DEPARTMENT OF MATHEMATICS & STATISTICS
UNIVERSITY COLLEGE OF SCIENCE
MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M.A. /M.Sc. STATISTICS (CBCS) 2021-22

Semester- II

Course no.	Course Code PSSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M2 STA 01 – CT 05	Core Course- 05 Sampling Distributions	4-1-0	5	80	20	100
II	M2 STA 02 – CT 06	Core Course- 06 Statistical Inference	3-1-0	4	80	20	100
III	M2 STA 03 – CT 07	Core Course- 07 Design of Experiments	4-1-0	5	80	20	100
IV	M2 STA 04 – CT 08	Core Course- 08 Statistical Computing with R	3-1-0	4	80	20	100
V	M2 STA 05 – CP 03	Core Course P- 03 Practical Based on CT 05 & CT 06	0-0-6	3	80	20	100
VI	M2 STA 06 – CP 04	Core Course P- 04 Practical Based on CT 07 & CT 08	0-0-6	3	80	20	100
VII	M2 STA 07-SC 0X	Skill Course- 0X	2-0-0	2	80	20	100

Skill Course (SC) for Semester II

Note: Students can opt one SC course with the permission of the Head of the Department.

Course no.	Course Code PSSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M2 STA 07-SP 01A	English Language Communication and Presentation	0-0-2	2	80	20	100
II	M2 STA 07-SC 01	Skill Course Elective 01 Measurable functions and Lebesgue Integral	2-0-0	2	80	20	100
III	M2 STA 07-SC 02	Skill Course Elective - 02 Official Statistics-I	2-0-0	2	80	20	100
IV	M2 STA 07-SC 03	Skill Course Elective 03 Statistical Methods For Total Quality Management-I	2-0-0	2	80	20	100
V	M2 STA 07-SC 04	Skill Course Elective - 04 Investments Under Uncertainty-I	2-0-0	2	80	20	100
VI	M2 STA 07-SC 05	Skill Course Elective - 05 Actuarial Statistics-I	2-0-0	2	80	20	100

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

SEMESTER II   M. Sc. STATISTICS   2021-22

There will be four core courses, two core course practicals and 1 skill course elective

M2 STA 01 – CT 05

SAMPLING DISTRIBUTIONS

L-T-P	4-1-0

TIME: 3 hours   **External Assessment 80**
Internal Assessment 20

UNIT-I

Univariate sampling distributions: Random sampling and sampling distribution, Chi-square distribution (Central and non-central) and their applications, large sample theroy.

UNIT-II

t and F distributions (central and non-central) and their applications.

UNIT-III

Curve fitting and orthogonal polynomials. Standard errors of functions of moments, Order Statistics and their distributions from any continuous population.

UNIT-IV

Sampling distributions of median and range from any univariate population. Regression and Correlation. Null and Non-null distributions of sample correlation coefficient.

UNIT-V

Bivariate Distributions (discrete and continuous): Bivariate normal distribution– distribution function and its properties, marginal and conditional distributions.

Recommended Books:
1.   Goon and others   : An outline of statistical Theory, Vol. I.
2.   Kale B.K   : A first course on parametric Inference,
                                    Narosa Pub. House, New Delhi.
3.   Kendall M.G. and   Stuart, A : Advanced Theory of Statistics, Vol.-I & II.
4.   Mood, Graybill and Boes   : Introduction to the Theory of Statistics.
5.   Rohatgi V.K.   : An Introduction to Probability Theory and
                                    Mathematical Statistics.
6.   Hogg and Craig   : Introduction to Mathematical Statistics.

Reference Books:
1.   Cramer, H   : Mathematical Methods of Statistics.
2.   Weiss,   : Statistical Decision Theory.
3.   Wald, A   : Sequential Analysis.
4.   Mukhopadhyay, P   : Mathematical Statistics.

