of which 80 marks will be written practical exam and 20 marks will be assigned each on practical annual record and viva-voce.

M.A./ M.Sc. II Semester

Course Code: STAT/C-201

Title: Survey Sampling

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Basic Principles: Census and sample surveys, advantages and disadvantages of sample surveys. Basic principles in sampling, survey enquiries, choice of sampling units, problems of sample size, Bias in selection and estimation, simple random sampling, sampling from finite populations with and without replacement, sampling of attributes, unbiased estimates of population total, mean and estimation of their variances.

Stratified Sampling: Reason for stratification, choice of strata, choice of sampling unit, stratified random sampling, estimation of population mean and its variance, choice of

sample sizes in different strata, variances of estimates with different allocation, effects of deviation from optimum allocation, estimation of the gain in precision due to stratification, cost function, construction of strata.

Systematic Sampling: Estimation of sample mean and its variance, comparison of systematic sampling with simple random and stratified sampling.

Two stage sampling: Estimation and sampling variance. Double sampling, multistage sampling, cluster sampling.

PPS Sampling schemes, sampling techniques with varying probabilities for simple random sampling. Horvitz Thompson Estimators, Mid Zuno Sen Sampling Scheme.

Books Recommended

1. Cochran. W. G.: Sampling Techniques, J. Wiley & Sons.
2. Leslie Kish: Survey Sampling, J. Wiley & Sons.
3. S. Sampath: Sampling Theory & Methods, CRC Press
4. Desraj: Sampling Theory, McGraw Hill
5. S.C. Gupta & V.K. Kapoor; Fundamental of Applied Statistics, Sultan Chand and Sons

Course Code: STAT/C-202

Title: Linear Models and Regression

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Standard Gauss-Markov models: Estimability of parameters, Best linear unbiased estimator (BLUE), method of least square and Gauss- Markov theorem, Variance and Covariance of BLUE.

Maximum likelihood, MINQUE and restricted maximum likelihood estimators of variance components, best linear unbiased predictors (BLUP).

Bi-variate and multiple linear regression, polynomial regression, use of orthogonal polynomial. Linear and non-linear regression models.

Books Recommended

1. Rao, C.R. and Kleffe, J.(1988): Estimation of Variance Component and Applications, North Holland
2. Chatterjee, S. and Prince, B.(1991): Regression Analysis by Example, John Wiley, New York.
3. Draper, N.R. and Smith H.(1998): Applied Regression Analysis 3rd Ed. Wiley
4. Cook, R.D. and Weisberg, S.(1982): Residuals and Inference in Regression, Chapman and Hall.

Course Code: STAT/C-203

Title: Design of Experiments

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Analysis of Variance for one-way, two-way with one/m observation per cell for fixed, mixed and random effects models. General theory of analysis of experimental designs; Completely randomized design, Randomized block design and Latin square design, Missing plot techniques in RBD and LSD.

General factorial experiment, main effects and interaction effects. 2^2 , 2^3 and 2^n factorial experiments. Analysis of above designs in randomized blocks.

Analysis of covariance, Confounding experiments: complete, partial and balanced confounding. Split and strip plot designs.

Balanced Incomplete block designs and its properties, Balanced Incomplete Block Design with and without recovery of inter information.

Books Recommended

1. Kempthorne, O: The Designs and Analysis of Experiments.
2. Raghav Rao. O.: Mathematics of Design of Experiments, J. Wiley
3. D.C. Montgomery: Designs and Analysis of Experiments, J. Wiley, New York, 2001
4. S.C. Gupta, V.K. Kapoor; Fundamental of Applied Statistics, Sultan Chand and Sons
5. Cochran. W.G: Experiment designs, J. Wiley

Course Code: STAT/C-204

Title: Distribution Theory

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Brief view of basic distribution theory, joint, marginal and conditional probability mass function (pmf) and probability density function (pdf), discrete and continuous distributions.

Probability distribution of random variables, properties of distribution functions, characteristics functions and its properties, Inversion theorem and Uniqueness theorem.

Univariate Discrete distributions; properties and applications of Uniform Discrete, Binomial, Poisson, Hypergeometric, Geometric, Negative Binomial distribution and Multinomial distribution.

