PREFACE

The Four-Year Undergraduate Programme (FYUGP) in Statistics aligns with the objectives outlined in the National Education Policy (NEP), fostering holistic development, and preparing students for the dynamic demands of the future.

The Curriculum and Syllabus of BSc (Honours) Statistics programme offers a comprehensive curriculum and syllabi aimed to equip students with theoretical and practical knowledge across various branches of Statistics. The programme is structured with Major and Minor courses (DSC, DCC, DCE, DSE etc), Multi-Disciplinary Courses (MDC), Skill Enhancement Courses (SEC), Value Added Courses (VAC), Internship and Research Projects.

Students pursuing the Bachelor of Science in Statistics have two exit options: B Sc Degree and B Sc Degree (Honours with Research), awarded after the successful completion of three and four years respectively. The curriculum integrates traditional components of Statistics with recent advancements in the field of Data Analytics, Machine Learning and Data Science, in general.

The B Sc (Honours) Programme in Statistics offered by Mar Athanasius College (Autonomous), Kothamangalam is with **Data Analytics and Machine Learning** as specialisations. It enables the students to acquire the skills needed to excel in the fields of data analytics and machine learning. In addition, the syllabi incorporate fundamental Statistics courses like advanced probability theory, advanced statistical inference, real analysis, etc. to enable the students to pursue careers in Academic and applied research, as well. The Curriculum focuses on Statistical programming, Clinical data analytics, Business analytics, Predictive analytics, and Statistical machine learning, which are the most sought-after courses of the hour.

The Chairperson

Board of Studies in Statistics

Mar Athanasius College (Autonomous)

Kothamangalam

BOARD OF STUDIES IN STATISTICS	
NAME	**DESIGNATION**
CHAIRMAN	
Smt. Sudha V	Assistant Professor and Head, Dept. of Statistics, Mar Athanasius College
EXPERTS (2)	
Dr. Rajesh G	Professor Department of Statistics Cochin University of Science and Technology Kochi - 682022, Kerala, India
Dr. Jerin Paul	Assistant Professor Department of Statistics Vimala College, Thrissur Kerala, India
ONE EXPERT TO BE NOMINATED BY THE VICE CHANCELLOR (MGU)	
Dr. Priya P Menon	Principal and Associate Professor Government College Tripunithura Ernakulam – 682301, Kerala, India
MEMBER TEACHERS IN THE DEPARTMENT	
Dr. Nidhi P Ramesh	Assistant Professor
Dr. Jitto Jose	Assistant Professor
MEMBER FROM INDUSTRY	
Dr. D Dhanuraj	Chairman Centre for Public Policy Research, Kochi, Kerala, India
MERITORIOUS ALUMNUS	
Dr. E. I. Abdul Sathar	Professor Department of Statistics University of Kerala Trivandrum – 695581, Kerala, India.

PROGRAMME OUTCOMES (PO)

PO 1: Critical thinking and Analytical reasoning
Capability to analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.

PO 2: Scientific reasoning and Problem solving
Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.

PO 3: Multidisciplinary/interdisciplinary/transdisciplinary Approach
Acquire interdisciplinary /multidisciplinary/transdisciplinary knowledge base because of the learning they engage with their programme of study; develop a collaborative-multidisciplinary/interdisciplinary/transdisciplinary- approach for formulating constructive arguments and rational analysis for achieving common goals and objectives.

PO 4: Communication Skills
Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

PO 5: Leadership and Entrepreneurship Skills
Ability to work effectively and lead respectfully with diverse teams; setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. After inculcating all the necessary graduate qualities, a graduate can become an entrepreneur.

PO 6: Social Consciousness and Responsibility
Ability to contemplate the impact of research findings on conventional practices, and a clear understanding of responsibility towards societal needs and reaching the targets for attaining inclusive and sustainable development.

PO 7: Equity, Inclusiveness and Sustainability
Appreciate equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism, and national integration to enable to act as dignified citizens; able to understand and appreciate diversity (caste, ethnicity, gender and marginalization), managing diversity and use of an inclusive approach to the extent possible.

PO 8: Moral and Ethical Reasoning

Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviour.

PO 9: Networking and Collaboration
Acquire skills to be able to collaborate and network with educational institutions, research organisations and industrial units in India and abroad.

PO 10: Lifelong Learning
Ability to acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme Specific Outcomes (PSO)

PSO NO:	Upon completion of the Four-Year BSc Statistics (Honours) Undergraduate Programme the students will be able to:	PO No:
PSO-1	Formulate and analyse statistical problems, precisely defining the key terms, and draw conclusions based on statistical analyses.	1, 2, 3
PSO-2	Use statistical techniques to solve real-life problems and present their theoretical background, both in oral and written format to various audiences.	1, 2, 3, 4, 10
PSO-3	Read, understand and construct correct mathematical and statistical proofs and use the library and electronic data-bases to locate information on statistical problems.	1, 2, 3, 4, 9, 10
PSO-4	Explain the importance of Statistics and its techniques to solve real life problems and understand the limitations of such techniques and the validity of the results.	2, 3, 5, 6, 8, 9
PSO-5	Formulate new statistical problems and use software packages and / or computer programming to solve them.	2, 5, 6
PSO-6	Continue to acquire statistical knowledge and skills appropriate to professional activities and to maintain high level of ethics in statistical investigations	7, 8, 10

SCHEME OF INSTRUCTIONAL CREDITS AND HOURS

No	Semester	Course Title		Course Type	Credit	Hrs/ Week	Total Hours
1	1	Fundamentals of Statistics and Data Visualization		DSCA	4	5	90
2	1	Statistical Data Collection Techniques		MDC	3	4	72
3	2	Introduction to Statistical Modelling		DSC A	4	5	90
4	2	Data Analytics Using JAMOVI		MDC	3	4	72
5	3	Statistical Models for Data Analytics		DSC A	4	4	72
6	3	Multivariate Data Analytics-I		DSC A	4	5	90
7	3	Statistical Computing Using R Programming	Any 1	DSE	4	5	90
	3	Statistics for Industrial Quality Control					
8	3	Applied Statistics		MDC	3	3	54
9	3	Statistical Documentation Tools		VAC	3	3	54
10	4	Models for Multivariate Data Analytics		DSC A	4	5	90
11	4	Statistical Inference		DSC A	4	5	90
12	4	Biostatistics	Any 1	DSE	4	4	72
13	4	Vital Statistics and Index Numbers					
14	4	Statistical Inference Using R/Python		DSC B	4	5	90
15	4	Data Analytics Using Gretl		VAC	3	3	54
16	4	Statistics for Competitive Examinations		SEC	3	3	54
17	4	Internship			2		
18	5	Predictive Analytics-I		DSC A	4	4	72
19	5	Multivariate Data Analytics-II		DSC A	4	5	90
20	5	Operations Research		DSC A	4	4	72
21	5	Statistical Methods for Economic Analysis- I (For B.A. Economics)		DSC A	4	5	90
21 22	5	Clinical Data Analytics	Any 1	DSE	4	4	72
		Statistical Reliability Analysis					
22 23	5	Statistical Computing Using Python	Any 1	DSE	4	5	90
		Stochastic Processes					
24	5	Statistical Reporting		SEC	3	3	54
25	6	Design and Analysis of Experiments		DSC A	4	4	72
26	6	Predictive Analytics-II		DSC A	4	5	90
27	6	Bayesian Analytics		DSC A	4	5	90
28	6	Mathematics for Economic Analysis (For B.A Economics)		DSC A	4	5	90
28 29	6	Business Analytics	Any 1	DSE	4	5	90
	6	Econometrics					
30	6	Analysis of Categorical Data		VAC	3	3	54
31	6	Statistical Analyses for Actuarial Science		SEC	3	3	54
32	7	Measure and Probability Theory		DCC	4	4	72
33	7	Advanced Distribution Theory		DCC	4	4	72
34	7	Advanced Multivariate Distributions		DCC	4	5	90
35	7	Statistical Methods for Economic Analysis -II (For B.A Economics)		DCC	4	5	90

36	7	Sampling Techniques	DCE	4	4	72
37	7	Analytical tools for Statistics-I	DCE	4	4	72
38	7	Population Dynamics	DCE	4	4	72
39	8	Advanced Probability Theory and Sampling Techniques	DCC	4	5	90
40	8	Advanced Estimation Theory	DCC	4	5	90
41	8	Statistical Methods for Economic Analysis -III (For B.A Economics)	DCE	4	5	90
42	8	Advanced Testing of Statistical Hypotheses	DCE	4	5	90
43	8	Analytical tools for Statistics-II	DCE	4	5	90
44	8	Advanced Operations Research	DCE	4	5	90
45	8	Research Project		12/8	-	-

