

BSC- I Statistics Detailed Structure

T = Theory , L = Lab

FS BSC I

ID	Title	Credits
Major Courses		
STM2001C	Reasoning with Data	04 (3T+ 1L)
STM2011C	Elements of Probability Theory	04 (3T+1L)
Minor Courses		
STE2001C	Elements of Probability Theory and Reasoning with Data	04 (T)
Multidisciplinary Course		
MDC2271C	Data Exploration	04 (2T+2L)
Ability Enhancement Course		
FOSxxx	<i>To be chosen from Faculty level pool</i>	02
Indian Knowledge System/ Value Added Course		
FOSxxx	<i>To be chosen from Faculty level pool</i>	02
Skill Enhancement Course*		
SEC2211C	Data Description Lab	02 (L)
TOTAL		22

SS BSC I

ID	Title	Credits
Major Courses		
STM2002C	Statistical Methods	04 (3T+1L)
STM2012C	Probability Distributions	04 (3T+1L)
Minor Courses		
STE2002C	Probability Distributions and Statistical Methods	04 (T)
Multidisciplinary Course		
MDC2262C	Statistical Inference	04 (2T+2L)
Ability Enhancement Course		
FOSxxx	<i>To be chosen from Faculty level pool</i>	02
Indian Knowledge System/ Value Added Course		
FOSxxx	<i>To be chosen from Faculty level pool</i>	02
Skill Enhancement Course*		
SEC2212C	Data Analysis Lab	02 (L)
TOTAL		22

* Only for the students with Statistics as Minor discipline

FSBSC-I

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2023-24
B.Sc. in Statistics: Regular Programme					
Year	I	STM2001C-Reasoning with data		Credits	04
Semester	I	Year of Introduction: 2023 Year of Syllabus Revision: -		Maximum Marks	100
Mode of Transaction		Lectures&Practicals (No. of Hours = 45 T + 30 L = 75)			
After the completion of the course students will C01:understand the subject statistics. C02 : learn how to reason with data. C03: be able to think statistically the real world problems through relevant data. C04: acquire knowledge on various types of data. C05: be able to visualize the data graphically. C06: be able to analyze and interpret the univariate data through measures of central tendency, dispersion, skewness and moments. C07: be exposed to Bivariate data. C08: be able to analyse and interpret Bivariate data. C09: understand the difference between correlation and association of attributes. C10: be able to analyze categorical type of data. C11: be able to understand the difference between correlation and regression tool. C12: be able to use regression analysis to analyze the data.					
Unit No.	Topic/Unit			Contact Hours	Weightage (%)
1	Introduction to Data and its importance, the discipline of Statistics and data science, understanding population and sample, collection/ capturing and storage of data. numerous types of data – numerical, categorical, structured, unstructured, text, audio, video, graph, etc; data at rest vs streaming data; Data types from analytical perspective – Qualitative, and quantitative; discrete and continuous; scales of measurement, Importance of data quality. Exploration of univariate data: Describing data – tabular, visual, summary statistics Tabular description: frequency distribution – with and without classification, discrete and continuous classification, selecting number of classes and class limits;			18	30

	idea of frequency function. Data Visualization: pie, bar, Pareto, dot plot, stem-and leaf plot, histogram, frequency polygon, frequency curve, ogive curve, time plot.Characteristics of frequency distributions viz central tendency, dispersion, Shape - skewness and kurtosis; measures of central tendency and measures of dispersion/ diversity, positional measures, moments, measures of skewness and kurtosis. Sheppard's correction for moments. Properties of these measures; box-plots for visualizing summaries		
2	Exploration of bivariate data: Bivariate frequency table, contingency table/ cross tabulation Visualizing Bivariate data – stacked/ clustered bar chart, multiple box plots, multiple dot plots, multiple histograms, scatter diagram Measuring association between numeric variables - Covariance, Karl Pearson's coefficient of correlation, Rank correlation: Spearman's and Kendall's rank correlation coefficients; correlation ratio; properties of these measures Measuring association between categorical variables: contingency tables, Yule's coefficient, Coefficient of Colligation, Chi-square based measures – Phi, Contingency coefficient, Cramer's V	15	25
3	Describing relationship between variables, use of scatter diagram, the regression problem, principle of least squares, linear regression analysis, modeling non-linear relationship using transformation, the coefficient of determination.	12	20
4	Laboratory sessions based on the contents of Units 1 to 3.	30	25
1 2 3 4 5	References: Nolan and Speed (2000): <i>Stat Labs – Mathematical Statistics through Applications</i>, Springer Gould et al (2017): <i>Essential Statistics – Exploring the world through data</i>, 2e, Pearson. Starnes et al. (2011): <i>Statistics Through Applications</i>, 2e, Freeman Goon, Gupta and Dasgupta: <i>Fundamentals of Statistics</i>, Vol. 1 (2005), The world press Pvt. Ltd, Kolkata www.onlinestatbook.com		

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2023-24
B.Sc. in Statistics: Regular Programme				
Year	I	STM2011C Elements of Probability Theory	Credits	04
Semester	I	Year of Introduction: 2023 Year of Syllabus Revision: -	Maximum Marks	100
Mode of Transaction	Lectures &Practicals (No. of Hours = 45 T + 30 L = 75)			
Course Outcomes After going through this course, the students will acquire CO1 understanding of the basic concept of probability and the approach of its theoretical development CO2 ability to distinguish between random and non-random experiments CO3 fundamental understanding of concept of probability as a tool for modelling data CO4 understanding of the notion of conditional probability including the concept of Bayes’ Theorem CO5 ability to distinguish between independent & dependent event CO6 gain the knowledge related to concept of discrete and continuous random variables CO7 ability to identify random variables from real life, and develop the understanding of the probability distribution of random variables CO8 ability to establish the joint, marginal and conditional probability distribution of random variables CO9 fundamental understanding of relating probability theory with descriptive statistics and inference				
Unit No.	Topic/Unit		Contact Hours	Weightage (%)
1	Meaning of probability, various approaches for defining a probability, Statistical definition (frequency approach), Classical definition, axiomatic definition: Algebra of sets, Probability on finite sample spaces; properties of probability measures, equally likely probability measures, counting techniques. Probability as a description of population under investigation, probability as a tool for modelling data.		25	30
2	Conditional probability, Bayes' theorem, Independence of events, Mutual Independence and pairwise independence.		10	20

3	Random variables on finite sample spaces, probability distribution of random variables, distribution functions, Expectation of a random variables, moments. Joint probability distributions, marginal distributions, Conditional distributions, Independence of random variables, moments, correlation coefficient, transformations of random variables. Relating probability theory to descriptive statistics and inference.	10	25
4	Laboratory sessions based on the contents of Units 1 to 3.	30	25

References:

1. Hogg, Tanis, Zimmerman (2015): Probability and Statistical Inference, 9e, Pearson
2. Feller :An introduction to probability theory and its applications, vol-I – Asia Publishing house
3. Gangoolli and Ylvisaker : Discrete Probability – Harcourt Brace Jovanovich Inc
4. Rohatgi V.K. (2001): An introduction to probability theory and mathematical statistics. – A Wiley Inter Science publications.

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2023-24
B.Sc. in Statistics: Regular Programme				
Year	I	STE2001C Elements of Probability Theory& Reasoning with data	Credits	04
Semester	I	Year of Introduction: 2023 Year of Syllabus Revision: -	Maximum Marks	100
Mode of Transaction	Lectures (No. of Hours = 60 T)			
After the completion of the course students will				
CO1 understand the basic concept of probability and the approach of its theoretical development				
CO2 have ability to distinguish between random and non-random experiments				
CO3 have fundamental understanding of concept of probability as a tool for modelling data				
CO4 understand of the notion of conditional probability including the concept of Bayes' Theorem				
CO5 be able to distinguish between independent & dependent event.				
CO6 be able to identify random variables from real life, distinguish between discrete and continuous random variables, and develop the understanding of the probability distribution of random variables				
CO7 be able to establish the joint, marginal and conditional probability distribution of random variables				
CO8 have fundamental understanding of relating probability theory with descriptive statistics and inference				
CO9 understand the subject statistics, and learn how to reason with data.				
CO10 acquire knowledge on various types of data and will be able to think statistically on the real worldproblems.				
CO11 be able to analyze and interpret univariate data through measures of central tendency, dispersion, skewness and moments, and also present the data graphically.				
CO12 be able to analyse and interpret Bivariate data.				
CO13 understand the difference between correlation and association of attributes, and also the difference between correlation and regression.				
CO14 be able to analyze categorical type of data.				
Unit No.	Topic/Unit		Contact Hours	Weightage (%)
SECTION-I				
1	Meaning of probability, various approaches for defining a probability, Statistical definition (frequency approach), Classical definition, axiomatic definition: Algebra of sets, Probability on finite sample spaces; properties of probability measures, equally likely probability measures, counting techniques. Probability as a description of population under investigation, probability as a tool for modelling data.		14	20

2	Conditional probability, Bayes' theorem, Independence of events, Mutual Independence and pairwise independence.	8	15
3	Random variables on finite sample spaces, probability distribution of random variables, distribution functions, Expectation of a random variables, moments. Joint probability distributions, marginal distributions, Conditional distributions, Independence of random variables, moments, correlation coefficient, transformations of random variables. Relating probability theory to descriptive statistics and inference.	8	15
SECTION-II			
4	Introduction to Data and its importance, the discipline of Statistics and data science, understanding population and sample, collection/ capturing and storage of data. numerous types of data – numerical, categorical, structured, unstructured, text, audio, video, graph, etc; data at rest vs streaming data; Data types from analytical perspective – Qualitative, and quantitative; discrete and continuous; scales of measurement, Importance of data quality. Exploration of univariate data: Describing data – tabular, visual, summary statistics Tabular description: frequency distribution – with and without classification, discrete and continuous classification, selecting number of classes and class limits; idea of frequency function. Data Visualization: pie, bar, Pareto, dot plot, stem-and leaf plot, histogram, frequency polygon, frequency curve, ogive curve, time plot.Characteristics of frequency distributions viz central tendency, dispersion, Shape - skewness and kurtosis; measures of central tendency and measures of dispersion/ diversity, positional measures, moments, measures of skewness and kurtosis. Sheppard's correction for moments. Properties of these measures; box-plots for visualizing summaries	12	20
5	Exploration of bivariate data: Bivariate frequency table, contingency table/ cross tabulation Visualizing Bivariate data – stacked/ clustered bar chart, multiple box plots, multiple dot plots, multiple histograms, scatter diagram Measuring association between numeric variables - Covariance, Karl Pearson's coefficient of correlation, Rank correlation: Spearman's and Kendall's rank correlation coefficients; correlation ratio; properties of these measures Measuring association between categorical variables: contingency tables, Yule's coefficient, Coefficient of Colligation, Chi-square based measures – Phi, Contingency coefficient, Cramer's V	10	18