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SEMESTER II   M. Sc. STATISTICS   2021-22

M2 STA 02 – CT 06
STATISTICAL INFERENCE

L-T-P	3-1-0

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT-I

Theory of Estimation: Criterion of good estimators, Sufficient statistics, Factorization theorem, Distributions admitting sufficient statistic, Exponential and Pitman family's procedure for finding minimal sufficient statistic. Complete family of probability distributions, Rao Blackwell and Lehmann-scheffe theorem.

UNIT-II

Cramer – Rao (CR) inequality, Generalization of Cramer-Rao Inequality for multi-parametric case, Methods of estimation – method of moments and its properties – method of maximum likelihood and its properties-Large sample properties of MLE. Confidence Interval: Determination of confidence intervals based on large sample & small samples.

UNIT-III

Testing of hypothesis: Randomized and non-randomized tests, Neyman – Pearson fundamental lemma, Most powerful tests, Uniformly most powerful test, Unbiased tests, generalized Neyman-Pearson lemma, Similar test and complete sufficient statistics, Similar tests with Neyman structure, Likelihood ratio test, its properties and its asymptotic distribution, Applications of the LR method.

UNIT-IV

Non-parametric tests: Goodness of fit test: Chi-square and Kolmogorov Smirnov test - Test for randomness, Sign tests, Wilcoxon Signed rank test – Two sample problems: Kolmogrov-Smirnov test, Wald-Wolfowitz run test, Mann-Whitney U test, Median test, Kruskal Wallis test and Friedman's test.

UNIT V

Sequential tests: Sequential Probability Ratio Test (SPRT) and its applications – Determination of the boundary constants – Operating Characteristic and expected sample size

of SPRT – Optimum properties of SPRT. Applications of SPRT for testing simple v/s simple hypothesis in case of Bernoulli and Normal populations.

Recommended Books:

1. Goon and others   :   An outline of statistical Theory, Vol. I.
2. Kale B.K   :   A first course on parametric Inference,
              Narosa Pub. House, New Delhi.
3. Kendall M.G. and   Stuart,   :   Advanced Theory of Statistics, Vol.-I & II.
4   Mood, Graybill and Boes   :   Introduction to the Theory of Statistics.
5   Rohatgi V.K.   :   An Introduction to Probability Theory and
              Mathematical Statistics.
6. Hogg and Craig   :   Mathematical Methods of Statistics.

Reference Books:

1. Cramer, H   :   Mathematical Methods of Statistics.
2. Sidney-siegal   :   Non-parametric Statistics for the Behavioral Sciences.
3. Weiss,   :   Statistical Decision Theory.
4. Wald, A   :   Sequential Analysis.
5. Mukhopadhyay, P   :   Mathematical Statistics.
6. Ferguson, T.   :   Theory of Mathematical Statistics.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER II   M. Sc. STATISTICS   2021-22
M2 STA 03 – CT 07

DESIGN OF EXPERIMENTS

L-T-P	4-1-0

TIME: 3 hours   **External Assessment 80**
                                                  Internal Assessment 20

UNIT-I

Analysis of 2^n and 3^2 factorial experiments, Total and partial confounding in 2^n and 3^2 factorial experiments.split-plot designs.

UNIT- II

General Block designs and its Information Matrix (C-matrix), Connectedness and Balance and Orthoganility.Resolvability and affine resolvability.   Linear estimation Gauss Markoff theorem, Testing of linear hypothesis (involving several linear functions, test of sub-hypothesis and test involving equality of some of the parameters).

UNIT- III

Construction of complete set of mutually orthogonal Latin square for prime and prime powers. Analysis of Balanced Incomplete Block Design, Simple methods of construction of BIB designs, Methods of obtaining residual and derived designs from SBIBD. Complementary design of a given design.

UNIT IV

Intra block and inter block analysis of BIBD, Analysis of Lattice and linked block designs. Analysis of Youden square design.

UNIT V

Intra block and inter block analysis of Partially Balanced Incomplete Block Design, Concept of association scheme with two associate classes, and relation among the parameters of PBIBD. Group divisible design and its classification.

Recommended Books:

1. Anderson R.L and Bancroft, T.A.   :   Statistical Theory in Research.
2. Kempthorne, O   :   Design and Analysis of Experiments.
3. Cochran W.G. and Cox G.M.   :   Experimental Designs.