Syllabus Index: Statistics Major

Name of the Major Subject: Statistics (Specialisations: Data Analytics(S1), Machine Learning(S2))

Semester-I

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ Week	Hour Distribution /Week			
					L	T	P	O
M24ST1DSC100	Fundamentals of Statistics and Data Visualization	DSC A	4	5	3	0	2	0
M24ST1MDC100	Statistical Data Collection Techniques	MDC	3	4	2	0	2	0

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others

Semester-II

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ Week	Hour Distribution /Week			
					L	T	P	O
M24ST2DSC100	Introduction to Statistical Modelling	DSC A	4	5	3	0	2	0
M24ST2MDC100	Data Analytics Using JAMOVI	MDC	3	4	2	0	2	0

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others

Semester-III

Course Code	Title of the Course	Type of the Course	Credit	Hour/ Week	Hour Distribution /Week

		DSC, MDC, SEC etc.			L	T	P	O
M24ST3DSC200	Statistical Models for Data Analytics	DSC A	4	4	4	0	0	0
M24ST3DSC201	Multivariate Data Analytics-I (S2)	DSC A	4	5	3	0	2	0
M24ST3DSE200	Statistical Computing Using R Programming (S1)	DSE	4	5	3	0	2	0
M24ST3DSE201	Statistics for Industrial Quality Control							
M24ST3MDC200	Applied Statistics	MDC	3	3	3	0	0	0
M24ST3VAC200	Statistical Documentation Tools	VAC	3	3	3	0	0	0

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others

Semester-IV

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ Week	Hour Distribution /week			
					L	T	P	O
M24ST4DSC200	Models for Multivariate Data Analytics	Discipline Specific Component-DSC A	4	5	3	0	2	0
M24ST4DSC201	Statistical Inference	DSC A	4	5	3	0	2	0
M24ST4DSE200	Biostatistics (S1)	DSE	4	4	4	0	0	0
M24ST4DSE201	Vital Statistics and Index Numbers							

M24ST4DSC202	Statistical Inference Using R/Python	DSC B	4	5	3	0	2	0
M24ST4VAC200	Data Analytics Using Gretl	VAC	3	3	3	0	0	0
M24ST4SEC200	Statistics for Competitive Examinations	SEC	3	3	3	0	0	0

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others

Semester-V

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ Week	Hour Distribution /Week			
					L	T	P	O
M24ST5DSC300	Predictive Analytics-I	DSC A	4	4	4	0	0	0
M24ST5DSC301	Multivariate Data Analytics-II (S2)	DSC A	4	5	3	0	2	0
M24ST5DSC302	Operations Research	DSC A	4	4	4	0	0	0
M24ST5DSC303	Statistical Methods for Economic Analysis- I	DSC A (For B.A. Economics)	4	5	3	0	2	0
M24ST5DSE300	Clinical Data Analytics (S1)	DSE	4	4	4	0	0	0
M24ST5DSE301	Statistical Reliability Analysis							
M24ST5DSE302	Statistical Computing Using Python	DSE	4	5	3	0	2	0
M24ST5DSE303	Stochastic Processes							
M24ST5SEC300	Statistical Reporting	SEC	3	3	3	0	0	0

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others

Semester-VI

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/Week	Hour Distribution /Week			
					L	T	P	O
M24ST6DSC300	Design and Analysis of Experiments	DSC A	4	4	4	0	0	0
M24ST6DSC301	Predictive Analytics-II	DSC A	4	5	3	0	2	0
M24ST6DSC302	Bayesian Analytics (S2)	DSC A	4	5	3	0	2	0
M24ST6DSC303	Mathematics for Economic Analysis	DSC A (For B. A. Economics)	4	5	3		2	
M24ST6DSE300	Business Analytics (S1)	DSE	4	5	3	0	2	0
M24ST6DSE301	Econometrics							
M24ST6VAC300	Analysis of Categorical Data	VAC	3	3	3	0	0	0
M24ST6SEC300	Statistical Analyses for Actuarial Science	SEC	3	3	3	0	0	0

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others

Semester-VII

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ Week	Hour Distribution /Week			
					L	T	P	O
M24ST7DCC400	Measure and Probability Theory	DCC	4	4	4	0	0	0
M24ST7DCC401	Advanced Distribution Theory	DCC	4	4	4	0	0	0
M24ST7DCC402	Advanced Multivariate Distributions	DCC	4	5	3	0	2	0
M24ST7DCC403	Statistical Methods for Economic Analysis -II	DCC (For B.A. Economics)	4	5	3	0	2	0
M24ST7DCE400	Sampling Techniques	DCE	4	4	4	0	0	0
M24ST7DCE401	Analytical tools for Statistics-I	DCE	4	4	4	0	0	0
M24ST7DCE402	Population Dynamics	DCE	4	4	4	0	0	0

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others

Semester-VIII

Course Code	Title of the Course	Type of the	Credit	Hours/	Hour Distribution /Week

		Course DSC, MDC, SEC etc.		Week	L	T	P	O
M24ST8DCC400	**Advanced Probability Theory and Sampling Techniques**	**DCC**	4	**5**	**3**	**0**	**2**	**0**
M24ST8DCC401	**Advanced Estimation Theory**	**DCC**	4	**5**	**3**	**0**	**2**	**0**
M24ST8DCE400	**Statistical Methods for Economic Analysis -III**	**DCE (For B. A. Economics)**	4	5	3	0	2	0
M24ST8DCE401	**Advanced Testing of Statistical Hypotheses**	**DCE**	4	**5**	**3**	**0**	**2**	**0**
M24ST8DCE402	**Analytical tools for Statistics-II**	**DCE**	4	**5**	**3**	**0**	**2**	**0**
M24ST8DCE403	**Advanced Operations Research**	**DCE**	4	**5**	**3**	**0**	**2**	**0**
M24ST8PRJ400	**Research Project**		**12**	**Honours with Research - 2 DCC + Project**				
			8	**Honours – 2 DCC + 1 DSC/DCE + Project OR 2 DCE**				

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others

Courses with Practical and Records

Sl. No	Name of Course	Type	Semester
1.	Multivariate Data Analytics-I	DSC A	3
2.	Statistical Computing Using R Programming	DSE	3
3.	Statistics for Industrial Quality Control	DSE	3
4.	Models for Multivariate Data Analytics	DSC A	4
5.	Statistical Inference	DSC A	4
6.	Statistical Inference Using R/Python	DSC B	4
7.	Multivariate Data Analytics-II	DSC A	5
8.	Stochastic Processes	DSE	5
9.	Statistical Computing Using Python	DSE	5
10.	Predictive Analytics-II	DSC A	6
11.	Bayesian Analysis	DSC A	6
12.	Business Analytics (S)	DSE	6
13.	Econometrics	DSE	6
14.	Advanced Multivariate Distributions	DCC	7
15.	Statistical Methods for Economic Analysis -III	DCE	8
16.	Advanced Operations Research	DCE	8

Courses with Practicum

Sl. No.	Name of Course	Type	Semester
1.	Fundamentals of Statistics and Data Visualization	DSC A	1

2.	**Statistical Data Collection Techniques**	**MDC**	**1**
3.	**Introduction to Statistical Modelling**	**DSC A**	**2**
4.	**Data Analytics Using JAMOVI**	**MDC**	**2**
5.	**Applied Statistics**	**MDC**	**3**
6.	**Statistical Documentation Tools**	**VAC**	**3**
7.	**Vital Statistics**	**DSE**	**4**
8.	**Data Analytics Using Gretl**	**VAC**	**4**
9.	**Predictive Analytics-I**	**DSC A**	**5**
10.	**Operations Research**	**DSC A**	**5**
11.	**Statistical Methods for Economic Analysis-I**	**DSC A**	**5**
12.	**Clinical Data Analytics**	**DSC A**	**5**
13.	**Statistical Reporting**	**SEC**	**5**
14.	**Design of Experiments**	**DSC A**	**6**
15.	**Mathematics for Economic Analysis**	**DSC A**	**6**
16.	**Statistical Analyses for Actuarial Science**	**SEC**	**6**
17.	**Statistical Methods for Economic Analysis-II**	**DCC**	**7**
18.	**Advanced Probability Theory and Sampling Techniques**	**DCC**	**8**
19.	**Advanced Estimation Theory**	**DCC**	**8**
20.	**Advanced Testing of Statistical Hypotheses**	**DCE**	**8**
21.	**Analytical tools for Statistics-II**	**DCE**	**8**