Univariate continuous Distribution; statement, derivation, properties and applications of Normal, Beta, Gamma, Cauchy, Exponential distribution

Sampling distribution from Binomial, Poisson, Exponential and Normal populations, Bivariate distributions; bivariate normal. Distribution of functions of random variables.

Books Recommended

1. Goon. Gupta and Dasgupta: An Outline of Statistical theory, Vol. 1, World Press Calcutta.

2. Cramer, H: Mathematical Methods of Statistics, Asia pub. House, Bombay
3. Parzen E.: Modern Probability Theory and Applications, John Wiley
4. Mood. A.M & Graybill: Mathematical Statistics
5. Kendall, M.G. & Stuart: Advanced Theory of Statistics Vol. I, Charles Griffin.

Course Code: STAT/P-205

Title: Practical/ Statistical Laboratory

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment : 20

Practical based on papers 203 and 204.

Practical will be of 100 marks out of which 80 marks will be written practical exam and 20 marks will be assigned each on practical annual record and viva-voce.

M.A./ M.Sc. III Semester

Course Code: STAT/C-301

Title: Statistical Processes

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Basic concept of process monitoring and control, process capability and process optimization.

General theory and review of control charts for attribute and variable data; O.C. and A.R.L. of control charts; Moving average and exponentially weighted moving average charts, Economic design of X-bar chart.

Acceptance sampling plans for attribute inspection; single, double and sequential sampling plans and their properties; Plans for inspection by variables for one-sided and two-sided specifications, continuous sampling plans of Dodge type and Wald-Wolfowitz type and their properties. Bayesian sampling plans.

Capability indices C_p , C_{pk} and C_{pm} ; estimation, confidence intervals and tests of hypotheses relating to capability indices for Normally distributed characteristics.

Use of Design of Experiments in SPC; factorial experiments, fractional factorial designs, construction of such designs and analysis of data.

Books Recommended

1. D.C. Montgomery: Designs and Analysis of Experiments, John Wiley and Sons, New York, 2001
2. S.C. Gupta, V.K. Kapoor; Fundamental of Applied Statistics, Sultan Chand and Sons
3. M.N. Das and N.C. Giri: Design and Analysis of Experiment, Wiley Eastern Limited, New Delhi
4. Angela Dean, Daniel Voss & Danel Draguljic: Design and Analysis of Experiments, Springer

Course Code: STAT/C-302

Title: Multivariate Analysis

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Singular and non-singular multivariate distributions, multivariate normal distribution, Marginal and Conditional distributions, characteristic functions, Maximum likelihood estimators of parameters of multivariate normal distributions. Distribution of linear and quadratic forms.

Wishart matrix- its distribution and properties, distribution of sample generalized variance, null and non-null distribution of multiple correlation coefficient.

Hotelling's T^2 and its sampling distribution, application in test on mean vector for one and more multivariate normal population.

Mahalanobish D^2 Statistics and its application, Principal component. Nad Dimension reduction.

Books Recommended

1. Sharma, S.: Applied Multivariate Techniques, Wiley
2. Kendall and Stuart: Advance Theory of Statistics Vol. I& II.
3. Anderson. T. W.: An Introduction to Multivariate Statistical Analysis 2nd Edition, John Wiley
4. Alvin C. Rencher: Methods of Mutivariate Analysis, 2nd Edition, J. Wiley

Course Code: STAT/C-303

Title: Advanced Operations Research

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Linear programming problem: feasible, basic feasible and optimal solution. Examples of LPP, solution of LPP using graphical method.

Transportation and assignment problem (both balanced and unbalanced case).

Basic characteristics of queuing system, different performance measures, steady state, solution of Markov queuing models: $m/m/1$, $m/m/1$ with limited waiting space, $m/m/c$, $m/m/c$ with limited waiting space

Inventory problems and analytical structure. Simple deterministic and stochastic models of inventory controls. Replacement problems: block and age replacement policies, dynamic programming approach for maintenance problems, PERT and CPM, Sequencing and scheduling problems.