Reference Books:

1. Das, M.N. and Giri N.C.   :   Construction & Analysis of experiments 2nd edition, Wiley Eastern Ltd.,
2. Chakraborti, M.   :   Mathematics of Design & Analysis-of Experiments.
3. Joshi, D.D.   :   Linear estimation & Design of Experiments., Wiley Eastern Ltd., New Delhi, 1987
4. Dey, Alok   Theory of block designs, Wiley Eastern.

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SEMESTER II   M. Sc. STATISTICS   2021-22

M2 STA 04 – CT 08

STATISTICAL COMPUTING WITH R

L-T-P	3-1-0

TIME: 3 hours   **External Assessment 80**

                                                     Internal Assessment 20

UNIT I

R language Essentials: The R package starting and quitting R. Basic features of R. Expressions and objects, Assignments, creating vectors, vectorized arithmetic, calculating with R Vectors. Logical operations in R. Relational operators. Data input and output. Vector arithmatics. Character vectors. Data Import.

UNIT II

Matrices and Arrays: Creating matrices, Operations on matrices: Triangular matrices, Matrix arithmetic, Matrix multiplication and Inverse. Lists.

R Programming: conditional statements – if and if else; loops – for, while, do-while; Repeated loops, break and next statements, Functions – built-in and user defined; Data entry – reading from text file, data editor; examples.

UNIT III

Data frames – creation, indexing, sorting and conditional selection; read.table function etc., examples.

Descriptive Statistics and Graphics: Obtaining summary statistics; generating tables; Programming statistical graphics: Bar charts, Pie charts, Histograms, Box plots, Scatter plots, QQ plots, exercises. Measurement of Central Tendencies, Dispersion, Skewness and Kurtosis.

UNIT IV

Probability and Distributions: Random sampling and combinatory; obtaining density, cumulative density and quantile values for discrete and continuous distributions; generating samples from discrete and continuous distributions; Generation of pseudo random numbers, Simulation of other random variables- Bernoulli, Binomial, Poisson, Exponential, Normal random variables. Plotting density and cumulative density curves; Q-Q plot. Monte-Carlo Simulations.

UNIT V

Correlation and Regression Analysis: Correlation: Pearson, Spearman and Kendall's correlation; Regression – fitting, obtaining residuals and fitted values; Statistical Tests: one and two sample tests for mean and variance – one way and two way ANOVA.

Recommended Books:

1. Michael J.Crawley (2007), The R Book, John Wiley and Sons Ltd.

2. Peter Dalgaard (2008), Introductory Statistics with R, 2nd edition, Springer.

Reference Books:

1. Braun, W.J. and Murdoch, D. J. : A First Course in Statistical Progg.with R, Cambridge Univ. Press.

2. Horton, N. J. & Kleinman, Ken: Using R and R Studio for data Management, Statistical Analysis and Graphics, CRC Press, USA.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER II   M. Sc. STATISTICS   2021-22
M2 STA 05 – CP 03
PRACTICALS BASED ON CT-05 & CT-06

L-T-P	0-0-6

TIME: 3 hours   **External Assessment 80**

Internal Assessment 20

External Assessment 80:   Practicals   : 60 Marks

Viva-voce   : 20 Marks

Internal Assessment 20:   Practical Record (Internal Assessment)   : 20 Marks

Note: Students will be required to do practicals, based on topics listed below, using R-Software:

List of Practicals:

1.   Correlation and regression coefficients for Bivariate frequency distributions.

2.   Large sample tests.

3.   Small sample tests viz Chi-square, t, F and Z tests.

4.   Bartlett's test for homogeneity of Variances.

5.   Fitting of Curves and Orthogonal Polynomials.

6. MLE and Standard error of ML estimators.

7. MLE through the method of successive approximation.

8. MLE for truncated distribution.

9. Method of Moments

10. Moment Estimation, Maximum Likelihood Estimation (for discrete, continuous, mixture, truncated distributions.)

   11. Interval estimation: Confidence interval for mean, difference of means, variance and ratio of variances.

11. UMP test and LR test

12.   Test of significance of sample correlation coefficient.

13. Construction of randomized and nonrandomized MP, UMP and UMPU tests of hypotheses and drawing the power curves.

14. Power curves for testing a simple hypothesis against a composite hypothesis (one sided and two sided).

15. Power curve for testing one sided Null hypothesis against one sided and two sided alternative for Binomial distribution, Poisson distribution, Normal distribution and exponential distribution.