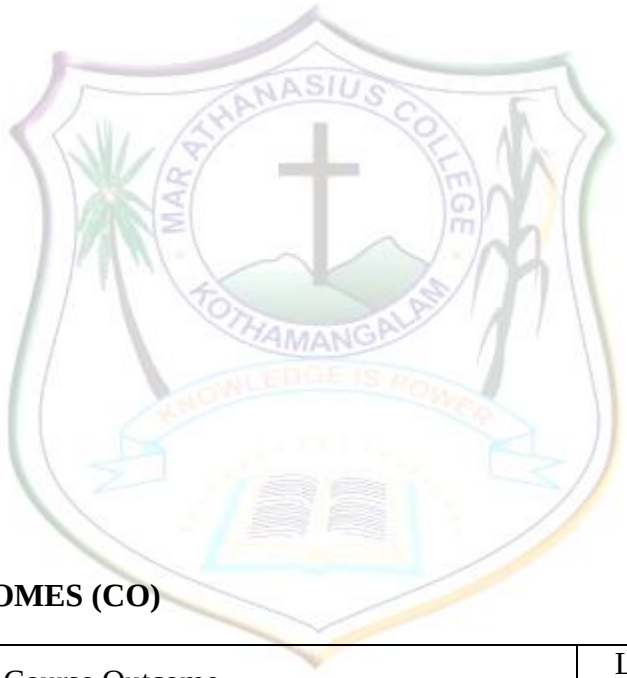
MAR ATHANASIUS COLLEGE
KOTHAMANGALAM
KNOWLEDGE IS POWER

SEMESTER I

	**Mar Athanasius College (Autonomous), Kothamangalam** **FYUGP SYLLABUS**

Department	**STATISTICS**
Programme	**B.Sc. Statistics**
Course Name	**Fundamentals of Statistics and Data Visualisation.**
Type of Course	**DSC(Major/Minor)**
Course Code	**M24ST1DSC100**
Course Level	**100**
Course Summary & Justification	This course helps to acquire basic knowledge of various types of data, probability theory, correlation and regression and their real-world applications. Additionally, spreadsheet functions are used to address the

	numerical challenges associated with the topics discussed.					
Semester	1	Credits			4	Total Hours
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practicum	Others	45+30
		3		2		75
Pre-requisites	Pass in plus two/VHSE/Equivalent with Mathematics/ Statistics as a subject					



COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the concepts of data-types, sampling, and techniques for sampling.	U	1,2, 4
2	Summarise data using various measures of central tendency, dispersion, skewness, and kurtosis and using graphical representations	U, A	2,4, 5
3	Analyse relationships between variables using scatter diagrams, correlation coefficients and regression methods.	A, An	1,4, 5
4	Develop skills in solving real- world problems through the application of regression techniques, particularly in predicting outcomes, understanding the limitations of predictions as well.	An, A	2,4,5
5	Understand basic probability concepts, including random experiments, sample space and other elementary concepts	U	4

6	Apply Bayes` theorem to revise probabilities based on new information and evidence.	E	1
7	Use spreadsheet for storing and editing data and apply statistical concepts to datasets using spreadsheet, enhancing practical skills.	A, An	1, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module-wise Syllabus

Module1	Course Description	Hours	CO
	Data and variables, Measures of central tendency, dispersion, and moments.	**20**	
1.1	Types of variables: Qualitative/quantitative, Discrete/Continuous Scales of measurement: ordinal, nominal, ratio, and interval. Types of data: concepts of primary data and secondary data Examples of univariate and bivariate data		1
1.2	Diagrams and Graphs: Bar diagrams, pie diagram and frequency graphs-Frequency curve, ogives, and histogram.		2
1.3	Population and sample Types of sampling: non-probability sampling, probability sampling- simple random sampling, systematic sampling, stratified random sampling and cluster sampling with real life examples (derivations not required).		1
1.4	Measures of central tendency: Arithmetic mean (A.M), geometric mean (G.M), harmonic mean (H.M), median and mode (examples using only raw data).		2
1.5	Measures of dispersion: Range, quartile deviation (Q.D), mean deviation (M.D), standard deviation (S.D) and the corresponding relative measures (examples using only raw data). Box Plot.		2
1.6	Moments, skewness, and kurtosis with examples using only raw data. (derivations not required).		2
	Problems (Practicum)		7
Module 2	**Correlation and Regression**	**15**	
2.1	Correlation, scatter diagram, Karl Pearson's correlation coefficient, Spearman's rank correlation coefficient. (Only the concepts, problems, and properties-without proof of the above topics).		3
2.2	Curve fitting, Regression- Two types of regression lines - formula and numerical problems.		4
	Problems (Practicum)		7
Module 3	**Elementary Probability Theory**	**10**	

3.1	Random experiment, sample space and event with examples.		5
3.2	Elementary ideas of probability: Frequency, Classical and Axiomatic definitions with examples. Basic properties of probability.		5
3.3	Conditional probability, independence of events, total probability law, Bayes' theorem (without proof) with examples.		5, 6
	Problems (Practicum)		7
Module 4	**Data Analysis using spreadsheet.**	**30**	
4.1	Introduction to spreadsheet, entering data into a spreadsheet, formatting cells, entering formulas, built-in functions- if function, vlookup, hlookup, sorting, filtering, etc., saving and opening files, pivot tables, conditional formatting, and data validation		7
	Problems (Practicum)		7
Module 5	**Teacher Specific content.** (Suggested Activity: Students should do a data analysis/case study/field work using the statistical tools learned in this course and prepare a report.)		

Practicum	
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop Problem Solving Skills. The practicum component is to be done in the classroom/ computer lab under the strict guidance of the teachers. Suggested Activity: Using spreadsheet, solve numerical problems associated with topics covered in various modules (A practicum record with minimum 10 problems has to be submitted).	
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brainstorming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz

Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, Practicum Record B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Gupta, S. C. and Kapoor, V. K. (2020) Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand, and Sons.
2. Gupta, S.P. (2021) Statistical Methods, 46th Edition, Sultan Chand and Sons: New Delhi.
3. Alejo, I. (2023) Google Sheets Tutorial Guide: The Definitive User Manual to Master Sheets with Illustrations, Amazon Digital Services LLC.
4. Beverly J. Dretzke. (2008) Statistics with Microsoft Excel, 4th Edition, Pearson.

References:

1. Medhi, J. (2006) Statistical Methods, 2nd Edition, New Age International Publishers.
2. Mukhopadhyay, P. (1999) Applied Statistics, New Central Book Agency Private Limited, Kolkata.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**
Programme	**B.Sc. Statistics**
Course Name	**Statistical Data Collection Techniques.**
Type of Course	**MDC**
Course Code	**M24ST1MDC100**
Course Level	**100**
Course Summary & Justification	This course helps the students to acquire the basic knowledge of statistical data collection and to familiarize with the principles of experimental design. Also, they will be able to design experiments incorporating the principles of experimentation and to perform basic exploratory data analysis on the collected data.

Semester	I	Credits			3	Total Hours
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practicum	Others	60
		30		30		60
Pre-requisites	Pass in plus two/VHSE/Equivalent.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No.
1	Understand the characteristics of scientific research	U	1
2	Understand different sampling schemes	U	1, 2
3	Describe concepts of data, methods of data collection and levels of measurements	U	1
4	Apply proper sampling scheme for a statistical investigation	A	2,4
5	Develop a research problem and formulate the research hypothesis	C, S	1, 5
6	Prepare questionnaire and/or design experiments for a statistical investigation and collect data using it	C, A, S	1
7	Apply the statistical methodologies in real life scenarios	A, S	1, 2, 4, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module 1	Course description	Hrs	CO. No
	Scientific Research	**20**	
1.1	Characteristics of scientific research: - Qualitative studies, quantitative studies, longitudinal studies, experimental studies, survey studies.		1,5
1.2	Stating hypothesis or research question, concepts & constructs, units of analysis & characteristics of interest, independent and dependent variables, extraneous or confounding variables.		1,5
	Practicum		7
Module 2	**Properties of Data**	**20**	

2.1	Primary and secondary data, different types of data– quantitative and qualitative data, continuous and discrete data, time series and cross-sectional data, methods of collection of primary data, sources of secondary data.		3
2.2	Concepts of statistical population and sample, complete enumeration and sampling, probability, and non-probability sampling. Simple random sampling and stratified sampling (Outline only).		2,4
2.3	Levels of measurement-nominal, ordinal, interval, and ratio.		3
	Practicum		7
Module 3	**Experimental Design**	**20**	
3.1	Designing of questionnaire		6
3.2	Planning of experiments: Basic principles of experimental design, uniformity trials		6
3.3	Completely randomized design (CRD), Randomized block design (RBD), Latin square design (LSD), Factorial experiments, Split plot experiments (RBD). (Only the Concepts and outline of the designs are needed)		6
	Practicum		7
Module 4	**Teacher Specific Content** (Suggested Activity: Students should do a data analysis/case study using the statistical tools learned in this course and prepare a report.)		