6	Describing relationship between variables, use of scatter diagram, the regression problem, principle of least squares, linear regression analysis, modeling non-linear relationship using transformation, the coefficient of determination.	08	12
1 2 3 4 5 6 7 8	References: Hogg, Tanis, Zimmerman (2015): Probability and Statistical Inference, 9e, Pearson Feller :An introduction to probability theory and its applications, vol-I – Asia Publishing house Gangoolli and Ylvisaker : Discrete Probability – Harcourt Brace Jovanovich Inc Rohatgi V.K. (2001): An introduction to probability theory and mathematical statistics. – A Wiley inter science publications. Nolan and Speed (2000): <i>Stat Labs – Mathematical Statistics through Applications</i> , Springer Gould et al (2017): <i>Essential Statistics – Exploring the world through data</i> , 2e, Pearson. Starnes et al. (2011): Statistics Through Applications, 2e, Freeman Goon, Gupta and Dasgupta: <i>Fundamentals of Statistics</i> , Vol. 1 (2005), The world press Pvt. Ltd, Kolkata www.onlinestatbook.com		

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2023-24
B.Sc. in Statistics: Regular Programme				
Year	I	MDC2271C Data Exploration (Multidisciplinary Course)	Credits	04
Semester	I	Year of Introduction: 2023 Year of Syllabus Revision: -	Maximum Marks	100
Mode of Transaction	Lectures &Practicals (No. of Hours = 30 T + 60 L = 90)			
Course Outcomes After going through this course, the students will acquire, CO1 understanding of the basic concept of probability and the approach of its theoretical development CO2 ability to distinguish between random and non-random experiments CO3 fundamental understanding of concept of probability as a tool for modelling data CO4 understanding of the notion of conditional probability including the concept of Bayes’ Theorem CO5 ability to distinguish between independent & dependent event CO6 gain the knowledge related to concept of discrete and continuous random variables CO7 ability to identify random variables from real life, and develop the understanding of the probability distribution of random variables CO8 ability to establish the joint, marginal and conditional probability distribution of random variables CO9 fundamental understanding of relating probability theory with descriptive statistics and inference				
Unit No.	Topic/Unit		Contact Hours	Weightage (%)
1	Types of data; Scales of Measurements; Data visualization through graphs and diagrams; Describing quantitative data (measures of averages, variation, skewness, kurtosis); Bivariate data – Scatterplots, correlation, regression; Describing qualitative data using two-way contingency tables, Association and independence; Idea of multivariate data. Applications of Statistics		15	25
2	Introduction to probability; counting techniques- Permutations and combinations; Conditional probability and idea of independence of events; Random variables – Discrete and continuous, probability mass function and		15	25

	probability density function; Expectations and Variance; Binomial, Poisson and Normal probability distributions. Probability Modelling.		
3	Laboratory sessions corresponding to the contents of Unit-1	30	25
4	Laboratory sessions corresponding to the contents of Unit-2	30	25
Reference Books 1. Gould et al (2017); <i>Essential Statistics – Exploring the world through data</i>, 2e, Pearson. 2. Starnes et al. (2011); <i>Statistics Through Applications</i>, 2e, Freeman			

SSBSC-I

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2023-24
B.Sc. in Statistics: Regular Programme					
Year	I	STM2002C: Statistical Methods	Credits	04	
Semester	II	Year of Introduction: 2023 Year of Syllabus Revision: -	Maximum Marks	100	
Mode of Transaction	Lectures &Practicals (No. of Hours = 45 T + 30 L = 75)				
Course Outcomes After going through this course, the students will C01: be exposed to the concept of statistical inference. C02: be able to understand the difference between point estimation and interval estimation. C03: aquire knowledge of method of moments to estimate the parameters. C04: understand various concept of hypothesis testing. C05: learn to test about independence of attributes for large as well as small samples. C06: learn to test goodness of fit for various discrete probability distributions. C07: learn to analyse trivariate data. C08: will be able to use all the above tools for real life data.					
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	
1	Introduction to Statistical inference, revisiting the concept of population and sample, approaches for inference – frequentist and Bayesian approaches, parametric and non-parametric approaches. The problem of estimation, point estimation - method of moments; idea of interval estimation. The problem of hypothesis testing, general approach for hypothesis testing, type-I and type-II errors, level of significance; concept of sampling distribution, Chi-square test for independence of attributes, exact test of independence based on hypergeometric distribution.		25	30	

2	Probability models for describing data, Frequency distribution vs probability distribution, modeling discrete data using discrete probability models - Graphical techniques: comparing shape of theoretical distribution with empirical distribution, Chi-square tests for goodness of fit: Fitting Binomial, geometric, Negative Binomial, Poisson, and discrete uniform distributions.	10	25
3	Multivariate data, visualizing multi variate data – scatter matrix, bubble plot; Multiple regression, Multiple correlation, partial correlation (Discussion restricted to only tri-variate case); Their definitions and meanings. Case of more than two attributes, multiple association and partial association, Association and causal relationship. (Derivation of formulae is not intended in this unit)	10	20
4	Laboratory sessions related to the contents of Units 1 to 3.	30	25
1 2 3	References: Alan Agresti (2017): Statistics: The Art and Science of Learning from Data, 4e, Pearson Nolan and Speed (2000): <i>Stat Labs – Mathematical Statistics through Applications</i> , Springer Goon, Gupta and Dasgupta (2015): Fundamentals of statistics, Vol. 1, The world press Pvt. Ltd. Kolkata		

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2023-24
B.Sc. in Statistics: Regular Programme				
Year	I	STM2012C: Probability Distributions	Credits	04
Semester	II	Year of Introduction: 2023 Year of Syllabus Revision: -	Maximum Marks	100
Mode of Transaction	Lectures &Practicals (No. of Hours = 45 T + 30 L = 75)			
Course Outcomes After going through this course, the students will acquire: CO1 basic understanding of the properties and applications of discrete probability distribution based on finite sample space CO2 knowledge of discrete probability distributions such as Discrete uniform, Binomial, and Hyper-geometric CO3 fundamental understanding of the theory of probability suitable for countable sample spaces CO4 knowledge of discrete probability distributions such as Poisson, Geometric, Negative Binomial CO5 ability to develop the skill to apply suitable probability distribution for solving different real life problems CO6 ability to develop the skill to use mathematical tools such as generating function in probability theory CO7 knowledge of various concepts of probability distribution as outlined above through practical assignments to understand real life situations				
Unit No.	Topic/Unit		Contact Hours	Weightage (%)
1	Probability distributions: Discrete uniform distribution, Bernoulli distribution, Binomial distribution, Hypergeometric distributions.		15	30
2	Probability measures and random variables on countable sample spaces, Poisson distribution, negative binomial distribution, geometric distribution.		15	25

3	Generating functions: Probability generating functions: its properties, convolutions; Moment generating functions and its properties. Additive properties of above mentioned distributions using pgf/mgf.	15	20
4	Laboratory sessions corresponding to the contents of Units 1 to 3.	30	25
References: 1. Gangoolli and Ylvisaker: Discrete Probability – Harcourt Brace Jovanovich Inc. 2. Feller: An introduction to probability theory and its applications, Vol-I – Asia Publishing House. 3. Rohatgi V.K.: an introduction to probability theory and math. Statistics (2001) A wiley – inter science publications.			

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2023-24
B.Sc. in Statistics: Regular Programme				
Year	I	STE2002C: Probability Distributions and Statistical Methods	Credits	04
Semester	II	Year of Introduction: 2023 Year of Syllabus Revision: -	Maximum Marks	100
Mode of Transaction	Lectures (No. of Hours = 60 T)			
Course Outcomes After going through this course, the students will have, CO1 basic understanding of the properties and applications of discrete probability distribution based on finite sample space such as Discrete uniform, Binomial, and Hyper-geometric CO2 fundamental understanding of the theory of probability suitable for countable sample spaces, and the knowledge of discrete probability distributions such as Poisson, Geometric, Negative Binomial CO3 developed the skill to apply suitable probability distribution for solving different real-life problems CO4 developed the skill to use mathematical tools such as generating function in probability theory CO5 conceptual understanding of statistical inference. CO6 good understanding of point estimation and interval estimation, and the knowledge of method of moments to estimate the parameters. CO7 good understanding of various concept of hypothesis testing. CO8 knowledge of testing about independence of attributes for large as well as small samples. CO9 ability to test goodness of fit for various discrete probability distributions. CO10 understanding for analysis of trivariate data. CO11 ability to use all the above tools for real life data.				
Unit No.	Topic/Unit		Contact Hours	Weightage (%)
SECTION-I				
1	Probability distributions: Discrete uniform distribution, Bernoulli distribution, Binomial distribution, Hypergeometric distributions.		10	20

2	Probability measures and random variables on countable sample spaces, Poisson distribution, negative binomial distribution, geometric distribution.	10	15
3	Generating functions: Probability generating functions: its properties, convolutions; Moment generating functions and its properties. Additive properties of above mentioned distributions using pgf/mgf.	10	15
SECTION-II			
4	Introduction to Statistical inference, revisiting the concept of population and sample, approaches for inference – frequentist and Bayesian approaches, parametric and non-parametric approaches. The problem of estimation, point estimation - method of moments; idea of interval estimation. The problem of hypothesis testing, general approach for hypothesis testing, type-I and type-II errors, level of significance; concept of sampling distribution, Chi-square test for independence of attributes, exact test of independence based on hypergeometric distribution.	14	20
5	Probability models for describing data, Frequency distribution vs probability distribution, modeling discrete data using discrete probability models - Graphical techniques: comparing shape of theoretical distribution with empirical distribution, Chi-square tests for goodness of fit: Fitting Binomial, geometric, Negative Binomial, Poisson, and discrete uniform distributions.	8	15
6	Multivariate data, visualizing multi variate data – scatter matrix, bubble plot; Multiple regression, Multiple correlation, partial correlation (Discussion restricted to only tri-variate case); Their definitions and meanings. Case of more than two attributes, multiple association and partial association, Association and causal relationship. (Derivation of formulae is not intended in this unit)	8	15
	References: 1 Gangoalli and Ylvisaker: Discrete Probability – Harcourt Brace Jovanovich Inc. 2 Feller: An introduction to probability theory and its applications, Vol-I – Asia Publishing House. 3 Rohatgi V.K.: an introduction to probability theory and math. Statistics (2001) A wiley – inter science publications. Alan Agresti (2017): Statistics: The Art and Science of Learning from Data, 4e, Pearson 4 Nolan and Speed (2000): Stat Labs – Mathematical Statistics through Applications, Springer 5 Goon, Gupta and Dasgupta (2015): Fundamentals of statistics, Vol. 1, The world press Pvt. Ltd. Kolkata 6		