16. Construction of randomized test of a desired size for testing simple null against simple alternative hypothesis for Bernoulli's trial and Poisson distribution.

17. Test of hypothesis using likelihood and generalized likelihood ratio test for testing equality of (i) two means (ii) two variances in normal distribution(s).

18. Non parametric tests: Kolmogorov Smirnov test, Mann-Whitney U test, Median test for k-sample problem, Kruskal Wallis test and Friedman's test

19. Sign, Median and Run tests for small and large samples.

20. Construction of SPRT and its OC and ASN curves.

21. Sequential probability ratio test and calculation of constants and graphical representation for testing simple null against simple alternative for (i) Binomial, (ii) Poisson, (iii) Normal, (iv) Exponential distributions.

22. Software development of above practical problems in R-Software and running the same on computers.

Books for reference:

1. Goon & Others   :   An outline of Statistical Theory, Vol. I.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
SEMESTER II   M. Sc. STATISTICS   2021-22

M2 STA 06 – CP 04
PRACTICALS BASED ON CT-07 & CT-08

L-T-P	0-0-6

Duration: 4 Hours   **External Assessment 80**

                                                         Internal Assessment 20

External Assessment 80:   Practicals   : 60 Marks

                              Viva-voce   : 20 Marks

Internal Assessment 20:   Practical Record (Internal Assessment)   : 20 Marks

Students will be required to do practicals, based on topics listed below, using R software:

LIST OF PRACTICALS:

1. Yate's method for analysis of a factorial experiment.

2. Analysis of a confounded factorial experiment.

3. Analysis of Split-plot Design.

4. Analysis of BIB Design

5. Analysis of Linked block Design

6. Analysis of simple Lattice Design with 2 or more replicates.

7. Analysis of Youden Square Design

8. Analysis of Group divisible Design

9. Construction of SBIBD.

10. Operations on vectors and matrices

11. Creating and manipulating data frames.

12. Writing user defined functions for finding arithmetic mean, median, factorial, matrix addition and multiplication.

13. Bar and Pie charts.

14. Box plots for single and multiple groups.

15. Density and cumulative density plots for Binomial, Poisson, Normal and exponential distributions.

16. Checking Normality using Histogram and Q-Q plot.

17. Correlation coefficient – Pearson's, Spearman and Kendall's Tau.

18. Fitting simple linear and multiple linear regressions.

19. One sample and two sample t test.

20. One way and two way ANOVA.

21. Software development of above practical problems in R-Software and running the same on computers.

Books for reference:

1.	Goulden C.H.	:	Methods of statistical Analysis.
2.	Snedecor G.W and Cochran,W.G.	:	Statistical Methods.
3.	Laha and others	:	Hand BooK of Methods of Applied Statistics.
4.	Singh, D and Choudhary F.S	:	Theory and Analysis of sample survey Designs, Wiley Eastern Ltd.
5	Michael J.Crawley (2007)	:	The R Book, John Wiley and Sons Ltd.
6	Peter Dalgaard (2008)	:	Introductory Statistics with R, 2nd edition, Springer.

Skill Course (SC) for Semester II

M2 STA 07-SP 01 A

Skill Course Elective 01

English Language Communication and Presentation

(At the beginning of the semester, students must be provided: Detailed Lecture schedule of topics to be covered in each lecture, tutorial topics, clearly defining chapters/ sections of reference books followed, link to web resources etc. Examiners are expected to take into consideration the lecture schedule while setting the question papers to ensue questions are set within scope of the syllabus).