Text books:

1. Gupta, S.C., and Kapoor, V.K. (2007). Fundamentals of Applied Statistics, Sultan Chand, and Sons.
2. Gupta, S.P. (2021). Statistical Methods, 46th Edition, Sultan Chand, and Sons: New Delhi.
3. Kothari, C.R. (2014). Research methodology, Second revised edition, New Age International publishers.

References:

1. Mukhopadhyay, P. (2009). Theory and Methods of Survey Sampling, Second Edition, PHI Learning (P) Ltd.
2. Das, M.N. and Giri, N.C. (1994). Design and analysis of experiments, Wiley Eastern Ltd.
3. Rangaswamy, R. (2010). A textbook on Agricultural Statistics, New Age International publishers.

Practicum	
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop Problem Solving Skills. The practicum component is to be done in the classroom/ computer lab under the strict guidance of the teachers. Suggested Activity: **Application in a Real-Life Scenario:** (1) Develop a research problem from the relevant disciplines of the students. (2) Formulate research hypothesis. Identify the target population, determine the variables of interest, decide the proper sampling scheme. (3) Prepare a questionnaire for the problem in (1), collect data using it and basic EDA using any statistical software. If experimentation is needed, design experiments incorporating the principles of experimentation and perform basic EDA using the data and submit the report.	
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brainstorming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz

SEMESTER II

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Introduction to Statistical Modelling**					
Type of Course	**DSC (Major/Minor)**					
Course Code	**M24ST2DSC100**					
Course Level	**100**					
Course Summary & Justification	To acquire basic knowledge of the theory of random variables, various probability functions and their applications. Also, spreadsheet functions are used to solve numerical problems associated with the topics discussed.					
Semester	**2**	**Credits**			**4**	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practicum**	**Others**	**45+30**
		3		**2**		**75**
Prerequisites	Pass in plus two/VHSE/Equivalent with Mathematics/Statistics as a subject					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand major components of random variable theory and distribution theory.	U	4
2	Understand basic components of random variable theory in higher dimension.	U	4
3	Apply the concept of averages to random variables in the form of mathematical expectation	A, E	1, 4
4	Develop skill for identifying statistical models corresponding to various situations.	S, A	1,4
5	Analyse various properties of statistical models.	An	1
6	Apply fitting procedure using spreadsheet to identify the suitable model for the given data	A, E & S	1, 4, 5
7	Apply the concepts to real life scenarios using spreadsheet	A, S	1,2, 4, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

	Course description	**Hours**	**CO No.**
Module1	**Random variable Theory.**	**15**	
1.1	Introduction to Random variables-discrete and continuous case		1
1.2	Probability mass function, probability density function and their properties, distribution function of a random variable: definition and properties.		1
1.3	Functions of random variables, transformations of random variable (univariate).		1
	Practicum		7
Module 2	**Random Variables in Higher Dimension**	**15**	
2.1	Bivariate random vector-joint probability mass function, joint probability density function and their properties, joint distribution function and its properties.		2
2.2	Marginal and conditional distributions (bivariate case), independence of random variables (bivariate case).		2

	Practicum		7
Module 3	**Mathematical Expectation**	**20**	
3.1	Mathematical expectation, its properties, and simple problems.		3,4
3.2	Expectation of a function of random variable- A.M, G.M, H.M, Mean Deviation and Variance in terms of expectation. Moments in terms of expectation		3,4
3.3	Generating functions: moment generating function, probability generating function, characteristic function, their properties, and simple problems.		3,4
3.4	Conditional expectation-Conditional mean and variance		3,4
	Practicum		7
Module 4	**Probability Distributions**	**25**	
4.1	Discrete uniform distribution, Bernoulli distribution, Binomial distribution, their properties, fitting of binomial distribution and simple problems.		5, 6
4.2	Poisson distribution and its properties, fitting of Poisson distribution, simple problems. Geometric distribution, its characteristics and lack of memory property.		5, 6
4.3	Continuous uniform distribution and its properties.		5
4.4	Exponential distribution, gamma distribution, beta distribution and their characteristics. Lack of memory property of exponential distribution.		5
4.5	Normal distribution and its properties in detail. Fitting of Normal distribution		5, 6

	Practicum		**7**
Module 5	**Teacher Specific content.** (Suggested Activity: Students shall be asked to fit a suitable distribution to a real-life dataset.)		

Practicum	
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom/ computer lab under the strict guidance of the teachers. Suggested Activity: Using spreadsheet, solve numerical problems associated with topics covered in various modules (A record with minimum 10 problems has to be submitted).	
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar, Practicum Record B**. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Gupta, S. C. and Kapoor, V. K. (2020) Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand, and Sons.
2. Gupta, S.P. (2021) Statistical Methods, 46th Edition, Sultan Chand and Sons: New Delhi.
3. Alejo, I. (2023) Google Sheets Tutorial Guide: The Definitive User Manual to Master Sheets with Illustrations, Amazon Digital Services LLC.
4. Beverly J. Dretzke. (2008) Statistics with Microsoft Excel, 4th Edition, Pearson.

References:

1. Goon, A. M., Gupta, N.K., Das Gupta, B. (1999). Fundamentals of Statistics-Vol.2. World Press, Kolkata.
2. Rohatgi, V.K. and Saleh, A.M.E. (2001) An Introduction to Probability and Statistics. 2nd edition. John Wiley & Sons, Inc, New York.
3. Wilks S.S. (1964). Mathematical Statistics, John Wiley, New York.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Data Analysis using JAMOVI**					
Type of Course	**MDC**					
Course Code	**M24ST2MDC100**					
Course Level	**100**					
Course Summary & Justification	This course introduces students to data analysis using JAMOVI, an open-source statistical software. It covers basic data manipulation, descriptive statistics, and inferential statistics, providing practical skills for analysing data in various disciplines.					
Semester	**2**	**Credits**			**3**	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practicum**	**Others**	**60**
		2		**2**		**60**
Pre-requisites	Pass in Plus two/ VHSE/ Equivalent					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No
1	Understand the interface and basic functionalities of JAMOVI software.	U	1
2	Perform data manipulation and management in JAMOVI.	A, An	2
3	Generate and interpret descriptive statistics and graphical representations.	A, An	3
4	Communicate statistical results effectively using JAMOVI outputs.	E	2,4
5	Apply JAMOVI to real-world data analysis scenarios across various disciplines.	S	4,5

*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Syllabus Module wise

Module 1	Course Description	Hours	CO No.
	Introduction to JAMOVI	**20**	
1.1	Overview of JAMOVI, Installation and Interface Navigation, Data Import and Export		1
1.2	Data Cleaning and Preparation, Creating and Managing Variables, Data Filtering and Transformation		2
	Practicum		
Module 2	**Statistical Analysis**	**20**	
2.1	Measures of Central Tendency and Variability, Frequency Distributions		3
2.2	Creating and Interpreting Graphical Representations (Histograms, Boxplots, etc.)		3
2.3	Correlation Analysis		3
	Practicum		
Module 3	**JAMOVI and Communicating Results**	**20**	
3.1	Creating Reports in JAMOVI		4
3.2	Interpreting and Presenting Results		4
3.3	Effective Communication of Statistical Findings		4
	Practicum		
Module 4	**Teacher Specific Content** Case Studies from Various Disciplines and Real-World Data Analysis Projects/Reports		

Practicum

Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom/ computer lab under the strict guidance of the teachers. Suggested Activity: Case Studies from Various Disciplines and Real-World Data Analysis Projects/Reports	
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar, Practicum Record **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References:

1. Navarro, D. J. and Foxcroft, D. R. (2022). Learning statistics with JAMOVI: A tutorial for psychology students and other beginners. (Version 0.75). DOI: 10.24384/hgc3-7p15 (Online Text)
2. Love, J., Selker, R., Marsman, M., Jamil, T., Dropmann, D., Verhagen, J., & Wagenmakers, E. J. (2019). JAMOVI: An Easy-to-Use Statistical Software for the Social Sciences. Journal of Open Research Software, 3(1), e31. doi:10.5334/jors.108
3. Field, A., Miles, J., & Field, Z. (2012**).** Discovering Statistics Using R. Sage Publications, Los Angeles, California.