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2023-24
B.Sc. in Statistics: Regular Programme				
Year	I	MDC2262C: Statistical Inference (Multidisciplinary Course)	Credits	04
Semester	II	Year of Introduction: 2023 Year of Syllabus Revision: -	Maximum Marks	100
Mode of Transaction	Lectures &Practicals (No. of Hours = 30 T + 60 L = 75)			
Course Outcomes After going through this course, the students will C01: be exposed to the concept of statistical inference. C02: be able to understand the difference between point estimation and interval estimation. C03: aquire knowledge of method of moments to estimate the parameters. C04: understand various concept of hypothesis testing. C05: learn to test about independence of attributes for large as well as small samples. C06: learn to test goodness of fit for various discrete probability distributions. C07: learn to analyse trivariate data. C08: will be able to use all the above tools for real life data.				
Unit No.	Topic/Unit		Contact Hours	Weightage (%)
1	Sample and observational studies; Sampling Techniques; Sampling distributions; Basics of Statistical Inference- types of errors, power, null and alternative hypothesis, problem of estimation (point and interval), problem of testing of hypothesis; One-sided and two-sided tests.		15	25
2	Idea of Central limit theorem and its applications; One and two sample Tests and Confidence Intervals concerning mean, variance and proportion; Inference using the concept of P-value. Idea of Designing Experiments (one-way and two-way) and Analysis of Variance.		15	25
3	Laboratory sessions based on the contents of Unit-1.		30	25

4	Laboratory sessions based on the contents of Unit-2	30	25
1	References:		
2	Alan Agresti (2017): Statistics: The Art and Science of Learning from Data, 4e, Pearson		
	Nolan and Speed (2000): <i>Stat Labs – Mathematical Statistics through Applications</i> , Springer		

BSC- II Statistics Detailed Structure

T = Theory , L = Lab

FS BSC II

ID	Title	Credits
Major Courses		
STM2003C	Probability Theory I	3T+1L
STM2013C	Real Analysis I	4L
STM2023C	Sampling Techniques	3T+1L
Multidisciplinary Course		
MDC2583C	Statistics for Sciences	3T+1L
Ability Enhancement Course		
FOSxxx	<i>To be chosen from Faculty level pool</i>	2
Indian Knowledge System Course		
IKS2383C	Indian Official Statistics	2
Skill Enhancement Course*		
SEC2473C	Designing Sample Surveys	2L
TOTAL		22

SS BSC II

ID	Title	Credits
Major Courses		
STM2004C	Probability Theory II	4T
STM2014C	Real Analysis II	4T
STM2024C	Sampling Distributions and Simulation	3T+1L

Minor Courses		
STE2004C	Applications of Matrices and Numerical Methods	3T+1L
Ability Enhancement Course		
FOSxxx	<i>To be chosen from Faculty level pool</i>	2
Value Added Course		
VAC2414C	Lean, Green, and Clean Science	2T
VAC2424C	Introduction to Population Science	2T
Skill Enhancement Course		
SEC2464C	Exploratory Data Analysis using Microsoft Excel	2L
TOTAL		22

FSBSC-II

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2024-25	
B.Sc. in Statistics: Regular Programme						
Year	II	Core Course STM2003C- Probability Theory – I			Credits	04
Semester	II	Year of Introduction: 2024 Year of Syllabus Revision: -			Maximum Marks	100
Mode of Transaction	Lectures &Practicals (No. of Hours = 45 T + 30 L = 75)					
Course Outcomes						
This course will acquaint the students with						
CO1 understanding of the concept of uncountable sample spaces and probability measure and R.						
CO2 understanding of the concept of distribution function and its properties.						
CO3 ability to derive moments, handle transformed random variables and derive associated distributions.						
CO4 knowledge of standard univariate distributions like Uniform, Gamma, Normal, Beta etc., their properties and their relation with other distributions.						
CO5 ability to handle bivariate random variablse, their distributions and bivariate transformations .						
CO6 knowledge of Bivariate normal and truncated distributions.						
Unit No.	Topic/Unit	Contact Hours	Weightage (%)			
1	Uncountable sample spaces, class of events, R as a sample space, probability measure on uncountable sample spaces -specifically on R. Random variables on a general probability space, probability distributions of random variables, specification of probability distributions in terms of (i) probability mass function (ii) probability density function and	15	25			

	(iii) distribution function. Expectation, moments, Chebyshev's inequality, Transformation of random variables.		
2	Univariate continuous distributions: Uniform distribution, exponential distribution, Normal distribution, Gamma distribution, Beta distribution, Cauchy distribution.	15	25
3	Joint probability distributions: Multivariate uniform distribution (Geometric probability), Bivariate normal distribution; marginal probability distribution, conditional probability distribution. Independence of random variables, Truncated distributions (Binomial, Poisson, Normal). Transformation of random variables in a Bivariate set-up. Inter-relationship between probability distributions discussed earlier.	15	25
4	Laboratory sessions related to the contents of Units 1 to 3.	30	25

Reference Books

1	An introduction to probability and Statistics (2nd edition) by V K Rohatgi and A K Md Ehsanes Saleh
2	Modern Probability Theory and its applications (1972) by E.Parzen – Wiley eastern Pvt. Ltd.

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2024-25
B.Sc. in Statistics: Regular Programme					
Year	II	Core Course STM2013C: Real Analysis-I		Credits	04
Semester	I	Year of Introduction: 2024 Year of Syllabus Revision: -		Maximum Marks	100
Mode of Transaction	Lectures (No. of Hours = 60 T)				
Course Outcomes					
After going through this course, the students					
C01: will understand the concept of field, sigma field and borel sigma field.					
C02: will understand the concept of set, functions, sequences series etc.					
C03: understands the idea of convergence of sequence of sets and understands the results analogous to those for sequence & series of numbers.					
C04: understands the basic concepts of calculus.					
C05: understands differential calculus for multivariate function.					
C06: will be able to apply the concepts of real analysis to understand probability					
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	
1	Field, ordered field and their properties; Real field. Sets, field of sets, σ -field, Borel σ -field, functions, image and inverse image, countability of a set.		15	20	
2	Sequences of real numbers, properties of convergent sequences, bounded sequence, monotone sequence, subsequences, Cauchy sequence,; limit superior and limit inferior. Set functions, Sequences of sets and their convergence.		17	40	

3	Convergence of series of real numbers, properties of convergent series, various tests of convergence, absolute convergence, power series.	10	20
4	Limit of a function, continuity and differentiability of functions and related results. Discontinuities of first and second kind. Riemann and Riemann-Stieltjes integrals, related results; Multivariate functions, continuity and differentiability and integrability of multivariate functions. (only ideas)	18	20
1 2	References: Methods of Real Analysis by R.R.Goldberg (1970) – Oxford & IBH Publishing Company Pvt. Ltd. Calculus, Vol.II by Tom. Apostol		

 सत्यं शिवं सुन्दरम्		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2024-25
B.Sc. in Statistics: NEP					
Year	II	STM2023C: SAMPLING TECHNIQUES		Credits	04
Semester	I	Year of Introduction: 2024 Year of Syllabus Revision: -		Maximum Marks	100
Mode of Transaction	Lectures&Practicals (No. of Hours = 45 T + 30 L = 75)				
Course Outcomes After going through this course, the students will acquire CO1 knowledge of the need of Statistical information, type of data, concept of sampling and complete enumeration and various definitions. CO2 knowledge of sampling and non sampling error, unbiased estimators, simple random sampling with and without replacement, CO3 knowledge of estimation of population mean, population total, proportion, variance of these estimators, their confidence interval, determination of sample size. CO4 knowledge of need for stratification and its principle, estimation of population mean, its variance, allocation of sample size by proportional and optimum allocation CO5 knowledge of Comparison of unstratified random sampling with stratified random sampling using different allocations namely Proportional and Neyman Allocation. CO6 knowledge of the linear and non linear systematic sampling, comparison with simple random sampling CO7 knowledge of Study cluster sampling and its application to real data, knowledge of concept of two stage sampling					
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	
1	Need for Statistical Information, types of data, complete enumeration, survey; need for sampling, errors, cost aspect, non-aspect, sampling and complete enumeration. Concepts, Definitions and Notations : Units and population, parameters, sampling units, sampling frames, random samples, unbiased estimator, measures of error, stages of randomization, efficiency, confidence intervals and cost functions. Simple random sampling with and without replacement: estimation of population mean, population total, proportion, variance of these estimators, their estimates confidence interval. Sample selection and sample size: procedures of selection, Determination of sample size.		15	25	

2	Stratified sampling: Need for stratification and its principle, Design of stratification variables, estimation of population mean, its variance and estimates of this variance in case of stratified SRSWOR & SRSWR gain due to stratification, its estimates, allocation of sample sizes of strata, estimation of proportion, its variance and its estimates.	12	20
3	Systematic sampling: Sampling procedure : Linear and circular systematic sampling, sampling variance of estimator of population mean, its estimator, comparison with SRS. Cluster sampling : Need, sampling with equal cluster. Estimation of population mean, its variance, estimation of the variance, efficiency of cluster sampling as compared to SRS determination of optimum cluster size for given cost, estimation of proportion, its variance and estimate of this variance. Idea of two stage sampling.	18	30
4	Laboratory sessions based on the contents of Units 1 to 3.	30	25

Books Recommended

1. **Sampling Theory and methods (1977) by M.N.Murthy – Statistical Publishing Society.**
2. **Theory and methods of survey sampling (2005) by Parimal Mukhopadhyay prentice – Hall of India Pvt. Ltd.**

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2024-25
B.Sc.: Regular Programme					
Year	II	Multi-Disciplinary Course (MDC) MDC2583C: Statistics for Science		Credits / Hours per week	3T + 1L
Semester	I	Year of Introduction: 2024 Year of Revision:		Maximum Marks / Grade	100
Mode of Transaction	Lectures&Practicals (No. of Hours = 45 T + 30 L = 75)				
Unit No.	Topic/Unit			Contact Hours	Weightage (%)
1	Introduction to Artificial Intelligence (AI) and Machine Learning (ML), relation and difference between AI and ML. Statistical Machine Learning: introduction, role of Statistics in Machine Learning, commonly used statistical machine learning techniques with examples and case studies in different disciplines of sciences.			15	25
2	Introduction to time series data, objectives of analyzing time series data, components of time series data. Difference between time series analysis and regression analysis. Idea of trend analysis, Idea of measuring seasonal variations, Idea of forecasting. Applications of time series analysis and discussion of case studies in different disciplines of sciences. Index Numbers: Introduction and importance in everyday life, cost of living index, consumer price index, wholesale price index, the layman understanding and interpretations of these indices.			15	25

3	Designing experiments: Completely Randomized Design (CRD) and Randomized Block Design (RBD), applications and case studies in various disciplines of sciences. Statistical Quality Control (SQC) and Statistical Process Control (SPC) – concepts, importance, and applications. Control charts for mean, range, proportion of defectives. Idea of other control charts. Discussion and case studies.	15	25
4	Practical sessions based on Unit 1, 2, 3	30	25

