UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

M.A./M.Sc. STATISTICS

(ANNUAL SCHEME)

M.A./M.Sc. (Previous) Examination 2020
M.A./M.Sc. (Final) Examination 2021
SCHEME OF EXAMINATION
(Annual Scheme)
3 Hrs. duration

<table>
<thead>
<tr>
<th>Paper Number</th>
<th>Nomenclature</th>
<th>Max. Marks</th>
<th>Duration of Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper I</td>
<td>Mathematical Analysis</td>
<td>100</td>
<td>3 Hours</td>
</tr>
<tr>
<td>Paper II</td>
<td>Probability and Measure Theory</td>
<td>50</td>
<td>3 Hours</td>
</tr>
<tr>
<td>Paper III</td>
<td>Distribution Theory</td>
<td>100</td>
<td>3 Hours</td>
</tr>
<tr>
<td>Paper IV</td>
<td>Sample Surveys &amp; Design of Experiment</td>
<td>100</td>
<td>3 Hours</td>
</tr>
<tr>
<td>Paper V</td>
<td>Statistical Inference</td>
<td>100</td>
<td>3 Hours</td>
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<tr>
<td>Paper VI</td>
<td>Computer Programming</td>
<td>100</td>
<td>3 Hours</td>
</tr>
<tr>
<td>Paper VII A</td>
<td>Practical based on paper V and VI</td>
<td>50</td>
<td>3 Hours</td>
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<tr>
<td>Paper VII B</td>
<td>Practical based on Paper V and VI</td>
<td>100</td>
<td>4 Hours</td>
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</tbody>
</table>

Total: 700

100 Marks

All the rest will be declared to have passed the examination.

The Thesis, Dissertation, Survey Report Field Work shall be typed and submitted in triplicate so as to reach the office of the Registrar at least 3 weeks before the commencement of the theory examinations. Only such candidates shall be permitted to offer Dissertation/Field Work/Survey Report Thesis (if provided in the scheme of examination) in lieu of a paper as have secured at least 50% marks in the aggregate of all the papers prescribed for the previous examination in the case of annual scheme irrespective of the number of papers in which a candidate actually appeared at examination.

M.A./M.Sc. STATISTICS

Previous

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**M.A. M.Sc. STATISTICS**

**Final**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Marks</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Compulsory Papers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multivariate Analysis and Statistical Inference</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>Advanced Design of Experiments and Sample Theory</td>
<td></td>
<td>3</td>
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<tr>
<td></td>
<td>Q.C. and O.R.</td>
<td>100</td>
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<tr>
<td>V</td>
<td>Practical based on Paper IX</td>
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<td>3</td>
</tr>
<tr>
<td></td>
<td>Paper VIII &amp; X</td>
<td>100</td>
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<tr>
<td></td>
<td><strong>OPTIONAL PAPERS</strong></td>
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<tr>
<td>XIII</td>
<td>Economic Statistics and Demography</td>
<td></td>
<td>3</td>
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<tr>
<td>XIV</td>
<td>Stochastic Process</td>
<td>100</td>
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<tr>
<td>XV</td>
<td>Reliability and Survival Analysis</td>
<td>100</td>
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<tr>
<td>XVI</td>
<td>Advance Multivariate Analysis and Bayesian Inference</td>
<td>100</td>
<td>3</td>
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<tr>
<td>XVII</td>
<td>Econometrics &amp; Investment System</td>
<td></td>
<td>3</td>
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<tr>
<td>XVIII</td>
<td>Project Work</td>
<td>100</td>
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</tr>
</tbody>
</table>

Notes:
1. The project work shall be based on either primary data involving field work or secondary data. The candidates will be required to prepare comprehensive and critical reports on the same.
2. The teacher supervising the Project work/Dissertation of a candidate shall be provided one hour per week towards his/her supervision.
3. In all theory papers of M.A./M.Sc. (Previous and Final) Statistics except Paper XIV the candidates will be required to answer five questions in all taking at least two questions from each section.

Dy. Registrar
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Syllabus
M.Sc. (Previous):
PAPER I
(MATHEMATICAL ANALYSIS)
SECTION A
(UNIT-I)
Real Analysis: Real Valued Function, Continuous Function, Uniform Continuity, Sequences of Functions, Uniform Convergence


(24L+12T)

(UNIT-II)

SECTION-B
(UNIT-I)

(24L+12T)

(UNIT-II)

(24L+12T)

References:
Paper II

Probability and Measure Theory

SECTION-A

(Unit-I)

General probability space, various definitions of probability, axiomatic definition of probability, combinations of events, laws of total and compound probability, Conditional probability, Baye’s theorem and its applications, concept of random variables, cumulative distribution function and probability density function, joint, marginal and conditional distribution.