SEMESTER III

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Statistical Models for Data Analytics**					
Type of Course	**DSC A (Major)**					
Course Code	**M24ST3DSC200**					
Course Level	**200**					
Course Summary & Justification	Gain foundational knowledge in random variables, explore discrete distributions like Binomial, Poisson, Uniform and Geometric, understand continuous distributions such as Uniform, Exponential, Gamma, Beta (two types), Normal, Lognormal, Cauchy and Laplace distributions and their basic properties. Students will get an idea about sampling distributions and their inter relationships. Spreadsheet is applied for practical applications.					
Semester	3	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	60
		4	0	0	0	60
Pre-requisites	Level 100 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand various concepts such as probability density functions and cumulative distribution functions etc. of random variables.	U	4
2	Derive various generating functions of random variables such as moment generating functions, characteristic functions, etc.	C	3

3	Find out characteristics of random variables like moments from either probability density (mass) functions or the generating functions.	E	1,2
4	Fitting of Binomial, Poisson, and Normal distributions.	A, E & S	1,2, 4
5	Derivation of the sampling distribution of sample mean and variance for a normal population.	C & S	3
6	Establish relationship between t, F and $\chi 2$ distributions.	A	3
*Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	**Hours**	**CO No.**
Module 1	**Random Variables and Properties**	**10**	
1.1	Random variables: discrete and continuous random variables, probability mass function and probability density function, distribution function, change of variables.		1
1.2	Definition of mathematical expectation, properties, mean, and variance using expectation.		1
1.3	Moment generating function (mgf), probability generating function (pgf), characteristic function, important properties.		2
	Practicum		
Module2	**Discrete Distributions**	**15**	
2.1	Binomial and Poisson distribution, mean, variance, mgf and characteristic function.		1, 2, 3
2.2	Uniform and Goemetric distribution, mean, variance, mgf and characteristic function, lack of memory property of geometric distribution.		1,2, 3
2.3	Fitting of Binomial and Poisson distributions.		4
	Practicum Problems based on Binomial, Poisson, Uniform and Geometric distribution, Fitting of Binomial and Poisson distribution		
Module3	**Continuous Distributions**	**20**	

3.1	Uniform and Exponential distributions: mean, variance, mgf and characteristic functions, lack of memory property of exponential distribution.		1, 2, 3
3.2	Gamma, Beta (two types) distributions: mean, variance, mgf and characteristic functions.		1, 2, 3
3.3	Laplace, Cauchy distribution: mean, variance, mgf and characteristic functions		1, 2, 3
3.4	Normal distribution, Standard normal distribution, use of standard normal tables for various probability computation, properties of normal distribution. Normal distribution as a limiting case of binomial and Poisson under suitable assumptions. Fitting of normal distribution. Lindberg-Levy central limit theorem(statement only), Lognormal distribution-definition and properties only (derivation not required).		1, 2, 3,4
	Practicum Problems based on Uniform, Exponential, Gamma, Beta, Normal and Standard normal distributions. Fitting of Normal distributions		
Module4	**Sampling distributions**	**15**	
4.1	Derivation of the sampling distribution of sample mean and variance for a normal population, standard errors of sample mean and sample variance.		5
4.2	Chi-square distribution, definition and nature of pdf curve for different degrees of freedom, mean, variance, mgf ,additive property of χ^2 distribution.		5
4.3	Student's t-distribution, its pdf nature of probability curve with different degrees of freedom, mean, variance.		5
4.4	Snedecor's F-distribution: pdf, nature of pdf curve with different degrees of freedom, mean, variance. Distribution of 1/F , Relationship between t, F and χ^2 distributions.		5
	Practicum Problems based on Normal, Chi-square, t and F distributions		6
Module 5	**Teacher Specific content.**		

Practicum

Practicum is designed to provide supervised practical application of theoretical knowledge and skills.
Its purpose is to encourage creativity and develop problem solving skills.
The practicum component is to be done in the classroom/ computer lab under the strict guidance of teachers.
A minimum of 10 problems is to be solved using spreadsheet and a record should be submitted to the teacher concerned.

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar, Practicum Record B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Gupta, S.C. and Kapoor, V.K. (2020). Fundamentals of Mathematical Statistics, (12th Edn.) Sultan Chand & Sons, New Delhi.
2. Mood, A.M., Graybill, F.A. and Boes, D.C. (2017). Introduction to the Theory of Statistics, 3rd Edn. (Reprint). Tata McGraw-Hill Pub. Co. Ltd.
3. Beverly J. Dretzke, (2011), Statistics with Microsoft Excel, Fifth Edition, Pearson.

References

1. Hogg, R.V., McKean, J.W. and Craig, A.T. (2014). Introduction to Mathematical Statistics, (7thEdn.), Pearson Education Publication.
2. Rohatgi, V.K. and Saleh, A.K.MD.E.(2015). An Introduction to Probability and Statistics, (3rd Edn.), John Wiley & Sons Inc.
3. Johnson, N.L., Kotz, S. and Balakrishnan, N (1994). Continuous Univariate Distributions, Vol.I, (2nd Edn.). John Wiley, New York.
4. Johnson, N.L., Kemp, A.W. and Kotz, S. (2005). Univariate Discrete Distributions, (3rd Edn.) John Wiley, New York.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Multivariate Data Analytics-I**					
Type of Course	**DSC A (Major)**					
Course Code	**M24ST3DSC201**					
Course Level	**200**					
Course Summary & Justification	Students will comprehend real vectors, vector space, orthogonality, quadratic forms, special types of matrices, spectral decomposition, singular value decomposition, etc., which play a crucial role in multivariate data analytics. Additionally, students will gain the ability to apply this knowledge in practical situations using R programming.					
Semester	3	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	+2 level knowledge in Mathematics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Interpret vector space, linear independence of vectors, spanning set, projection of vector, inner product, and various types of matrices.	U	3, 4
2	Evaluate trace, determinant, inverse, eigen values and eigen vectors, etc. of matrices	An, A, S	3, 4
3	Solve system of linear equations using generalized inverse	A, S	1, 3 ,4
4	Classify quadratic forms based on the rank of the matrix	E	1, 3
5	Find the spectral as well as singular value decompositions of matrices	E, A	1, 3

6	Apply the concepts to real life problems using R language	A, S	1, 3, 4, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	**Hours**	**CO No.**
Module 1	**Real vectors**	**10**	
1.1	Real vectors (generalization of co-ordinates), angle and norm of vectors, orthogonality, and Gram-Schmidt orthogonalization process, Axiomatic approach, and examples.		1
1.2	Subspaces, intersection and sum of subspaces, span of a set, linear dependence and independence, dimension and basis, dimension theorem.		1
1.3	Direct sum and complement subspace, orthogonal projection of a vector.		1
Module2	**Matrices and Determinants**	**10**	
2.1	Trace of a matrix, determinant, singular and non-singular matrices, adjoint and inverse of a matrix and related properties.		2
2.2	Algebra of matrices, theorems related to triangular, symmetric, and skew symmetric matrices, idempotent matrices, orthogonal matrices, and their properties. Elementary transformations, Echelon form and Normal form. System of homogeneous and non-homogeneous linear equations, Cramer's rule		2
2.3	Product of determinants, rank of a matrix, row-rank, column-rank, standard theorems on ranks, rank of the sum and the product of two matrices. Rank factorization and Sylvester's Inequality.		2
2.4	Partitioning of matrices, determinant and inverse of partitioned matrices.		2
Module3	**G-inverse, Quadratic forms, and Characteristic roots**	**25**	
3.1	Generalized inverse, Moore-Penrose inverse		3