Reference Books

1.	An Introduction to Statistical Learning: With Applications in R, Trever Hastie, Springer
2.	
3.	Design of Experiments, D. C. Montgomery, Wiley
4.	Introduction to Time Series Analysis and Forecasting, D. C. Montgomery,
5.	Textbook of Index Number and Time Series, a. K. Sharma, Discovery Publishing house

 THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2014-25	
B.Sc. in Statistics: Regular Programme						
Year	II	IKS2383C: Indian official Statistics			Credits	02
Semester	I	Year of Introduction: 2024 Year of Syllabus Revision: -			Maximum Marks	50
Mode of Transaction	Lectures (No. of Hours = 30 T)					
Course Outcomes After going through this course, the students will understand CO1 The working of Indian and international statistical systems CO2 The role and responsibilities of related govt. organizations including ministries in India CO3 The need and importance of population census CO4 The approaches for evaluating various govt. programs and schemes CO5 The methodology for collecting important data on various aspects of national/international level. CO6 The necessity of Statistics in Social Science studies						
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	
1	Introduction to Indian and International statistical systems.role, function and activitiesof central and state statistical organizations, organization of large scale sample surveys, role of national sample survey organization general and special data dissemination systems.			10	40	
2	Population growth in developed and developing countries, evaluation and performance of family welfare programmes, projections of labour force and manpower, scope and content of population census of India.			10	30	
3	System of collection of agricultural statistics, crop forecasting and estimation, productivity, fragmentation of holdings, support prices, buffer stocks, impact of irrigation projects.			10	30	

References:

- 1. Basic Statistics Relating to the Indian Economy (CSO), 1990.**
- 2. Guide to Official Statistics (CSO) 1999.**
- 3. Statistical System in India (CSO), 1995.**
- 4. Principles and accommodation of National Population Censuses, UNESCO.**
- 5. Panse, V.G.: Estimation of Crop Yields (FAO).**
- 6. Family Welfare Yearbook, Annual Publication of D/o Family Welfare.**
- 7. Monthly Statistics of Foreign Trade in India, DGCIS, Calcutta and other Govt. Publications.**

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2024-25	
B.Sc. in Statistics: Regular Programme						
Year	II	Core Course			Credits	02
		SEC2473C: Designing Sample Surveys				
Semester	I	Year of Introduction: 2024 Year of Syllabus Revision: -			Maximum Marks	50
Mode of Transaction	Practicals (No. of Hours = 60 L)					
Course Outcomes						
This course will acquaint the students with						
CO1 understanding of the concept of sampling, questionnaire, primary data and secondary data						
CO2 schedules, referring the web sites, FGD (Focused Group Discussions)						
CO3 Measurement and scaling techniques with examples						
CO4 differential, semantic differential, summated and Guttman type of scales.						
CO5 Idea of population, sample and sampling unit idea of probability and non-probability sampling methods						
CO6 SRSWR/SRSWOR how to draw a sample						
CO7 Stratified random sampling and systematic sampling						
Unit No.	Topic/Unit				Contact Hours	Weightage (%)
1	Primary and secondary data. Collection of primary data through questionnaire, validity of it, data collection through schedules, difference between questionnaire and schedules. Secondary data via referring to authentic web-sites, FGD and interview method. Measurements and Scaling techniques. Nominal, Ordinal, interval and Ratio scales with examples and brief discussion of applicable Statistical techniques. Scaling: Differential scale(Thurston type), Semantic differential(Osgood				30	45

	type),Summated (Likert type) and Cumulative(Guttman type)		
2	Idea of population, sample and sampling unit, ideas of probability and Non-probability sampling methods, SRSWR/SRSWOR, how to take random sample with examples, purposive and quota sampling. Different steps in survey sampling, sample size determination (only through level of significance approach).Basic idea of Stratified random Sampling(Proportional allocation only),Systematic sampling(Linear approach only) explanation of these techniques with examples.	30	55

SSBSC-II

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2024-25	
B.Sc. in Statistics: Regular Programme						
Year	II	Core Course STM2004C:Probabilitytheory II		Credits / Hours per week	04	
Semester	II	Year of Introduction: 2024			Maximum Marks / Grade	100
Mode of Transaction	Lectures (No. of Hours = 60 T)					
Course Outcomes This course will enable students to CO1 understand the idea of characteristic function and its properties CO2 learn how to obtain moments of various probability distribution using characteristic functions CO3 understand Inversion formula and uniqueness theorem along with their applications CO4 understand of sequence of independent repeated trials CO5 understand derivation of binomial and multinomial probability laws CO6 understand DeMoivre-Laplace local limit theorem and Integral limit theorem for approximation of binomial probabilities CO7 understand derivation of Poisson probability law CO8 develop understanding of sequence of random variables CO9 study various modes of convergence of sequence of random variables CO10 understand the Laws of large numbers for i.i.d. random variables CO11 understand the idea of stochastic processes CO12 introduction to Birth – and -Death process and Poisson process with applications						
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	
1	Characteristic function, The problem of addition of independent random variables, Moment generating functions and their properties, Moment problem, factorial moments, cumulant generating function.			16	25	

2	Demoivre-Laplace Theorem (the integral limit theorem and local limit theorem), Poisson theorem.	13	25
3	Sequences of random variables and various approaches to their convergence, viz. Convergence in distribution, convergence in Probability and almost sure convergence. The weak law of large numbers (Chebyshev's form), special cases of Bernoulli's and Poisson. WLLN (Khinchin's theorem), SLLN for i.i.d.r.v.s. (only statement), the Central Limit Theorem (CLT) for iid random variables with finite mean and variance (Lindberg-Levy Theorem), Lindberg-Feller Theorem (only statement), Lyapunov's theorem.	16	25
4	Introduction to stochastic processes, importance through some real – life examples. Pure Birth process, Birth – and – Death Process, application in queueing theory. Poisson Process, applications of Poisson process.	15	25

Reference Books

1.	Parzen, E. (1972): Modern Probability Theory and its Applications, Wiley eastern ltd.
2.	Statistical Theory By B.W.Lindgren (3 rd edition) – Macmillan Publishing house.
3.	Gut, Allan (2009): An Intermediate Course in Probability, Springer
4.	Bhat, B R (1999): Modern Probability Theory: An Introductory Textbook, 3E, New Age International Pvt Ltd.
5.	The Theory of Probability by B.V. Gnedenko (1969) - Mir Publishers.
6.	A first course in probability by Sheldon Ross (2010) – Pearson Prentice Hall

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2024-25	
B.Sc. in Statistics: Regular Program						
Year	II	Core Course STM2014C: Real Analysis-II			Credits	04
Semester	IV	Year of Introduction: 2024 Year of Syllabus Revision: -			Maximum Marks	100
Mode of Transaction	Lectures (No. of Hours = 60 T)					
Course Outcomes After going through this course, the students will C01: understands the basic concepts of calculus. C02: understand the concept of metric space, and basic topology C03: understand the concepts of continuity in more general setup of metric spaces C04: acquire knowledge of sequence& series of functions. C05: understand integration & differentiation of sequence & series of function. C06: be able to apply the concepts of real analysis to understand probability.						
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	
1	Metric spaces, open and closed sets, perfect sets, dense sets, connected sets, compact sets.			20	30	

2	The limit of a function, Continuity of function, continuity and compactness, continuity and connectedness, uniform continuity , Discontinuity, Monotonic functions, infinite limits and limits at infinity.	15	25
3	Sequences and series of functions, point-wise converge and uniform convergence and continuity, uniform convergence and continuity, uniform convergence and differentiation, Stone-Weierstrass theorem.	10	25
4	Power series, Integration and differentiation of series of functions, function expressible as a power series, Exponential and logarithmic functions.	15	20
1 2	REFERENCES: Methods of Real Analysis by R.R.Goldberg (1970) – Oxford & IBH Publishing Company Pvt. Ltd. Principles of Mathematical Analysis-second edition-Walter Rudin		

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2024-25	
B.Sc. in Statistics: Regular Programme						
Year	II	Core Course STM2024C: Sampling Distributions and Simulation			Credits	04
Semester	II	Year of Introduction: 2024 Year of Syllabus Revision: -			Maximum Marks	100
Mode of Transaction	Lectures&Practicals (No. of Hours = 45 T + 30 L = 75)					
Course Outcomes						
After going through this course, the students will acquire						
CO1 the knowledge of sampling distribution. Some commonly used sampling distribution such as t, chi square, F distribution						
CO2 the knowledge of applications of t-distribution, F-distribution.						
CO3 the knowledge of relationship between some standard probability distribution, transformation of random variables.						
CO4 the knowledge of order statistics and related results.						
CO5 the knowledge of the process of Simulation						
CO6 the knowledge of how to simulate real life applications.						
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	
1	Random sampling, Sample characteristics and their distributions: empirical distribution function, quantile function, Glivenko-Cantelli theorem (Only statement), moments of sample mean, moments of sample variance, m.g.f and characteristic function of sample mean, sampling distribution (t, F and chi square) of sample mean, sample variance, sample proportion, difference between two sample means, ratio of two sample variances, difference between two sample prorortions, non-central t, F and chi-square			15	25	

2	Result based on transformations of random variables based on the distributions discussed in unit-1 and related exercises, order statistics: definition and importance, distributions of minimum, maximum, rth order statistics, joint distribution of two order statistics, joint distribution of k out of n order statistics, joint distribution of all order statistics, distribution of range, related examples	15	25
3	Introduction to Simulation, Importance and Application in various fields, Modelling concepts (probability models and Regression models), Probability and statistics, Probability integral transformation, Random numbers and tables, Random number generation, Idea of Monte Carlo Simulation, and generation of Uniform samples.	15	25
4	Simulation of Sampling distributions, Simulation of Normal samples (Simulation of t, chi-square and f distributions). Inferences based on the simulated samples. Simulation of discrete and continuous distribution and their inferences. Simulation software's, and Real-world applications.	30	25
References:- 1. An Introduction to Probability Theory and Mathematical Statistics By V.K Rohatgi- A wiley- inter science publications. 2. Introduction to Mathematical Statistics (3 rd edition) By Robert V. Hogg, Allen T. Craig – American publishing Pvt. Ltd. 3. Essentials of Monte Carlo Simulation: Statistical methods for building Simulation models, Nick, T. Thomopoulos, Springer.			