External: 80 Marks   Internal: 20 Marks

Contact Hours: 40hrs

Note:

   a. Of the 40 contact hours, alteast 30 hours must be devoted to practical exercises.
   b. Five assignments and fie internal assessments, one from each unit are to be carried out.
   c. Use of audio/ visual aids must be made.

UNIT I

Introduction: Theory of Communication, types and modes of communication.

UNIT I

Language of Communication: Verbal and non-verbal (Spoken and Written) personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group Communication.

UNIT I

Speaking Skills: Monologue, Dialogue, Group Discussion, Effective communication/ Miscommunication, Interview, Public Speech.

UNIT I

Reading and Understanding: Close Reading Comprehensive Summary Paraphrasing Analysis and Interpretation Translation (from Indian Language to English and vice-versa) Literary/ Knowledge Texts.

UNIT I

Writing Skills: Documenting, Repost Writing Making notes Letter Writing.

SWOC Analysis

Reference Books:

1. Bansal, R.K. & Harrison, J.B. (2013). Spoken English: A Manual of Speech and Phonetics, 4th ed. New Delhi: Orient Black Swan.

2. Sharma, N. (2010). Communication Skill. Satya Prakashan, New Delhi.

3. Lesikar R.V., Flately M E, Rentz K & Pandey. (2009). Business Communication: Making Connections in a Digital World. New Delhi, Tata McGraw Hill.

4. Vibrant English. (2013). Hyderabad: Orient Black Swan.

5. Raymond Murphy, Essential English Grammar, 2nd Ed, Cambridge University Press, Cambridge, 2007.

6. Any other related Reading may be recommended.

List of sample practical exercises: (Spoken and Written)

1. Greeting and Self Introduction
2. Introducing people
3. Talking about favorite things
4. Making offers
5. Expressing shock and disbelief
6. Making appointments
7. Talking about preferences
8. Inviting, advising, giving suggestions
9. Expressing thanks and gratitude
10. Responding to thanks
11. Giving opinion, complaints
12. Talking about hope, expressing regret
13. Agreement, disagreement, apologizing, requesting
14. Talking about fear, making predictions, expressing certainty and uncertainty
15. Lack of understanding and asking for clarifications
16. Asking for and giving directions
17. Shopping, phone conversations
18. Giving and responding to bad and good news
19. Interrupting people, expressing feelings (good and bad), congratulating
20. Narration of an incident, storytelling
21. Writing a resume
22. Letters to various authorities/ offices (eg. Electricity, Bank, etc.)

M2 STA 07-SC 01

Skill Course Elective 01

Measurable functions and Lebesgue Integral

UNIT I

Convergence of sequence of Measurable function: Convergence pointwise, uniform Convergence, Convergence almost every where (a.e.).

UNIT II

Convergence in measure of a sequence of measurable functions, characteristic function of a set, simple function, step function, pointwise Convergence, theorem of measure functions.

UNIT III

Lebesgue Integral; Characteristic function of a set; Simple functions, Lebesgue integral of a simple function; Lebesgue integral of a bounded measurable function.

UNIT IV

Lebesgue integral and Riemann integral of a bounded function defined on a closed interval; Lebesgue integral of a non-negative function; Lebesgue integral of a measurable function.

UNIT V

Properties of Lebesgue integral. Convergence Theorems and Lebesgue integral; the bounded convergence theorem; Fatou's Lemma: Monotone convergence theorem; Lebesgue convergence theorem.

Books Recommended:

1. George F-Simmons : Introduction to Topology and Modem Analysis,
   McGraw Hill Book Co.
2. S.I.Hu : Elements of Real Analysis
3. H.L. Royden : Real Analysis.
4. G.N. Purohit : Lebesgue Measure and Integration.
5. Bartle, Robert G. : The elements of integration and Lebesgue measure

M2 STA 07-SC 02

Skill Course Elective 02

OFFICIAL STATISTICS-I

UNIT I

Introduction to Indian and International Statistical systems. Role, function and activities of Central and State statistical organizations.

UNIT II

Organization of large scale sample surveys. Role of National Sample Survey Organization. General and special data dissemination systems.