3.2	Characteristic roots and characteristic vectors, properties of characteristic roots (symmetric and general matrices).		2
3.3	Diagonalization of matrices, spectral decomposition, and singular value decomposition, power method, Cayley-Hamilton theorem		5
3.4	General concepts of inner product and norm.		4
3.5	Quadratic forms: classification & canonical reduction, linear transformations, extrema of quadratic forms.		4
Module4	**Practical using R**		
	Problems from the above modules, including the topics: Linear independence and dependence. Orthogonality and Gram-Schmidt orthogonalization Process. Basis and Dimension Basis of sum intersection and complement of subspaces. Projection of vectors on a subspace Determinant of a matrix. Inverse of matrix. Decomposition of matrix. Elementary transformations. Solutions of system of linear equations. Finding G-inverse of a matrix Problems on quadratic forms Problems related to characteristic roots and vectors. Problems related to linear transformations. (A practical record with minimum 10 problems has to be submitted).	**30**	6
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar, Practical Record Practical Total = 15 marks

	Lab performance, record, field report, etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Books:

1. Shanti, N. and Mittal, P.K. (2007). A Textbook of Matrices, S Chand & Co. Ltd.
2. Mathai A.M. (1996) Jacobins of Matrix Transformations and functions of Matrix Argument, World Scientific Pub Co. Pvt. Ltd.
3. Lipschutz, S. and Lipson, M. (2017) Schaum's Outline of Linear Algebra (3rd Edition), McGraw Hill Education.
4. Fieller, N. (2021) Basics of Matrix Algebra for Statistics with R, 1st Edition, Chapman & Hall.
5. Jadhav, A. and Sakhare, N. (2018). Linear Algebra Using Python, Himalaya Publishing House.

References:

1. Hadley G. (2020) Linear Algebra, Narosa Publishing House
2. Rao A.R. and Bhimasankaram P. (2000) Linear Algebra(2nd Edn.),Hindustan Book Agency.
3. Searle S.R. and Khuri A.I. (2017) Matrix Algebra Useful for Statistics (2nd Edn.), Wiley.
4. Rao C.R. (2009) Linear Statistical Inference & its Applications (2nd Edn.), Wiley.
5. Strang G. (2023) Introduction to Linear Algebra (6th Edn.), Wellesley-Cambridge Press, U.S.

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Statistical Computing Using R**					
Type of Course	**DSC E Major**					
Course Code	**M24ST3DSE200**					
Course Level	**200**					
Course Summary & Justification	Through this course, students will be acquainted with computer programming in general and R programming, in particular. They will be able to perform data manipulations using R. Moreover, they will get the ability to conduct exploratory data analysis and regression modelling in R.					
Semester	3	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 100 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the fundamentals of computer programming and various methods of data input and commands in R software.	U	4
2	Manipulate data using various commands and functions in R.	A, S	1, 4
3	Analyse data using R software.	An, S	1, 2, 4, 5
4	Apply various visualization techniques.	A, S	1, 4, 5
5	Evaluate various measures of central tendency, dispersion, skewness and kurtosis.	E	1, 2, 4
6	Fitting probability distributions using R software.	C	4, 5
7	Apply correlation and regression techniques using R software.	A, S	2, 4
8	Apply the theoretical concepts to datasets using R programming.	A, S	1,2, 4, 5

*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module 1	**Introduction to Programming**		
1.1	Introduction to computer programming- algorithm, flow chart, variables, types of variables, constants, scope of variables, functions, control statements, looping statements, conditional statements, comments. Comparison of traditional programming languages with R	**10**	1
1.2	Introduction to statistical software R- Installing R and RStudio, interface of RStudio, Basic syntax rules, atomic data types in R, data structures in R, Manipulating vectors, matrices, lists, and data frames.		1
Module 2	**Data Manipulation using R**	**15**	
2.1	Control and loop Statements- for, repeat, while, if, if else etc. Calling functions in R-default arguments, arguments by name and by position Built in functions in R-sum, max, min, pmax, which, etc. User-defined functions- Writing own functions with one or more arguments Installing and loading packages-RCommander interface		2,3
2.2	Importing and exporting data- excel files, SAS files, JSON files and SQL database, etc. Dealing with missing values Recoding variables with lookup vector Joining datasets row wise and column wise. Joining tables based on key columns-inner join, outer join.		2,3
2.3	Cleaning data using dplyr verbs		2,3
Module 3	**Exploratory Analysis using R**	**20**	
3.1	Diagrammatic and graphical representation of data –ggplot-grammar of graphics concept, layers in ggplot		4

	Diagrams using ggplot- bar diagram, pie diagram, histogram, violin plot, box plot, Q-Q plot, stem and leaf plot, scatter plot, etc.		
3.2	Contingency table from raw data, Descriptive measures		5
3.3	Probability Distributions using R-plotting probability functions, generating random numbers, computing quantiles, fitting of normal distribution		6
3.4	Correlation and Regression Analysis: Correlation, Simple linear regression		7
Module 4	**Practical from the above modules using R**	**30**	8
Module 5	**Teacher Specific content**. (Suggestion: Submit a project report based on a case study/secondary data using R programming.)		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar and Practical Record Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Book:

1. Crawley, M. J. (2007). The R Book. Germany: Wiley.
2. Rizzo, M.L. (2007). Statistical Computing with R, Chapman, and Hall/CRC.
3. Wickham, H., Grolemund, G. (2016). R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. United States: O'Reilly Media.

References

1. Zuur, A.F, Leno, E.N.and Meesters, E.H.W.G. (2009): Use R, Springer.
2. W. N. Venables, D. M. Smith and the R Development Core Team (2009). An Introduction to R (2nd Edn.). , Network Theory Limited.
3. Dalgaard,P. (2008).Introductory Statistics with R, Springer.

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Statistics for Industrial Quality Control**					
Type of Course	**DSE**					
Course Code	**M24ST3DSE201**					
Course Level	**200**					
Course Summary & Justification	To acquire the basic knowledge of the process and product control techniques. Also, built in functions in R programming are used to solve numerical problems associated with the topics discussed.					
Semester	3	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 100 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand quality and dimensions.	U	1
2	Describe statistical process control and causes of variations.	U, A	1,4
3	Learn statistical control charts and its construction.	K. A	1,3
4	Learn process capability analysis and process capability indices	K, A	1,4
5	Understand the concept of Acceptance sampling plans.	U	1,4
6	Practical: Use R built in functions to solve numerical problems associated with topics covered in various modules	A, S	2,5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.

Module 1	**Control charts**		
1.1	Quality: Definition, dimensions of quality, Quality system and standards: Introduction to ISO quality standards, Quality registration.	**25**	1
1.2	Statistical Process Control - Seven tools of SPC, chance and assignable Causes of quality variation.		2
1.3	Statistical Control Charts- Construction and Statistical basis of 3-σ Control charts, Rational Sub-grouping.		3
1.4	Control charts for variables: X-bar & R-chart, X-bar & s-chart. Control charts for attributes: np-chart, p-chart, c-chart and u-chart.		4
1.5	Comparison between control charts for variables and control charts for attributes.		4
1.6	Analysis of patterns on control chart.		4
Module 2	**Process capability analysis**		
2.1	Process capability analysis, process capability indices – Cp Cpk, Cpm., estimation of process capability.	**10**	5
2.2	Introduction to Six-Sigma: Overview of Six Sigma, Lean Manufacturing and Total Quality Management (TQM).		5
Module 3	**Acceptance sampling plans**		
3.1	Principle of acceptance sampling plans. Single and Double sampling plan.		5
3.2	OC, AQL, LTPD, AOQ, AOQL, ASN, ATI functions with graphical interpretation of SSP and DSP.	**10**	5
3.3	Use and interpretation of Dodge and Romig's sampling inspection plan tables.		5
Module 4	**Practical using R programming**	**30**	
4.1	Introduction to R		6
4.2	Use R built in functions to solve numerical problems associated with topics covered in various modules.		6
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar and Practical Record Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Books:

1. Montogomery, D. C. (2009). Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd, New Delhi.
2. Goon A.M., Gupta M.K. and Dasgupta B. (2002). Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
3. Mukherjee, P. N. (2018). Statistical Quality Control (4th ed.). New Delhi, India: PHI Learning Pvt. Ltd.