(24L+12T)

(Unit-II)

Mathematical Expectation, moments, conditional expectation, moment generating functions, cumulative generating functions and their applications, Characteristic function, uniqueness theorem, Levy’s continuity theorem (statement only), Probability inequalities: Chebyshev, Markov and Johnson, Convergence in probability and in distribution, weak law of large numbers and central limit theorem for a sequence of independent random variable under Landenberg’s condition, central limit theorem for identical independent and identically distributed random variables: Zero one laws of Borel and Kolmogorov, almost sure convergence in mean square, Khinchin’s weak law of large numbers, Kolmogorov inequality, strong law of large numbers.

(24L+12T)

SECTION-B

(Unit-I)

Classes of sets: semi ring, ring, field, sigma field, monotone classes. Sequence of sets, limit supremum and limit infimum of a sequence of sets. Additive set functions, measure, outer measure and their properties. Carathéodory extension theorem (Statement only), definition of complete measure. Lebesgue and Lebesgue-Stieltjes measure (one dimension only). Probability measure, distribution function and its correspondence with lebesgue Stieltjes.

(24L+12T)

(Unit-II)

Measurable sets and space, measurable space. Simple, elementary and measurable functions. Sequence of measurable functions. Integrability of measurable function, properties of integrals Lebesgue monotone convergence theorems, Fatou’s lemma, dominant convergence theorem, Absolute continuity. Random Nondyn theorem, product measure, fubinies theorem.

(24L+12T)

Reference:

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Paper III
Distribution Theory
SECTION A
(Unit-I)

Continuous variables and their distributions using Jacobian of transformation.
Bernoulli, Binomial, compound
and truncated also. Negative Binomial distributions.

(Unit-II)
Geometric, Hyper-geometric and Multinomial distributions. Rectangular, Normal (truncated also),
Exponential, Cauchy (truncated also), Lognormal and Triangular distributions.

(24L+12T)

SECTION B
(Unit-I)
Sampling distributions- Chi-square, t and F distributions (Central and non-central) & their applications.
Bivariate normal (including marginal & conditional distribution), Beta and Gamma distributions.

(Unit-II)
Linear regression and correlation: intraclass correlation & correlation ratio, null & non-null distributions
of sample correlation coefficient, standard errors of functions of moments. Order statistics, their
Distributions and properties: joint & marginal distributions of order statistics; Sampling Distributions of
range & median.

(24L+12T)

References:
Wiley
McGraw Hill.
Calcutta
Wiley Eastern.
Paper-IV  
Sample Surveys & Design of Experiment  
SECTION-A  
(UNIT-I)  
(24L+12T)  

(UNIT-II)  
Systematic sampling schemes and related results on estimator of mean/total. Cluster sampling, double sampling, two-stage sampling with equal and unequal number of second stage units. Ratio, Product and regression method estimation: Estimators based on SRSWOR method of sampling  
(24L+12T)  

SECTION-B  
(UNIT-I)  
Analysis of Experimental model by least square, Cochran’s Theorem and Regression Analysis (Case of Full rank). Analysis of variance and covariance Transformations, Principles of Experimentation. Uniformity Trials, Randomized experiments, Randomized Blocks, Latin squares, Balanced Incomplete Block Design, Intra-Block Analysis, Missing Plot Technique  
(24L+12T)  

(UNIT-II)  
Factorial Experiment $2^n$ and $3^2$, total and partial confounding, split-plot designs. Construction of confounded factorial experiments belonging to $2^n$ series  
(24L+12T)  

References:  
Paper A
Statistical Inference

(UNIT I)
Point estimation, Criteria of good estimator, unbiased estimator, uniformly minimum variance unbiased estimator (UMVUE) among Rao Inequality, Consistent estimator, Sufficient estimator. Fisher Neyman factorization theorem, non uniqueness theorem, Exponential theorem (without proof) Davis theorem (without proof). Rao-Blackwell efficient estimator. Completeness and Lehmann-Scheffe theorem minimal sufficient statistic, maximum likelihood estimator and its properties (without proof) and the method of estimation (moments, minimum Chi-square and modified minimum Chi-square) 

(UNIT II)
Confidence intervals, Determination of confidence intervals based on large samples, confidence interval based on small samples. Hypothesis- simple and composite, Critical region, error of I\textsuperscript{st} and II\textsuperscript{nd} kind, power of test, most powerful test. Neyman-Pearson lemma. Derivations of some Common tests of a simple hypothesis against a simple alternative, uniformly most powerful test.