Books Recommended

1. Churchman, C.W. Acoff and Anoff: Introduction to Operations Research, Wiley.
2. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 8th Edition, 2007
3. Gass. S.I.: Linear Programming. Methods and applications, Mc.Graw Hill
4. Hadley, G.: Linear Programming, Wesisey.
5. Satty, T. L: Mathematical Methods of Operations Research, Mc.Graw Hill

Course Code: STAT/E-304

E-304 (Choose one)

1. **Computational Statistics**
2. **Reliability**

Course Code: STAT/E-304.1

Title: Computational Statistics

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Windows: Use of windows, its operations and applications.

MS Word: operations of MS Word and applications.

MS excel: Use of MS excel, its operations, solution of statistical problems using MS excel.

MATLAB/MINITAB: Use of MATLAB/MINITAB, computation of statistical problem using MATLAB/MINITAB.

SPSS: uses of SPSS, computation of statistical problems using SPSS.

Books Recommended

1. B. Ryan and B.L. Joiner (2001): Minitab handbook, 4th Edition, Duxbury
2. R.A. Thisted (1988): Elements of statistical computing, Chapman and hall
3. S. Jain: MS-Office 2007 Training Guide, BPB Publication
4. Pradeep Sinha and Priti Sinha: Computer Fundamentals 6th Edition, Bpb Publications

Course Code: STAT/E-304.2

Title: Reliability Theory & Maintenance

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Reliability concepts and measures, components and systems; coherent systems, Reliability of coherent system.

Classes of life distribution, Series, parallel, standby configurations, Bridge structure, R00eliability models of maintained & non-maintained systems. Availability theory for various configurations.

Renewal theory and its applications to one unit repairable systems with simple different maintenance policies (Age, Block , Preventive & Corrective), Minimal repair replacement policies, ordering policies, notions of ageing.

Optimization problem with respect to system reliability, Overhaul and repair decisions, reliability allocations problems.

. Books Recommended

1. P.K. Kapur, R.B. Garg, S. Kumar: Contributions to Hardware and Software Reliability, World Scientific, Singapore
2. Riccardo Manzini, Alberto Regattieri, Hoang Pham, Emilio Ferrai: Maintenance for Industrial Systems, Springer-Verlag, London Limited
3. Zacks, S.: Reliability Theory, Springer.
4. Barlow, R.E. and Proschan, F(1985): Statistical Theory of Reliability and Life Testing; Holt, Rinehart and Winston.
5. Nelson, W. (1982): Applied life Data Analysis; John Wiley.

Course Code: STAT/P-305

Title: Practical/ Statistical Laboratory

Maximum Marks :100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment : 20

Practical based on papers 301 and 303.

Practical will be of 100 marks out of which 80 marks will be written practical exam and 20 marks will be assigned each on practical annual record and viva-voce.

M.A./ M.Sc. IV Semester

Course Code: STAT/C-401

Title: Research Methodology

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Meaning of Research ,Objective of Research , Approach to research , significance of research , type of research , research in Social Sciences , facts, theories and concepts in Social Science research , research design , features of a good research design.

Research problem , Identifying the research problem, formulation of research problem concept of hypothesis , role and formulation of hypothesis , scientific method of research – nature of scientific research – stages of scientific method.

Logic and scientific method , Deductive and inductive methods , the Case study method, merits and demerits of Case study methods , survey methods , merits and demerits of survey methods , types of survey ,selecting the survey method ,sample surveys , different types , merits and demerits.

Schedule and questionnaire, Principle underlying the construction of questionnaire measurement and scaling techniques, processing and analysis of data.

Interpretation and report writing, bibliography, quality of a good research report.

Books Recommended

1. Kothari, C.R. (1985): Research Methodology: Methods and Techniques, Wiley Eastern
2. Mishra, R.P. (1980): Research Methodology, Handbook Concept Publishing Company, New Delhi
3. Ranjit Kumar: Research Methodology: A Step by Step Guide for Beginners, SAGE Publication Ltd.
4. Paul D. Leedy: Practical Research: Planning and Design, Pearson 2013

Course Code: STAT/C-402

Title: Applied Statistics

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Time Series Analysis: Objects, Decomposition, Tests of Randomness, Trend component, polynomial, logistic, Log-normal trend functions, Moving average, Spencer's formulae and effects, Variate difference method, Measurement of seasonal and cyclic functions, Periodogram and Harmonic analysis, Autocorrelation and Correlogram analysis.