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2024-25	
B.Sc. in Statistics: Regular Programme						
Year	II	Core Course			Credits	04
		STE2004C: Applications of Matrices and Numerical methods				
Semester	II	Year of Introduction: 2024 Year of Syllabus Revision: -			Maximum Marks	100
Mode of Transaction	Lectures&Practicals (No. of Hours = 45 T + 30 L = 75)					
Course Outcomes of STA13XXXX						
After going through this course, the students will acquire						
CO1 understanding of the basic properties of vectors, vector spaces and matrices.						
CO2 knowledge of the quadratic forms and their classification ,nature and properties.						
CO3 ability to obtain characteristic roots and vector sand knowledge of theirapplications.						
CO4 ability to obtain g-inverse using various algorithms .						
CO5 ability to solve system of linear equations.						
CO6 ability to apply all above results in statistics.						
CO7 knowledge of different numerical methods, essential for providing mathematical support to the Statisticians						
CO8 ability to apply various difference, interpolation formulae						
CO9 ability to apply various interpolation formulae						
CO10 ability to find solutions to equations using Bisection, Newton Raphson and Regula Falsi Methods						
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	
1.	Brief review of matrices and basic results. Brief Review of vectors and vector spaces. Quadratic forms, their classification. congruence relationship for symmetric matrices. characterisation of quadratic forms in terms of rank and index. characterisation of positive definiteness and semi-definiteness in terms of principle subdeterminants Characteristic roots and characteristic vectors of a square matrix, algebraic and geometric multiplicities, inner products, orthogonality, orthogonal matrices, orthonormal basis, CalayHemiltanttheorem Cochran's theorem. (Both theorems without proof), Orthogonal			12	20	

	compliment of subspace.		
2.	Generalised inverse, algorithms to derive generalized inverse, solutions to system of linear equations. Applications of the above theory in statistics-correlation matrices, S.S. & S.P. matrices, vector valued function, function of vectors, derivative w.r.t. vectors.	12	20
3.	Numerical Analysis: Operators- Shift operator, forward difference, backward difference, central difference, average, differential and interrelations between them. Finite differences of order n, divided differences of order n. Newton's forward, backward and divided difference interpolation formulae with error term. Idea of interpolation and extrapolation, Lagrange's interpolation formula. Central difference formulae: Gauss and Stirling's formulae.	21	35
4.	Practicals	30	25

Reference Books:

1.	Sam Perlis(1958) The Theory of Matrices , Wesley Publishing Co.Inc.
2.	Serale S. R. (1982) Matrix Algebra useful for Statistics, John Wiley & Sons
3.	Hohn (1964) Elementary Matrix Algebra, Amerind Publishing company Pvt. Ltd.
4.	Jain, M.K., Iyengar, S.R. K. and Jain, R.K. (2007). Numerical Methods for Scientific and Engineering Computation, Second Edition, Wiley Eastern Ltd.
5.	Sastry, S.S. (2000). Introductory Methods of Numerical Analysis, 3rd edition, Prentice Hall of India Pvt. Ltd., New Delhi.
6.	Saxena, H.C. (2005). Finite Differences and Numerical Analysis, 15th Revised Edn. (Reprint). S. Chand & Co.

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2024-25	
B.Sc. in Statistics: Regular Programme (Foundation)						
Year	II	VAC2414C:Lean, Green, and Clean Sciences			Credits	02
Semester	II	Year of Introduction: 2024 Year of Syllabus Revision: -			Maximum Marks	100
Mode of Transaction	Lectures (No. of Hours = 30 T)					
Course Outcomes						
After going through this course, the students will acquire						
CO1 understanding of the basic concept of probability and the approach of its theoretical development						
CO2 ability to distinguish between random and non-random experiments						
CO3 fundamental understanding of concept of probability as a tool for modelling data						
CO4 understanding of the notion of conditional probability including the concept of Bayes' Theorem						
CO5 ability to distinguish between independent & dependent event						
CO6 gain the knowledge related to concept of discrete and continuous random variables						
CO7 ability to identify random variables from real life, and develop the understanding of the probability distribution of random variables						
CO8 ability to establish the joint, marginal and conditional probability distribution of random variables						
CO9 fundamental understanding of relating probability theory with descriptive statistics and inference						
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	
1	What is lean? Lean and Quality, Quality definitions and dimensions, Lean Principles, 3P's (People, Process and product) of Lean, Types of wastes, Lean and Green supply chain.			05	20	
2	Principles and examples of green Sciences, Renewable and sustainable sources of energy, Green Science legislation, carbon footprint, carbon credit and Carbon audit. Green and Clean Biodiversity, Impact of lean in Biodiversity, Green wastes and environmental impact, Climate change issues.			10	30	

3	Lean and Green technologies in Business, Green Statistics: Qualitative and Quantitative assessment, Green quality guidelines. Reverse logistics.	05	20
4	Continuous improvement: 5S (Sort, Set-in-order, Shine, Standardize, Sustain), Kaizen (continuous improvement), Poka-Yoke (mistake proofing), and KANBAN (workplace management). Other quality improvement programs.	10	30

References:

1. Muralidharan, K. (2015). Six Sigma for Organizational Excellence: A Statistical Approach, Springer Nature, India.
2. Feigenbaum, A. (1991). Total Quality Control, 3rd ed. revised, McGraw-Hill, New York.
3. Kubiak, T. M. and Benbow, D. W. (2010). The Certified Six Sigma Black Belt Handbook, 2nd ed., Dorling Kindersley (India) Pvt. Ltd.
4. Pande, P. S. Newuman, R. P. And Cavanagh, R.R. (2003). The Six Sigma way. Tata McGraw Hill, New Delhi.
5. Crosby, P. (1979). Quality is Free, McGraw-Hill, New York.
6. Montegomory, D. C. (2003). Introduction to Statistical Quality Control, Wiley India.
7. Juran, J. M., and F. M. Gryna, Jr. (1980). Quality planning and analysis, 2nd ed., McGraw-Hill, New York.

 सत्यं सिवं सुन्दरम्		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2024-25	
B.Sc. (Hons) Regular Programme							
Year	II	Foundation Course VAC2424C:Introduction to Population Science				Credits	02
Semester	I/II	Year of Introduction: 2024 Year of Syllabus Revision: -				Maximum Marks	50
Mode of Transaction		Lectures (No. of Hours = 30 T)					
Unit No.	Topic/Unit					Contact Hours	Weightage (%)
1	Demography: Definition, demography Vs population science, Basic concepts of demography, Nature and scope of demography; the demographic equation. Types and Sources of Demographic Data: Data and types of Data, Different sources of data: Population census - details of different data items in Indian census, Vital registration system, Sample registration system (SRS), survey on causes of death, NSSO surveys, Nationwide sample surveys – NFHS, DLHS; Strengths and weaknesses of various data sets. Population Processes: Fertility, mortality, and migration; Concepts and measurements of fertility: CBR, GFR, ASFR, TFR, GRR, NRR; Determinants of fertility, trends of fertility; Concepts and measures of mortality: CDR, ASDRs, IMR, MMR; Life table, causes of death, mortality trends; Concepts and measures of migration: IMR, OMR, NMR, GMR, MER; internal and international migration, migration trends.					15	50
2	Age and Sex Composition: Definitions of Age and Sex, Sex ratio, sex ratio at birth, Age-specific sex ratio, Classification of age groups and their importance, Analyzing Age-Sex structure – Population pyramid, Measures of age structure - Percent distribution, Median age,					15	50

	dependency ratio and parent support ratio, population aging; Factors affecting age and sex structure, Importance of age-sex structure in Demography, Brief overview of Socio-economic implications of age and sex structure, Demographic dividend. Population Distribution, Density, and Population Growth: Definition of Population distribution and density, factors affecting population distribution; Population growth, trends of population growth in India; Urbanization; Demographic profiles of India and states. Population Theory: Malthusian theory and Demography transition model. Brief overview of the impact of population on environment, economy, and public health.		
References: 1. Weeks (2015): Population - An Introduction to Concepts and Issues, 12th edition, Thomson 2. Poston and Bouvier (2010): Population and Society – An introduction to Demography, Cambridge University Press. 3. Principles Of Population Studies: Asha A. Bhende and Tara Kanitkar 4. Handbook of Indian Demography: J.P. Singh			

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2024-25	
B.Sc. in Statistics: Regular Programme						
Year	II	Core Course			Credits	02
		SEC2464C Exploratory Data Analysis using Excel				
Semester	I	Year of Introduction: 2024 Year of Syllabus Revision: -			Maximum Marks	50
Mode of Transaction	Practicals (No. of Hours = 60 L)					
Course Outcomes						
This course will acquaint the students with						
CO1 Manage Excel workbooks and worksheets effectively, including creating, saving, protecting, and organizing them.						
CO2 Format cells and data using advanced features like conditional formatting, text wrapping, and customizing rows and columns.						
CO3 Apply essential and advanced formulas and functions for data analysis and problem-solving.						
CO4 Create and interpret visualizations using charts, graphs, and advanced graphing techniques.						
CO5 Design and utilize pivot tables and pivot charts for data summarization and multi-level analysis.						
CO6 Perform statistical analysis using the Analysis ToolPak for tasks like histograms and descriptive statistics.						
CO7 Automate workflows by creating and using macros with VBA for improved efficiency.						
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	
1	Introduction to Spreadsheets: Creating and opening workbooks, To create a new blank workbook, To open an existing workbook, Saving workbooks, To use the Save As command, To save as an Excel 97-2003 workbook, To save as a PDF, The Quick Access toolbar, Collaborate in Excel. Managing Worksheets: To rename worksheets, To insert new worksheets, To delete worksheets, To copy a worksheet, To move a worksheet, To colour code worksheet tabs, Freezing worksheet panes: To freeze rows, To freeze columns, To unfreeze panes. Protecting Workbook, Protecting cells and worksheets, View Multiple workbooks, View Multiple worksheets, Group Worksheets and Consolidate. Introduction to cells and cell content: To copy and paste cell content, To access more paste options, To access formatting commands by right-clicking, To drag and drop cells, To use the fill handle to fill cells, Using formulas in Excel and their copy and paste using absolute and relative referencing. Formatting Cells: Formatting text, To change the font, To change the font size,			26	45	