(SECTION B)

(UNIT I)

(UNIT II)
Non-Parametric tests: Sign Tests, Signed rank test, Kolmogorov- Smirnov one sample test, General two sample Problem: Wallis tests, two sample Kolmogorov-Smirnov test for sample of equal sizes, Median test, Wilcoxon-Mann-Whitney test. Test of randomness based on runs, test based on the total number of runs, test based on the length of longest run.

Reference:
5. Mood, Graybill and Boes: Introduction to the theory of Statistics 3\textsuperscript{rd} ed.

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Paper VI (a)
Computer Programming (Theory)

SECTION-A


Programming through C-Language: Introduction, Structure & Execution of C Program. Character Set, Keywords, Constants & Variables, Data Types, Types of Operators & Precedence, Input & Output Statements, Assignment Expression, Decision making structure, Looping Structures and Branching Structures and related C-Programs.

(24L+12T)

SECTION-B

Arrays, Character Strings, Standard Library Functions, Header Files, Modular Programming-User defined Functions, Returning values, Parameter passing Mechanism, Structures, Pointers Defining a Pointer.
Array Vs Pointers, Dynamic Memory allocation C-Preprocessors, Related Programs.

(24L+12T)

Reference:
4. Gottfried B.S., Theory and Problems of programming with TMH.

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M.Sc. (Final)
Paper- VIII
Multivariate Analysis and Statistical Inference
SECTION-A
(Unit-I)

(24L+12T)

(Unit-I)

(24L+12T)

(Unit-I)

(24L+12T)

(Unit-II)

References:
11. Wald, A: Sequential Analysis

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Paper-IX
Advanced Sample Survey & Design of Experiments  
Section-A  
(Unit-I)

Unequal probability sampling: Probability Proportional to size with and without replacement method (PPSWR/PPSWWR including Lahiri's scheme), related estimators of finite population mean (Hansen-Horvitz and Desraj's estimators for general sample size & Murthy's estimator for a sample of size of 2), Horwitz-Thompson estimator (HTE) of a finite population total/mean and expression for V(HTE) and its unbiased estimator. Sure on non-negative variance estimation. I.P.P.S. Schemes of sampling due to Midzuno-Sen, Brewer, Durbin and JNK Rao (Sample size of 2 only) Rao-Hartley Cochran sampling scheme and their estimation procedure. Theory of multi-stage sampling with varying probabilities with or without replacement. Introduction to super population models.  

(24L+12T)

(Unit-II)

Quenouille's technique of bias reduction and its application to ratio type estimator. Hartley and Ross Unbiased ratio type estimator. Ratio method of estimator under Midzuno scheme of sampling when X is known. Multivariate extension of ratio and regression method of estimator (when population mean of auxiliary variable is known).  

(24L+12T)

Section-B  
(Unit-I)


(24L+12T)

(Unit-II)

Group divisible, lattice and linked block designs- intrablock analysis, Latin square and Youden square designs. Combination of result in groups of experiments. Construction of orthogonal Latin square- (i) for prime power numbers and (ii) by Mann-Mecneish theorem, simple methods of construction of BIB designs. Constructions of symmetrical fractional factorial designs.  

(24L+12T)

References:
Statistical Quality Control & Operation Research

Section-A

(Unit-I)

Meaning of specification limits, item quality, process and product control, objective of SQC. control charts for measurable quality characteristics. Chance variation and assignable variation of process. Distribution of chance variable. Need for detection of assignable causes of variation. Determination of control limits and central line in various situations. Mean ($\bar{X}$) and R control charts. Control charts for defectives. p, np, c, u charts. Meaning of Statistical Control and its relation with specification limits

Modified control limits: warning limits and tolerance limits. Methods of estimation of rational sub-grouping and successive estimate. Advantages of SQC. Comparison of Mean ($\bar{X}$) and R charts with p-chart for common use.