References

1. Mukhopadhyay, P (2011). Applied Statistics, 2nd edition revised reprint, Books and Allied(P) Ltd, Pune.
2. Purohit, S.G., Deshmukh, S.R., and Gore, S.D. (2008). Statistics using R. Alpha Science International, United Kingdom
3. Wilks S.S. (1964). Mathematical Statistics, John Wiley, New York.
4. Gupta, S. C. (2001). Statistical Quality Control. New Delhi, India: Khanna Publishers.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**
Programme	**B.Sc. Statistics**

Course Name	**Applied Statistics**					
Type of Course	**MDC**					
Course Code	**M24ST3MDC200**					
Course Level	**200**					
Course Summary & Justification	Introduce the concepts of Index numbers and Demographic measures such as mortality and fertility measures to equip the student to use these tools for comparative studies.					
Semester	**3**	**Credits**			**3**	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45
		3	0	0		45
Pre-requisites	Pass in plus two/VHSE/Equivalent.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the concept of Index Numbers and Demographic measures.	U	4
2	Understand the role of Index Numbers in diversified fields and construction of different types of Index Numbers	U, E	3,4
3	Calculate Consumer Price Index, Wholesale Price Index, and Index of Industrial Production.	A, An	2
4	Verify various tests for consistency of Index Numbers	A	1,2
5	Apply the processes base shifting, splicing, and deflating in real data.	A	1,2
6	Understand the various measures of mortality and fertility	U	3
* Understand (U), Apply (A), Analyse (An), Evaluate (E)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module 1	**Index Numbers**	**15**	
1.1	Introduction to Index Numbers-Price, Quantity and Value indices.		1
1.2	Construction of unweighted Index Numbers-Simple Aggregative, Simple Average of Price relatives-AM, GM, HM		2
1.3	Construction of weighted Index Numbers -Laspeyre's, Paasche's, Dorbish-Bowley, Marshall Edgeworth, Fisher's and Kelly's Index Numbers, Uses and Limitations of Index Number.		**2**
	Practicum Problems based on weighted and unweighted Index Numbers, Quantity and Value Index Numbers		
Module 2	**Tests for Consistency of Index Numbers**	**20**	
2.1	Unit Test, Commodity Reversal Test, Time Reversal Test, Factor Reversal Test, Circular Test		4
2.2	Chain-Index Numbers.		2
2.3	Formulae and uses of some Important Indices: Consumer Price Index, Wholesale Price Index and Index of Industrial Production		3
2.4	Base Shifting, Splicing, Deflating of Index Numbers		5
	Practicum		

	Problems based on Tests on Index Numbers, Chain Index Numbers, Consumer Price Index Numbers, Base shifting, Splicing and Deflating of Index Numbers		
Module 3	**Sources of Vital Statistics**	**10**	
3.1	Introduction and sources of collecting data on vital statistics: Census, registration, adhoc surveys, hospital records.		6
3.2	Measures of Mortality: Crude Death Rate (CDR) and Specific Death Rate (SDR)-Age Specific Death Rate (ASDR), Cause Specific Death Rate (CSDR), Infant Mortality Rate (IMR), Maternal Mortality Rate (MMR)-Definitions only		6
3.3	Measures of Fertility: Crude Birth Rate (CBR), General Fertility Rate (GFR), Age-Specific Fertility Rate (ASFR), Total Fertility Rate (TFR), Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR)-Definitions only		6
Module 4	**Teacher Specific content.**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom/ computer lab under the strict guidance of teachers. A minimum of 5 problems is to be solved using spreadsheet and a record should be submitted to the teacher concerned.

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz

Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Gupta, S.C. and. Kapoor, V.K. (2018). Fundamentals of Applied Statistics, Sultan Chand & Co. New Delhi.
2. Srivastava, O.S. (1983). A Text Book of Demography, Vikas Publishing House, New Delhi.
3. Parimal Mukhopadhyay. (2005). Applied Statistics. Books & Allied (p) Ltd

References:

1. Goon, A.M. Gupta, M.K. and Das Gupta, B. (2016): Fundamentals of Statistics, Vol. II, World press, Calcutta.
2. Newsholme, A. (2021). The Elements of Vital Statistics, Routledge, Taylor & Francis Group.
3. Keyfitz, N, and Beekman, J.A. (2010), Demography through Problems, (1st Edn.), Springer- Verlag.
4. Jhingan, M.L., Bhatt, B.K. and Desai, J.N. (2016). Demography, (3rdEdn.) Vrinda Publications (P) Ltd, Delhi.
5. Benjamin B (1960). Elements of Vital Statistics, Quadrangle Books.
6. Whipple, G.C. (2022). Vital Statistics: An Introduction to the Science of Demography, Legare Street Press.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**			
Programme	**BSc. Statistics**			
Course Name	**Statistical Documentation Tools**			
Type of Course	**Skill Enhancement Course (SEC)**			
Course Code	**M24ST3VAC200**			
Course Level	**200**			
Course Summary & Justification	To get basic knowledge and skill in data analytics using spreadsheet and to get the ability to create scientific documents using Latex.			
Semester	3	**Credits**	3	**Total Hours**

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	45
		3		0		45
Pre-requisites	Level 100 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the fundamentals of spreadsheets	U	4
2	Perform data manipulations using spreadsheet	A, S	1, 5
3	Apply exploratory data analysis techniques to datasets using spreadsheet	A, An, S	1, 2, 5
4	Create visual representations of the data	A, S	1, 5
5	Create scientific documents and presentations in LATEX	A, S	2
6	Use spreadsheets and LATEX together to perform data analysis and to prepare its report	A, S	1, 2, 4, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
Module 1	**Introduction to Spreadsheet**	**15**	
1.1	Basics of spreadsheets and data types, creation of worksheets, editing, formatting, and saving		1
1.2	Introduction to functions in a spreadsheet, if function, freeze panes, vlookup, hlookup, sorting, filtering		1,2
	Practicum		6
Module 2	**Statistics in Spreadsheet**	**15**	

2.1	Pivot tables, Statistical functions in spreadsheet, conditional formatting and data validation,		3
2.2	Data visualization, Exploratory analysis using spreadsheet functions.		3, 4
	Practicum		6
Module 3	**Introduction to LATEX Typesetting**	**15**	
3.1	Understanding Latex compilation, basic Syntax Writing equations, matrix, tables. Page layout - Titles, abstract, chapters, sections, references, equation, citation. List making environments.		5
3.2	Table of contents, generating new commands, figure handling, numbering, list of figures, list of tables, generating index		5
3.3	Classes: article, book, report, beamer, slides. Applications to: Writing articles/ Projects Presentation using beamer.		5, 6
	Practicum		6
Module 4	**Teacher Specific Content**		

Practicum	
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop Problem Solving Skills. The practicum component is to be done in the classroom/ computer lab under the strict guidance of the teachers. Suggested Activity: **Application in a Real-Life Scenario:** Using a suitable secondary dataset, perform basic EDA using the data in spreadsheet, prepare a report using Latex and submit the report.	
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz

Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar, Practicum Report **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text books:

1. Alexander, M., Kusleika, R., Walkenbach, J. (2018). Excel 2019 Bible. United States: Wiley.
2. Griffiths, D. F., Higham, D. J. (2016). Learning LaTeX. United States: Society for Industrial and Applied Mathematics.
3. van Dongen, M. R. C. (2012). LaTeX and Friends. Germany: Springer Berlin Heidelberg.

References

1. Ramirez, A. (2020). Excel Formulas and Functions 2020: The Step-by-Step Excel Guide with Examples on How to Create Powerful Formulas. (n.p.): Caprioru.
2. Kottwitz, S. (2024). LaTeX Cookbook: Over 100 Practical, Ready-to-use LaTeX Recipes for Instant Solutions. United Kingdom: Packt Publishing.