	To use the bold, italic, and underline commands, To add a border, To change font color, To add a fill color, Modifying Columns, Rows, and Cells: To modify column width, To set column width with a specific measurement, To modify row height, To set row height with a specific measurement, To insert rows, To insert columns, To delete rows, To delete columns, Wrapping text and merging cells, Hide and Unhide command: Column and Row, copy visible cell only, Name Cells/Ranges: Insert name- Define, Data Validation, Removing Duplicates, Flash Fill and Text to Columns, Working with arrays, matrix, names. Conditional Formatting: Highlight Cells Rules, Top/Bottom Rules, Data Bars, Color Scales, Find Duplicates, Shade Alternate Rows, Custom Formatting Rule. Tables: Insert a Table and Style Options, Add Rows and Columns, Perform a Function in a Table.		
2	Overview of Formulas and Functions in Excel: Introduction to the IF, Nested IF, IFS, SUM, SUMIF, SUMIFS, SUMPRODUCT, COUNT, COUNTIF, COUNTIFS, COUNTA, ROUND, ROUNDUP, RAND, RANDBETWEEN, VLOOKUP, HLOOKUP, XLOOKUP, XMATCH, FILTER, UNIQUE, SORT, SORTBY functions etc. Data sorting: To sort in alphabetical order, To sort in numerical order, To sort by date or time, Custom sorting: To sort in the order of your choosing, To sort by cell color, font color, or cell icon, Sorting multiple levels. Data filtering: auto Filter and advance Filter, number and text Filters, Date Filters. Advanced Graphing and Charting: Line diagram, Simple Bar diagram, Multiple Bar diagram, Subdivided Bar diagram, Pie chart, Scatter diagram, Box Plot. Pivot Table: Insert a pivot table, Sort, Filter, change summary calculation, Two-dimensional pivot table. Frequency Distribution, Pivot chart: Insert Pivot Chart, Filter Pivot Chart, Filter Pivot Chart, Change Pivot chart type, Group Pivot Table Items: Group products, Group Dates, Multi-level Pivot table: Multiple Row fields, Multiple value fields, Multiple report filter fields, Update Pivot Table: Refresh, Change Data source, Calculated field/item. Analysis ToolPak: Histogram, Descriptive Statistics etc. Visual Basic for Applications (VBA): Create a Macro: Developer Tab, Command Button, assign a Macro, Visual Basic Editor, Macro Recorder: Record a Macro, Run a Recorded Macro.	34	55
Reference Books			
1.	Michael Alexander and Dick Kusleika (2022). <i>Microsoft Excel 365 Bible</i> , Wiley, ,1st Edition.		
2.	Ken Bluttman (2021). <i>Excel Formulas & Functions For Dummies</i> , an imprint of John Wiley & Sons, Inc, 6th Edition.		
3.	Nathan George (2023). <i>Mastering Excel 365: An All-in-One Tutorial Resource</i> , ISBN: 9781915476111		

BSC- III Statistics Detailed Structure

FS BSC III

ID	Title	Credits
Major Courses		
STM3005C	Actuarial Statistics	3T+1L
STM3015C	Theory of Estimation	3T+1L
STM3025C	Regression Analysis	3T+1L
Skill Enhancement Course		
SEC3705C	Advanced Excel Skills for Data Analytics	02
Minor Courses		
STE3xx5C	Minor Elective-I*	3T+1L
STE3xx5C	Minor Elective-II*	3T+1L
	Total	22

** Minor Elective-I and Minor Elective-II are to be selected from the following List*

STE3005C Statistical Ecology (3T+1L)
STE3015C Fundamentals of Econometrics (3T+1L)
STE3025C Statistical Quality Control (3T+1L)

SS BSC III

ID	Title	Credits
Major Courses		
STM3006C	Testing of Hypothesis	3T+1L
STM3016C	Introduction to R	3T+1L
STM3026C	Design of Experiments	3T+1L
Ability Enhancement Course		
AEC3456C	Data Visualization	2L
Minor Course		
STE3xx6C	Minor Elective-III**	04
Internship		
SEC3496C	Internship in Statistics and Actuarial Science	04
	Total	22

*** Minor Elective-III course is to be selected from the following list*

STE3006C Index numbers and Time Series (3T+1L)

STE3016C Indian Official Statistics & Demography (04)

FSBSC-III

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2025-26	
B.Sc. (Hons) Regular Programme						
Year	III	Major course STM3005C Actuarial Statistics			Credits	3T + 1L
Semester	I	Year of Introduction: 2025 Year of Syllabus Revision: -			Maximum Marks	100
Mode of Transaction	Lectures and Lab Sessions					
Course Outcomes						
This course will acquaint the students with						
CO1 Basic concepts of actuarial Science						
CO2 Probability models for Life, Life table and its applications						
CO3 Probability models for individual and aggregate claims						
CO4 Computations various types of Insurance payables.						
CO5 Different types of life annuities and their computation						
CO6 Net premiums and Net premium reserves.						
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	
1	Utility theory, insurance and utility theory, models for individual claims and their sums, survival function, curtate future lifetime, force of mortality. 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.			15	25	

2	Multiple decrement models, deterministic and random survivorship groups, associated single decrement tables, central rates of multiple decrement, net single premiums and their numerical evaluations. Distribution of aggregate claims, compound Poisson distribution and its applications. Distribution of aggregate claims, compound Poisson distribution and its applications.	15	25
3	Concept of Survival Models, censored data, Estimation procedures of Life time Distributions –Cox Regression model – Nelson and Aalen Estimates. Binomial and Poisson models of mortality – MLE for probability of death – Comparison	15	25
4.	Lab sessions based on Units 1, 2, and 3	30	25

Reference Books

1.	Shailaja R Deshmukh (2009). Actuarial Statistics: An Introduction using R. University Press Pvt.LtdHyderabad(Text Book)
2.	N. L. Bowers, H. U. Gerber, J. C. Hickman, D. A. Jones and C. J. Nesbitt, (1986), Actuarial Mathematics', Society of Actuaries, Itasca, Illinois, U. S. A. Second Edition (1997)
3.	Spurgeon E. T. (1972), Life Contingencies, Cambridge University Press
4.	Neill, A. (1977). Life Contingencies, Heinemann

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2025-26
B.Sc. in Statistics: Regular Programme					
Year	III	Major course STM3015C Theory of estimation			Credits 3T+1L
Semester	I	Year of Introduction: 2025 Year of Syllabus Revision:			Maximum Marks 100
Mode of Transaction	Lectures and Lab Sessions				
Course Outcomes					
This course will acquaint the students with					
CO1 understanding of the concept of sufficiency and minimal sufficiency.					
CO2 understanding of the concept of unbiasedness, UMVUE and bound estimators.					
CO3 Understand the concept of interval estimation					
CO4 knowledge of various properties of estimators.					
CO5 ability to use various methods of estimations.					
Unit No.	Topic/Unit			Contact Hours	Weightage (%)
1	Sufficiency: Definition of sufficiency through i) partition of sample space, ii) conditional distribution and iii) through factorization, proof of equivalence of these definition in discrete case, Idea of minimal sufficient statistic, Use of factorization theorem to obtain sufficient statistic, method of finding minimal sufficient statistic, use of factorization theorem to obtain sufficient statistics for sample from standard distribution (both regular and non-regular cases).Sufficient statistics for one parameter exponential family.			12	20
2	Point estimation, Unbiasedness, concept of MVUE, the Cramer-Rao inequality and Bound estimator, simple examples to show that the C-R bound may not be attained. Proof that sample mean is the BLUE of population mean. Interval estimation: confidence level, Shortest length confidence interval.			18	30

3	Concept of efficiency, and consistency. The methods of point estimation: The method of moments, the method of maximum likelihood, Iterative method to find MLE, properties of MLE, method of minimum chi-square. A brief introduction to Bayesian Inference – Bayesian Estimation.	15	25
4	Lab sessions based on Units 1, 2, and 3	30	

Reference Books

1.	An introduction to probability and Statistics (2 nd edition) by V K Rohatgi and A K Md Ehsanes Saleh
2.	B.W.Lindgren: Statistical Theory (IIIrd edition) – Macmillan Publishing house..
3.	Statistical inference (2 nd edition) by G. Casella and R I Berger

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2025-26
B.Sc. in Statistics: Regular Programme					
Year	III	Major course STM3025C REGRESSION ANALYSIS			Credits 3T+1L
Semester	I	Year of Introduction: 2025 Year of Syllabus Revision: -			Maximum Marks 100
Mode of Transaction	Lectures and Lab Sessions				
Course Outcomes					
After going through this course, the students will acquire					
CO1 the concept of analysis of variance & its use while developing a regression model.					
CO2 the development of regression theory using matrix notations.					
CO3 the knowledge of fitting of a straight line ,Inverse regression, extra sum of squares and general linear hypothesis					
CO4 concept of residuals, examinations of residuals, multiple regression with two variables					
CO5 able to analyze the residuals for validating and improving the regression models					
CO6 learn the skills of developing regression models using various approaches					
Unit No.	Topic/Unit			Contact Hours	Weightage (%)
1	The need for statistical analysis, Fitting a straight line, Analysis of variance, Estimation and hypothesis testing, Correlation and regression, Inverse regression (straight line case). The linear regression with more than one regressors (Analysis using matrix notations), the extra sum of squares principle, orthogonal columns in x matrix, F tests, testing a general linear hypothesis. The examination of residuals, overall plot, time sequence plot, plot against Y, plot against the predictor variables.			15	25

2	Multiple regression with two predictors as a sequence of straight-line regressions. Models involving transformed variables (Use of scatter plots), the use of dummy variables in multiple regression, polynomial models and use of orthogonal polynomials.	15	25
3	Regression Model building: All possible regressions, 'best subset' regression, Backward elimination procedure, the stepwise regression procedure. One-way classification viewed on a regression problem. Partial/ Multiple correlation, obtaining various formulae in terms of covariance matrix/ correlation matrix, in terms of lower order correlations, regression in multivariate normal population	15	25
4	Lab sessions based on Unit 1, 2, and 3.	30	25
Reference Books			
1	Drapper and Smith: Applied regression Analysis (2nd Edition) – John Wiley & Sons.		

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2025-26	
B.Sc. in Statistics: Regular Programme						
Year	III	Minor course STE3005C Statistical Ecology			Credits	3T+1L
Semester	I	Year of Introduction: 2025 Year of Syllabus Revision:			Maximum Marks	100
Mode of Transaction	Lectures and Lab Sessions					
Course Outcomes This course will acquaint the students with CO1 understanding of the concept of Ecology CO2 understanding of the population dynamics of single species population CO3 Understand the concept survivor data and hazard rates. CO4 understanding of the population dynamics of two interacting species. CO5 understanding the concept of abundance and biodiversity. CO6 ability to use various methods of abundance estimations. CO7 ability to use various indices of diversity.						
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	
1	Introduction to ecology and evolution. Population dynamics: Single species – Linear, Exponential, Sigmoidal growth, Logistic and Gompertz models, Laslie matrix model for age and stage structured population, Survivorship Data – Exponential, Weibull distribution. Constant, monotone and bathtub shaped hazard rates			12	20	
2	Two species: Lokta – Volterra equations, Isoclines, Competition and Coexistence, predator-pray oscillations.			15	25	

3	Abundance estimation: nearest neighbour, line transect sampling, Capture-recapture, Indirect methods. Ecological diversity: species abundance distributions, indices of diversity (Simpson's index, Shannon-Weiner index), Diversity as average rarity.– maximum sustainable yield,	18	30
4	Lab sessions based on Units 1, 2, and 3	30	25

Reference Books

1	Gore Anil, Paranjape, S. A. (2000): A Course on mathematical and statistical ecology, Kluwer).
2	Farber P. L. (2000): Finding order in nature, Johns Hopkins University Press
3	Pielou, E. C. (1977): An Introduction to Mathematical Ecology
4	Seber, G. A. F. (1982): Estimation of Animal Abundance and Related Parameters, Charles Griffin.
5	Stephens, D. W. and Krebs, J. R. (1986): Foraging Theory, Princeton University Press.
6	Odum E. and Barrett G. (2004): Fundamentals of Ecology, 5 th Edition, Brooks/Cole