(24L+12T)

(Unit-I)


(24L+12T)

Section-B

(Unit-I)

Inventory Control System: Inventory Models. Costs, Advantages. EOQ Models. Models without shortages. Reorder level and Optimum Buffer Stock. EOQ Models with shortages. Multi-item Inventory Models with quantity Discount. Probabilistic Models. Queueing System: Characteristics of Queueing System. Steady State Solution of (M/M/1) and (M/M/C) models. (M/G/1) model Pollaczek-Khintchine Formula. Steady State solution of (M/M/1) models. Mixed Queueing Model (M/D/1). (M/D/1) FCFS.

(24L+12T)

References:

Additional References:

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Paper-XI
Practicals based on Paper IX

Paper XII
Practicals based on Paper VIII & Paper X

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Jaipur
Optional Papers

Paper-XIII

Economic Statistics & Demography


Unit-II


Section-B

(Unit-I)


(Unit-II)

Demographic trends in India. Labour force analysis, Birth & Death stochastic process. Stochastic population models, logistics model, bivariate growth models, migration models, fertility analysis model, mortality analysis models. Decennial population census in India.

(24L+12T)

REFERENCES:

2. Barlow, Techniques of Population Analysis
5. Clemen, H.B. Inner Industrial Economics
Paper XIV
STOCHASTIC PROCESSES
Section-A
(Unit-I)

(Unit-II)

Section-B
(Unit-I)

(Unit-II)

References:

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Jaipur
Reliability concepts and measures: components and systems, coherent systems, reliability of coherent systems, cuts and paths, modular decomposition, bounds on system reliability, structural and reliability importance of components. Life distributions, reliability function, hazard rate, common life distributions—exponential, Weibull, gamma, etc. Estimation of parameters and test in these models

(24L+12T)

(UNIT-II)

Notions of ageing: IFR, IFRA, NBU, DMRL, and NBUE Classes and their duals, loss of memory property of the exponential distribution, closures or these classes under formation of coherent systems, convolutions and mixtures. Reliability estimation based on failure times in variously censored life tests and in tests with replacement of failed items. Maintenance and replacement policies, availability of repairable systems, modeling of a repairable system by a nonhomogeneous Poisson process. Basic ideas of accelerated life testing

(24L+12T)

(UNIT-II)


(24L+12T)

(UNIT-II)


(24L+12T)

References:
Advance Multivariate Analysis and Bayesian Inference

Section - A
(Unit-I)
Principal components, dimension reduction, canonical variables and canonical correlation definition, use. estimation and computation, multivariate linear regression model, estimation of parameters, tests of their hypotheses about regression co-efficient. Likelihood Ratio test criterion. Multivariate analysis of variance MANOVA, one and two way classified data.

(Unit-II)
Wishart matrix & its distribution. Distribution of sample generalized variance Non-Null distribution of partial and multiple correlation coefficient distribution of sample regression coefficient. Distribution of sample intra-class correlation coefficient in a random sample from a symmetric multivariate normal distribution. Application in testing and interval estimation.

Section - B
(Unit-I)
Subjective interpretation of probability in terms of fair odds. Evaluation of (i) subjective probability of an event using a subjectively unbiased coin (ii) subjective prior distribution of a parameter. Bayes theorem and computation of the posterior distribution. Bayesian point estimation as prediction problem from posterior distribution. Bayes estimators for (i) absolute error less (ii) squared error less (iii) 0-1 less. Generalization of a common loss function. Evaluation of the estimate in terms of posterior risk. Bayesian interval estimation Edible interval. Highest posterior density regions interpretation of the confidence coefficient for a classical confidence interval.

(Unit-II)
Bayesian testing of hypothesis Specification of the appropriate form of the prior distribution for a Bayesian test of hypothesis problem. Prior odds, posterior odds, Bayes factor for various types of testing hypothesis problems depending upon whether the null hypothesis and the alternative hypothesis are simple or composite. Specification of the Bayes tests in the above cases. Discussion of Lindley's paradox for testing a point hypothesis for normal mean against the two sided alternative hypothesis Bayesian prediction problem.

References:

Additional references:
Paper-XVII
Econometrics & Investment System
Section-A
(Unit-I)

(Unit-II)

Section-B
(Unit-I)

(Unit-II)

REFERENCES:

Additional References:
Paper XVIII
Project work

Important:
1. The project work shall be based on either primary data involving field work or secondary data.
2. The candidate will be required to prepare comprehensive and critical reports on the same.
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[Signature]