UNIT III

Population growth in developed and developing countries.

UNIT IV

evaluation of performance of family welfare programmes, projections of labour force and manpower.

UNIT V

Scope and content of population census of India.

References:

Basic statistics Relating to the Indian Economy (CSO) 1990.

Guide to Official Statistics (CSO), 1999.

Statistical System in India (CSO) 1995).

Principles and Accommodation of National Population Censuses, UNESCO.

Panse, V. G., Estimation of Crop Yields (FAO)

Family Welfare Yearbook. Annual Publication of D/0 Family Welfare.

Monthly Statistics of Foreign Trade in India, DGCIS, Calcutta and other Govt. Publications.

M2 STA 07-SC 03
Skill Course Elective 03
STATISTICAL METHODS FOR TOTAL QUALITY MANAGEMNET-I

UNIT I

Quality System: ISO 9000 standard, QS 9000 standards, Concept of six-sigma and the define-measure-analysis-improve-Control Approach.

UNIT II

Precision and accuracy in measurement systems. Estimation of Measurement Uncertainty.

UNIT III

Total Quality Management, Process Analysis and Optimization.

UNIT IV

Quality at Design Stage, Quality Function Deployment, Failure Mode and Effect Analysis.

UNIT V

Conjoint Analysis, System, Parameter and tolerance designs.

References:

1. Logothetis, N. (1992)/ Managing Total Quality; Prentice Hall of India.
2. Okland J.S. (1989). Total Quality Management; Butterworth-Heinemann.
3. Mittag H.J. and Rinne H. (1993) Statistical Methods of Quality Assurance.
4. Montgomry D.C. (1985); Statistical Process Control; John Wiley.
5. Montgomery D.C. (1999) Design and Analysis of Experiments; John Wiley.

M2 STA 07-SC 04
Skill Course Elective 04

INVESTMENTS UNDER UNCERTAINTY-I

UNIT I

Main Theme: Risk – Return Trade off.

UNITI II

Money market, Fixed income, equity, stocks and bonds, Treasury notes, market indexes, Rates of interest.

UNIT III

Compound interest, inflation, Risk in a portfolio context, law of one price and arbitrage.

UNIT IV

Risk and risk aversion, mean variance analysis, allocation between risky and risk free portfolios.

UNIT V

Diversification and portfolio risk, Markovitz portfolio selection, optimal portfolios.

References:

Bodie, Z., Kane, A. and Marcus, A.J. (1996), Inversments 4th Edition, Irwin.

(Chapters: 1, 2, 4, 5, 6, 7, 8, 9, 10,20, 21, 22)

Additional References:

Arrow, K. J. (1971), Essays in the Theory of Risk Bearing, North Holland.

Hull John C. (1993) options, Futures and other Derivative Securities. 2nd Ed. Prentice Hall.

M2 STA 07-SC 05
Skill Course Elective 05
ACTUARIAL STATISTICS-I

UNIT I

Probability Models and Life Tables.

UNIT II

Utility theory, insurance and utility theory, models for individual claims and their sums, survival function, curtate future lifetime, force of mortality.

UNIT III

Life table and its relation with survival function, examples, assumptions for fractional ages, some analytical laws of mortality, select and ultimate tables.

Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple life functions evaluation for special mortality laws.

UNIT IV

Multiple decrement models, deterministic and random survivorship groups, associated single decrement tables, central rates of multiple decrement, net single premiums and their numerical evaluations.

UNIT V

Distribution of aggregate claims, compound Poisson distribution and its applications, Distribution of aggregate claims, compound Poisson distribution and its applications.

References:

N.L. Bowers, H.U. Gerber, J.C. Hickman, D.A. Jones and C.J. Nesbitt, (1986), 'Actuarial Mathematics,' Society of Actuarias, Ithaca, Illiois, U.S.A. Second Edition (1997)

Additional References:

Spurgeon E.T. (1972), Life Contingencies, Cambridge University Press.

Neill, A. (1977). Life Contingencies, Heineman.