Demand Analysis: Distribution of Income, Income and Demand elasticities. Methods for estimating elasticities using family budget data and time series data, Engel's Curve and Engel's law, Pareto's law.

Demography: Source of Demographic data, Limitations and uses of demographic data, vital rates and ratios, Definition, construction and uses, life tables, complete and abridged construction of life table from vital statistics, uses of life tables. Logistic and other population growth curves. Measure of fertility: Gross and Net reproduction rates, stationary and stable population theory.

Books Recommended

1. Powker A. II. & Goode: Sampling Instruction Variables, Mc Graw Hill
2. Lodge, II. F & Romming: Sampling Inspection Plans and Tables, John Wiley

3. Kendall, M.G. & Stuart A.: Advanced Theory of Statistics. Vol. III, Charies Griffin
4. S.C. Srivastava: Studies in Demography, Anmol Publication Pvt Ltd.
5. S.C. Gupta & V.K. Kapoor: Fundamental of Applied Statistics, S. Chand & Sons

Course Code: STAT/C-403

Title: Official Statistics

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Introduction to Indian and International Statistical systems. Present Official Statistical System in India, role, functions and activates of central and state organization. Organization of large scale sample surveys methods of collection of official statistics, Role of National Sample Survey Organization.

General and special data dissemination systems, population growth in developed and developing countries. Evaluation of performance of family welfare programs projection of labor force and manpower. Scope and content of population of census of India.

Statistics related to industries, balance of payment, cost of living, educational and other Social Statistics.

Books Recommended

1. Basic Statistics relating Indian Economy (CSO). 1990
2. Statistical System in India (CSO), 1975
3. Guide to Official Statistics (CSO), 1999
4. Principles and accommodation of National Populations Census. UNESCO

Course Code: STAT/E-404

E- 404 (Choose one)

1. **Econometrics**
2. **Project Work & Viva-Voce**

Course Code: STAT/E-404.1

Title: Econometrics

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

Nature of econometrics: the general model (GLM) and its existence. Ordinary least square (OLS) estimation and prediction. Use of dummy variables. Generalized least square (GLS) estimation and prediction.

Estimation: Methods of estimation – two stage, three stage, least squares, k – class estimates with properties. Bias and Moments Matrix. Maximum likelihood estimators, full information and limited information, Monte Carlo studies.

Models and Identification: Meaning of Econometrics, formulation of economic phenomena with specification analysis, Problems involved in construction of Econometric models. Endogenous and exogenous variables. Concept of Multicollinearity. Identification everywhere in the parametric space, Ward's criteria of identification.

Books Recommended

1. J. Johnson: Econometric Methods, McGraw Hill
2. Apte, P.G.: Text Book of Econometrics, McGraw Hill
3. Christopher Dougherty: Introduction to Econometrics, 3rd Ed., Oxford University Press, 2007.
4. D.N. Gujarati and D.C. Porter: Essentials of Econometrics, 4th Ed., McGraw Hill, International Edition 2009.

Course Code: STAT/E-404.2

Title: Project Work & Viva-Voce

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment 20

The Project Work will spread over the whole semester. A project may be undertaken by a group of students. However, the project report shall be submitted by each member of the group separately. A project report shall clearly state the problem addressed, the methodology adopted, the assumption and the hypotheses formulated, any previous reference to the study undertaken, statistical analyses performed and the broad conclusion drawn. There shall be an external examiner and an internal examiner (preferably the supervisor of the student) for the evaluation of the project work. Out of the total 100 marks assigned to the project, 80 marks will be assigned on the evaluation of the project work separately by both the examiner and 20 marks will be assigned jointly by the examiners on the oral presentation and viva-voce.

Course Code: STAT/P-405

Title: Practical/ Statistical Laboratory

Maximum Marks: 100

(a) Semester Examination: 80

(b) Sessional /Internal Assessment : 20

Practical based on papers 402 and 404.

Practical will be of 100 marks out of which 80 marks will be written practical exam and 20 marks will be assigned each on practical annual record and viva-voce.