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2025-26
B.Sc. in Statistics: Regular Programme					
Year	III	Minor course STE3015C Fundamentals of Econometrics			Credits 3T+1L
Semester	I	Year of Introduction: 2025 Year of Syllabus Revision: -			Maximum Marks 100
Mode of Transaction	Lectures and Lab sessions				
Course Outcomes					
This course will acquaint the students with					
CO1 what is econometrics, CNLRM, Dummy variable regression models					
CO2 Multicollinearity: Nature, detection, remedial measures.					
CO3 Heteroscedastic disturbances :Nature ,estimation in presence of Heteroscedasticity					
CO4 detection and remedial measures ,concluding remarks.					
CO5 Autocorrelation detection, consequences and remedial measures					
CO6 Additional aspects of Autocorrelation and concluding remarks					
Unit No.	Topic/Unit			Contact Hours	Weightage (%)
1	Nature of econometrics: Types of Econometrics, Classical Normal Linear Regression Models(CNLRM) Multiple Regression Analysis(MRA) :The problem of Estimation. The problem of Inference inferential problems, Dummy variable regression models			12	15
2	Multicollinearity :Nature, OLS Estimation in presence Of Multicollinearity, detection, remedial measures.			11	20
3	Heteroscedasticity: Nature detection ,OLS in presence of heteroscedasticity, GLS estimation, remedial measures .Concluding remarks			11	20

4	Autocorrelation: Nature, OLS in presence of Autocorrelation, detection, Durbin-Watson test, remedial measures, Additional aspects of Autocorrelation.	11	20
5	Lab sessions based on Units 1, 2, 3, and 4.	30	25

Reference Books

1.	Basic Econometrics: Damodar Gujarati, Dawn C. Porter and Sangeeta Gunasekar. Mc Graw Hill Education, 5 th edition SCPOE: Unit-1 Part-I Chapter 4, 7, 8, 9 Unit-2 : Part-II chapter 10, Unit-3 : Part-II chapter-11 Unit-4: Part-II chapter -12.
2.	Goldberger, A.S., Topics in Econometrics, Mcmillan, New York, 1968
3.	Maddala, G.S. Introduction to Econometrics, 3 rd Edition, John Wiley & Sons, New York 2001
4.	Draper, N.R. and H. Smith, Applied Regression Analysis 3 rd Edition, John Wiley & Sons, New York 1998.

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2025-26	
B.Sc. in Statistics: NEP Programme						
Year	III	Minor Course STE3025C Statistical Quality Control			Credits	3T+1L
Semester	I	Year of Introduction: 2025 Year of Syllabus Revision: -			Maximum Marks	100
Mode of Transaction	Lectures and Lab Sessions					
Course Outcomes						
After going through this course, the students will acquire						
CO1 understanding of the concepts of chance and assignable causes of quality variation						
CO2 knowledge of the use of control charts to detect assignable causes						
CO3 basic understanding of the need and importance of control charts for attributes						
CO4 basic understanding of the concepts of control charts for variables						
CO5 ability to develop the skill to choice between attributes and variable control charts						
CO6 understanding of the need of sampling plan for attributes						
CO7 understanding of the need of sampling plan for variables						
CO8 gain knowledge of real data implementation of various concepts through practical assignments						
Unit No.	Topic/Unit				Contact Hours	Weightage (%)
1	Chance and assignable causes of quality variation, statistical basis of control charts, choice of control limits, sample sizes and sampling frequency, rational subgroups, analysis of pattern on control chart.				10	15
2	Control charts for attributes: Control chart for fraction nonconforming, development and operation of chart, np-control chart, variable sample size, control chart for nonconformities, U-chart.				11	15
3	Control chart for variables, control charts for $\bar{X}$ and R, statistical basis of chart, development and use of chart, control limits, specification limits, natural tolerance limits, rational subgroups, design of control chart, probability limits on $\bar{X}$ and R, chart the effect of nonnormality on $\bar{X}$ and R charts, the OC function of the $\bar{X}$ and S chart, the S^2 control chart, choice between attributes and variable control chart.				12	22

4	Lot-by-lot acceptance sampling for attributes, advantages and disadvantages of acceptance sampling, single sampling plan for attributes, designing single sampling plan with specified OC curve, rectifying inspection. ATI and AOQ functions, double sampling plan, the OC curve, rectifying inspection with ATI and AOQ functions, multiple sampling plan. Acceptance sampling by variables, advantages and disadvantages of variable sampling plan to control lot fraction nonconforming, procedure 1(k-method) and procedure 2 (M-method) for designing variable sampling plan with specified OC curve.	12	23
5	Lab sessions based on Units 1, 2, 3, 4	30	25
Reference Books:			
1. Douglas C. Montgomery: Introduction to Statistical Quality Control (4th Edition) (2001) John Wiley & Sons			

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2025-26	
B.Sc. in Statistics: Regular Programme						
Year	III	Core Course SEC3705C Advanced Excel Skills for Data Analytics			Credits	02
Semester	I	Year of Introduction: 2025 Year of Syllabus Revision: - 2025			Maximum Marks	50
Mode of Transaction	Practicals (No. of Hours = 60 L) (Min. Marks:18, Max. Marks: 50) (IA:25, UA:25)					
Course Outcomes						
This course will acquaint the students with						
CO1 Effectively managing, transforming and extracting data from raw data as per requirement using inbuilt reference formulas.						
CO2 Data preparation for the data analysis using date and time, time series functions and formulas.						
CO3 Efficiently carry out statistical data analysis using data analysis tool pack.						
CO4 Projecting the future values based on the available data points using forecast sheets.						
CO5 Solving Goal oriented problems using solver and what-if analysis facility.						
C06 Automate workflows by creating and using power query.						
Unit No.	Topic/Unit				Contact Hours	Weightage (%)
1	Advance Pivot table functions: slicer and timeline, DATE, WEEKDAY, EDATE, EOMONTH, ISOWEEKNUM, WEEKNUM, IFERROR, Overview of Formulas and Functions in Excel: HLOOKUP, VLOOKUP, XLOOKUP, INDEX, MATCH, OFFSET, VSTACK, HSTACK, DATEDIF, NETWORKDAYS, FORESCATE.ETS FORECAST.ETS.CONFINT, FORECAST.ETS.SEASONALITY, FORECAST.ETS.STAT, SLOPE, financial analysis formula like PV (Present Value), FV (Future Value), NPV (Net Present Value), IRR (Internal Rate of Return), PMT (Payment), PPMT (Principal Payment), IPMT (Interest Payment), XNPV (Net Present Value with Dates), XIRR (Internal Rate of Return with Dates), MIRR (Modified Internal Rate of Return) forecast sheet, power pivot: Data				28	45

	modeling, building relationship between tables, Data analysis. STANDADIZE		
2	Data analysis tool pack: Descriptive Statistics, Random number generation, Sampling, One-way ANOVA, Two-way ANOVA, moving average, exponential smoothing, regression (with and without intercept), F-test for two sample, t-test from one two and paired, z-test, What-if analysis: Scenario Planning, Sensitivity Analysis, Goal Seeking, Data Table Analysis, use of Solver for Financial Decision-Making, Supply Chain Optimization, Root Finding , power query: Data Acquisition and Connection, Data Transformation and Cleaning, Data Combination, Automated Data Preparation, Integration with other Excel Features	32	55
Reference Books			
1.	Alexander, M., & Kusleika, D. (2025). <i>Microsoft Excel 365 Bible</i> . John Wiley & Sons. Review like of the book		
2.	Collie, R., & Singh, A. (2015). <i>Power Pivot and Power BI: The Excel User's Guide to DAX, Power Query, Power BI & Power Pivot in Excel 2010-2016</i> . Tickling Keys, Inc. Review link of the book		
3.	Harvey, G. (2018). <i>Excel 2019 All-in-one for Dummies</i> . John Wiley & Sons. Review link of the book		
4.	Mount, G. (2024). <i>Modern Data Analytics in Excel: Using Power Query, Power Pivot, and More for Enhanced Data Analytics</i> . " O'Reilly Media, Inc.". Review link of the book		
5.	Schmuller, J. (2021). <i>Statistical analysis with Excel for dummies</i> . John Wiley & Sons. Review link of book		

SSBSC-III

 सत्यं शिवं सुन्दरम्		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2025-26
B.Sc. in Statistics: Regular Programme					
Year	III	Major Course STM3006C Testing of Hypothesis			Credits 3T+1L
Semester	II	Year of Introduction: 2025			Maximum Marks 100
Mode of Transaction	Lectures and Lab sessions				
Course Outcomes					
This course will acquaint the students with					
CO1 understanding of the basic concepts of Testing of Hypothesis.					
CO2 solving exercises based on above concepts.					
CO3 Understanding NP lemma and it's use to derive MP, UMP tests.					
CO4 knowledge of likelihood ratio tests and their applications.					
CO5 Knowledge of various non-parametric tests.					
Unit No.	Topic/Unit			Contact Hours	Weightage (%)
1	Testing of Hypothesis: Null hypothesis, Alternative hypothesis, simple and composite hypothesis, setting up of null hypothesis, types of error, Critical region, level of significance, power with examples.			10	15
2	The Neyman-Pearson lemma, the most powerful test of a simple hypothesis against a simple alternative, UMP tests (obtainable using N-P lemma, relation between testing of hypothesis and construction of confidence interval.			12	20

3	Heuristic justification (using likelihood ratio test procedure) of the t-test and the F-test as applied to the normal populations, the χ^2 -test for goodness of fit, the χ^2 -test for independence in contingency tables, the Fisher-Irwin test for a 2×2 table,	12	20
4	Nonparametric tests-the sign test, the sign-rank test, Wilcoxon-Mann-Whitney test, test for randomness (Run test), Kolmogorov-Smirnov one sample test.	11	20
5	Lab sessions based on Units 1, 2, 3, and 4.	30	25
Reference Books			
1.	V K Rohatgi and A K Md Ehsanes Saleh (2008): An introduction to probability and Statistics, 2nd edition, Wiley		
2.	B. W. Lindgren (1993): Statistical Theory, 4 th Edition, Chapman & Hall/ CRC		
3.	G. Casella and R. L. Berger (2002): Statistical inference, 2 nd Edition, Cengage		
4.	D. Bhattacharya and S. Roychowdhury (2017): Nonparametric Statistical methods, Medtech publications		

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2025-26
B.Sc. in Statistics: Regular Programme					
Year	III	Major Course STM3016C Introduction to R		Credits / Hours per week	3T+1L
Semester	II	Year of Introduction: 2025		Maximum Marks / Grade	100
Mode of Transaction	Lectures and Lab sessions				
Course Outcomes					
After studying this course students will be exposed to					
CO1 Basic understanding of R language, the R environment and introduction to basic data structures in R					
CO2 Use of built-in R functions for exploratory data analysis of univariate data					
CO3 Use of built-in R functions for exploratory data analysis of bivariate data					
CO4 Use of built-in R functions for probability distributios and random number generations					
CO5 Importing and exporting data files					
CO6 Developing simple programs in R					
CO7 Fitting various linear models using R					
CO8 Creating 2D and 3D graphics using R					
CO9 Cross tabulation and analysis of categorical data					
CO10 Fitting various nonlinear models using R					
Unit No.	Topic/Unit			Contact Hours	Weightage (%)
1	Introduction to R- A programming language and environment for data analysis and graphics, Syntax of R expressions: names and assignments, Operators and their precedence, subscripting, Data classes, modes and types. Data objects: Basic data objects, vectors, matrices, arrays, lists, factors and ordered factors, Creating and using these objects; Functions- Elementary functions and summary functions, applying functions to subsets of data. Data frames: The benefits of data frames, Creating data frames, Combining data frames, Adding new classes of variables to data frames; Data frame attributes.			12	15

2	Mathematical computing in R: vector and matrix computations, probability and random numbers; The object oriented matrix library. Performing data analysis tasks: Reading data with scan function, Exploring data using graphical tools, computing descriptive statistics, One sample tests, two sample tests, Goodness of fit tests. Exploring relationships between data: plotting scatter diagrams, correlation coefficient and testing its significance, regression analysis- Fitting the model, examining residuals, pairwise scatter plots, Adding and dropping terms from a model, Stepwise regression, Updating models.	14	23
3	Specifying models in R: Basic formulas, effect of a categorical variable, specifying interactions, specifying nested effects, Specifying contrasts; Using models with fitting formulas, Useful functions for model fitting; Analysis of variance for designed experiments. Importing data files: import.data function, read.table function; Exporting data: export.data function, cat, write, and write.table functions; Outputting results - sink function, formatting output - options, and format functions; Exporting graphs - export.graph function. Developing simple programs in R for data analysis tasks, saving programs, executing stored programs.	08	15
4	Graphics in R: creating graphs using plot function, Plot shapes, plot types, multiple plot layout, plot titles, formatting plot axes; 3-D plots: Contour plots, perspective plots, and image plots. Interactively adding information of plot - Identifying the plotted points, adding trend lines to current scatter plot, adding new data to current plot, adding text and legend. Visualizing the multivariate data: Scatter plot matrices, Star plots, Faces. Cross tabulating data, cross classifying subsets of data frames, manipulating and analysing cross classified data; Weighted regression, Polynomial regression, linear mixed effect models.	11	22
5	Lab sessions based on Units 1, 2, 3, and 4	30	25

Reference Books

1.	Peter Dalgaard (2002): Introductory Statistics with R, Springer.
2.	Tilman M. Davies (2016): The Book of R-A first course in programming and Statistics, No starch Press
3.	J. Maindonald and W. John Braun (2010): Data analysis and graphics using R- An example based approach (3 rd Edition), Cambridge University Press.
4.	Michael Crawley (2007): The R Book, John Wiley & Sons.
5.	Chambers J. M. (1998): Programming with Data: A guide to S language, Springer.
6.	Venables W N and Ripley B D (2000): S Programming, Springer

	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2025-26
B.Sc. in Statistics: Regular Programme				
Year	III	Major Course STM3026CDesign of Experiments	Credits / Hours per week	3T+1L
Semester	II	Year of Introduction: 2025	Maximum Marks / Grade	100
Mode of Transaction		Lectures and Lab sessions		
Course Outcome (CO) CO1 carry out one way and two-way Analysis of Variance CO2 understand the basic terms used in design of experiments CO3 use appropriate experimental designs to analyse the experimental data, CO4 analyse 2 ² and 2 ³ factorial experiment				
Unit No.	Topic/Unit		Contact Hours	Weightage (%)
1	Concepts of experimentation: Design and analysis. Three principles of experimentation's, contrasts techniques, using this technique for comparison of treatment contrast, statistical models for experimental data, concept of fixed, random and mixed effect models, models and analysis of variance.		12	20
2	Completely randomized design, randomized block design, missing observation in above design and their analysis. Latin square design, missing observations in above design and their analysis.		18	30
3	Factorial experiments: Factorial experiment with factors at two level, concept of confounding: partial and total confounding, Yates' procedure for analysis of these experiments.		15	25
4.	Lab sessions based on Units 1, 2, and 3.		30	25
Reference Books				
1.	Das M. N. and Giri N. C. (1987): Design and Analysis of experiments, 2 nd edition, Wiley Blackwell			

2.	HinkelmannK. and Oscar Kempthorne (1994): Design and Analysis of Experiments, Volume 1: Introduction to Experimental Design, Wiley Blackwell
3.	Montgomery D. C. (2019): Design and Analysis of Experiments, 10 th edition, Wiley

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2025-26	
B.Sc. in Statistics: Regular Programme						
Year	III	Ability Enhancement Course AEC3456C Data Visualization			Credits / Hours per week	02
Semester	II	Year of Introduction: 2025			Maximum Marks / Grade	50
Mode of Transaction	Laboratory sessions					
Course Outcomes CO1 CO2 CO3 CO4						
Unit No.	Topic/Unit				Contact Hours	Weightage (%)
1	Importance of data visualization, its relevance in the modern age; Data Visualization – as a means of communicating information, as a means of data exploration; perception and data visualization, visual tasks involved in interpreting visual displays, different channels for representing data. Data Visualization through ggplot2 package: ggplot – implementation of the grammar of graphics, aesthetics and geometry, working of ggplot, building ggplot layer by layer, mapping aesthetics, grouped data and group aesthetics, using facet, using geoms to transform data, creating various plots, annotations, working with models, drawing maps, refining plots.				30	50
3	Interactive Data Visualization: Interactive web graphics, The JavaScript library plotly.js, creating a plotly object – direct initialization, transforming a ggplot2 object; Creating and publishing views, Combining multiple views, Linking multiple views at client side, a brief overview of server side linking with shiny. Introduction to Tableau: Tableau interface, connecting to data, preparing data for visualization, building a data visualization, refining visualization, building maps, building a dashboard by combining views, publishing visualizations				30	50
References Books						

1.	Kieran Healy (2019): Data Visualization – A Practical Introduction, Princeton University Press.
2.	Carson Sievert (2020): Interactive Web-Based Data Visualization with R, plotly, and shiny, CRC Press. (https://plotly-r.com)
3.	https://www.tableau.com/learn

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics			Academic Year	2025-26
B.Sc. in Statistics: Regular Programme					
Year	III	Minor Course STE3006E Index Numbers and Time Series	Credits	3T + 1L	
Semester	II	Year of Introduction: 2025 Year of Syllabus Revision: -	Maximum Marks	100	
Mode of Transaction	Lectures and lab sessions				
Course Outcomes After going through this course, the students will acquire the knowledge CO1 of various types of index numbers their construction and their applications CO2 of basic concepts and objectives of time series CO3 and skill for analyzing time series data using by various descriptive techniques CO4 of Auto correlation and will study various probability models for time series data CO5 of probability models fitted to the given time series data CO6 of forecasting and its various methods					
Unit No.			Contact Hours	Weightage (%)	
1.	Index numbers: problems in construction of index numbers, errors in index numbers, chain index number, cost of living index number, index number of wholesale price.		10	12	

2.	Introduction to time series, objectives of time series analysis, various approaches to time series analysis. Descriptive techniques: Types of variations (trend, seasonal effect, cyclic changes, irregular changes), analyzing series which contain a trend, measuring a seasonal effect.	10	18
3.	Autocorrelation: The correlogram and its interpretation. Probability models for time series: A purely random process MA, AR, processes.	12	20
4.	Fitting a suitable model to the given time series: Fitting an autoregressive process, Fitting a moving average process, Residual Analysis. Forecasting: Extrapolation of trend curves, exponential smoothing.	13	25
4.	Lab sessions based on Units 1, 2, 3, and 4	30	25
References Books:			
1. A. M. Goon, M. K. Gupta and B. Dasgupta (2005): Fundamentals of Statistics, Vol. 2, The world press Pvt. Ltd. 2. Chatfield, C. (2004): The analysis of Time series: An Introduction, 6 th Edition, Chapman and Hall/ CRC Press			

		The Maharaja Sayajirao University of Baroda Faculty of Science Department of Statistics		Academic Year	2025-26
B.Sc. in Statistics: Regular Programme					
Year	III	Minor Course STE3016C Indian Official Statistics and Demography			Credits 04
Semester	II	Year of Introduction: 2025			Maximum Marks 100
Mode of Transaction		Lectures and Tutorials			
		Section-I (Indian Official Statistics)			
Unit No.	Topic/Unit			Contact Hours	Weightage (%)
1	Introduction to Indian and International statistical systems. role, function and activities of central and state statistical organizations, organization of large scale sample surveys, role of national sample survey organization general and special data dissemination systems.			10	
2	Population growth in developed and developing countries, evaluation and performance of family welfare programmes, projections of labour force and manpower, scope and content of population census of India.			10	15
3	System of collection of agricultural statistics, crop forecasting and estimation, productivity, fragmentation of holdings, support prices, buffer stocks, impact of irrigation projects.			10	15
References: 1. Basic Statistics Relating to the Indian Economy (CSO), 1990. 2. Guide to Official Statistics (CSO) 1999. 3. Statistical System in India (CSO), 1995. 4. Principles and accommodation of National Population Censuses, UNESCO. 5. Panse, V.G.: Estimation of Crop Yields (FAO). 6. Family Welfare Yearbook, Annual Publication of D/o Family Welfare. 7. Monthly Statistics of Foreign Trade in India, DGCIS, Calcutta and other Govt. Publications.					

	Section-I(Demography)		
Course Outcomes			
After going through this course, the students will acquire			
CO1 understanding of the need and importance of Census and registration methods for collecting the data			
CO2 fundamental understanding of various measures of mortality and fertility			
CO3 ability to construct and implication of life tables			
CO4 ability to estimate and project population using various methods			
CO5knowledge of various demographic concepts as outlined above through practical assignmentsto understand real life data			
Unit No.	Topic/Unit	Contact Hours	Weightage (%)
1	Census and registration methods for collecting the data, measures of mortality: crude death rate, age specified death rate, standardized death rate, comparative mortality index, cause of death rate, maternal mortality rate, infant mortality rate, case fatality rate, measures of fertility: crude birth rate, general fertility rate, total fertility rate, gross reproduction rate, net reproduction rate, measurement of morbidity: morbidity incidence rate, morbidity prevalence rate.	12	22
2	Life tables: description of life table, construction of life table, use of life table, abridged life table, King’s method Greville’s method, Chiang’s method.	10	15
3	Population estimates and projections: Intercensal and postcensal estimates by mathematical method, projection by mathematical method, projection by component method.	8	13
References Books			
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