SEMESTER IV

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**
Programme	**B.Sc. Statistics**
Course Name	**Models for Multivariate Data Analytics**
Type of Course	**DSC A (Major)**
Course Code	**M24ST4DSC200**
Course Level	**200**
Course Summary & Justification	Students will be proficient in analysing relationship between variables using correlation and regression analysis. They will be able to understand the basics of bivariate and multivariate models, and will be able to familiarize some of the most popular multivariate models. Results about the distribution of quadratic forms will be supplemental to the study. They

	will also be able to apply this knowledge in practical scenarios using R software.					
Semester	4	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 100 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Apply various types of correlation measures and multiple linear regression model in modelling scenarios	A	1, 4
2	Understand the properties of bivariate normal distribution	U	4
3	Identify the distribution of quadratic forms	An	1, 4
4	Understand the basic concepts of multivariate models	U	1, 4
5	Model real life datasets using the multivariate normal model.	A, C, S	1, 4, 5
6	Use multinomial distribution for modelling data generated by experiments with finite number of outcomes	A, C, S	1, 4, 5
7	Use R programming to apply the theoretical concepts to datasets	A, S	1,2, 4, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module1	**Correlation and Regression**	**15**	
1.1	Multiple correlation, and partial correlation – properties and related results.		1
1.2	Multiple linear regression-model fitting and basic diagnostics		1
Module2	**Bivariate Normal Distribution and Quadratic Forms**	**15**	

2.1	(Review of bivariate random vector, joint pmf, joint pdf, and bivariate cdf, marginal and conditional distributions and independence of random variables.) Bivariate normal distribution: pdf, marginal distributions, conditional distributions, and independence.		2
2.2	Distribution of quadratic forms: independence, properties, Cochran's theorem		3
Module 3	**Multivariate distributions**		
3.1	Random vectors, mean vector, and dispersion matrix.		4
3.2	Multivariate normal distribution: characterizations, moment generating function, characteristic function, marginal distributions, conditional distributions, and other properties.	**15**	5
3.3	Transformations of normal vectors, orthogonal transformations. Estimation of mean vector and dispersion matrix		5
3.4	Multinomial distribution and its basic properties.		6
Module4	**Practical using R**	**30**	
4.1	Numerical problems from the following topics to be worked out in R: Multiple correlation, partial correlation, and multiple regression. Partial Correlation. Multivariate normal distribution-Estimating variance-covariance matrix, obtaining the distribution of transformations. Quadratic forms -Finding distribution of quadratic forms. (A practical record with minimum 5 problems has to be submitted).		7
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz

Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar and Practical Record Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Books:

1. Anderson, T.W. (2009). An Introduction to Multivariate Statistical Analysis,3rd Edition, John Wiley.
2. Rencher, A. C. (1998). Multivariate Statistical Inference and Applications,1st Edition, Wiley-Inderscience.
3. Purohit, S. G., Gore, S. D., and Deshmukh, S. R. (2019) Statistics Using R, 2nd edition, Narosa Publishing House.
4. Fernandez, F. M. H. (2022) R Programming Language, Booknetz.
5. Mathai, A. M., Provost, S. B., and Haubold, H. J. (2022). Multivariate Statistical Analysis in the Real and Complex Domains, Springer.
6. Mathai, A. M. (1997). Jacobians of Matrix Transformation and Functions of Matrix Arguments, World Scientific Publishing Company.
7. Gupta, S.C., and Kapoor, V.K. (2020). Fundamentals of Mathematical Statistics,12th Edition, Sultan Chand & Sons, New Delhi.

References:

1. Rohatgi, V.K. and Saleh, A.K.M. D. E. (2015) An Introduction to Probability and Statistics, 3rdEdition, John Wiley & Sons Inc.
2. Johnson, R.A., and Wichern, D.W. (2013) Applied Multivariate Statistical Analysis, 6th Edition, Pearson Education.
3. Hogg, R.V., McKean, J.W. and Craig, A.T. (2014) Introduction to Mathematical Statistics,7thEdition, Pearson Education Publication.
4. Mood, A.M., Graybill, F.A. and Boes, D.C. (2007) Introduction to the Theory of Statistics, 3rdEdition (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Statistical Inference**					
Type of Course	**DSC A (Major)**					
Course Code	**M24ST4DSC201**					
Course Level	**200**					
Course Summary & Justification	Students will be well-equipped to apply statistical hypothesis testing, parametric and non - parametric tests, and conduct data analysis using R					
Semester	**4**	**Credits**			**4**	**Total Hours**
Total Student Learning	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30

Time (SLT)						
		3		2		75
Pre-requisites	Level 100 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the basic concepts of stochastic convergence, applications of Chebychev's inequality, Law of large numbers and CLT to sequence of random variables.	U, A	1, 4
2	Examine the properties of a good estimator and understand the applications of Cramer-Rao inequality.	A	2
3	Estimate parameters using various methods.	E	1,2
4	Construct confidence intervals for parameters.	C	1,2
5	Understand basic concepts of statistical hypotheses and their applications.	U & A	3
6	Apply various parametric and non-parametric test procedures in analysing data	U, A & An	1, 2, 5
7	Conduct data analysis using R Programming	A, An	5, 6
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module1	**Point and Interval Estimation**	**15**	
1.1	Chebychev's inequality, sequence of random variables, convergence of sequence of random variables, Law of large numbers (statement only).		1
1.2	Properties of a good estimator, Cramer-Rao inequality (without proof) and its applications.		2

1.3	Confidence interval, confidence coefficient, confidence intervals for the mean, difference of means, variance, ratio of variances, proportion, difference of proportions and Odds ratio.		4
Module 2	**Methods of Estimation**	**10**	
2.1	Method of moments.		3
2.2	Method of maximum likelihood, properties of maximum likelihood estimation (statement only).		3
2.3	Method of minimum variance and method of least squares.		3
Module 3	**Statistical Hypothesis**	**20**	
3.1	Introduction to statistical hypothesis testing, most powerful test, Neyman- Pearson test procedure, Neyman-Pearson lemma (without proof),		5
3.2	Parametric Tests: Tests concerning mean, equality of means, proportion and equality of proportions, paired-t test, tests for variance and equality of variance: Chi- square test, F test, Bartlett's test and Levene's test, One way ANOVA, tests for sphericity. (Problem oriented approach)		6,7
3.3	Non - parametric tests: Chi-square tests: goodness of fit, independence and homogeneity, Tests for normality- Kolmogorov-Smirnov Test, Anderson-Darling test, Shapiro-Wilk test, one sample and paired sample: Sign test, Wilcoxon signed rank test, Mann-Whitney U test and Kruskal-Walli's test. (Problem oriented approach).		6,7
Module 4	**Practical using R**	**30**	
4.1	Use R Programming to solve numerical problems associated with topics covered in modules 1-3. (A practical record with minimum 10 problems has to be submitted).		7
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz

Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar and Practical Record Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Department	**STATISTICS**					
Programme	**B. Sc. Statistics**					
Course Name	**Biostatistics**					
Type of Course	**DSE (Major)**					
Course Code	**M24ST4DSE200**					
Course Level	**200**					
Course Summary & Justification	Biostatistics is the application of statistical techniques to scientific research in health-related fields, including medicine, biology, and public health. This course will cover fundamental concepts and methods in biostatistics, including descriptive statistics, probability theory, hypothesis testing, regression analysis, and more. The emphasis will be on practical applications and interpretation of statistical results in biomedical research.					
Semester	4	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	60
		4		0		60

Pre-requisites	Level 100 knowledge in Statistics.

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand and apply fundamental concepts of biostatistics to health-related research.	U, A	1,4
2	Perform descriptive and inferential statistical analyses using appropriate software.	A, S	2,5
3	Design and analyse biomedical studies using statistical methods.	C, A	1,3,4
4	Interpret and critically evaluate the results of statistical analyses in biomedical research.	An, E	1,4
5	Communicate statistical findings effectively to a range of audiences.	A, An	2,6
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module 1	**Introduction to Biostatistics**	**15**	
1.1	Definition and scope of biostatistics, Role of biostatistics in biomedical research, Examples of bio statistical applications in epidemiology and clinical trials		1
1.2	Types of data: nominal, ordinal, interval, ratio, Primary vs. secondary data, Surveys, experiments, observational studies		1
1.3	Data presentation: tables, charts, graphs		1
Module 2	**Statistical Concepts**	**10**	
2.1	Measures of central tendency: mean, median, mode; Measures of variability: range, variance, standard deviation		2
2.2	Basic probability concepts, Conditional probability and Bayes' theorem, Probability distributions: binomial, Poisson, normal		2
2.3	Sampling methods and sample size determination, Correlation and Regression		2

2.4	Odds ratios and interpretation, Concepts of survival analysis		2
Module 3	**Design of Biomedical Studies**	**10**	
3.1	Study designs: cross-sectional, cohort, case-control		3
3.2	Randomized controlled trials		3
3.3	Ethical considerations in biomedical research		3
Module 4	**Advanced Analytical Concepts**	**25**	
4.1	Introduction to longitudinal data and mixed effect models		4
4.2	Introduction to Meta-analysis, Bayesian methods in Biostatistics		4
4.3	Introduction to appropriate statistical software, Data cleaning and visualization		2,5
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Daniel, W. W., & Cross, C. L. (2018). Biostatistics: A Foundation for Analysis in the Health Sciences (10th ed.). Hoboken, New Jersy: Wiley.
2. Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). Introduction to Meta-Analysis. Chichester, United Kingdom: Wiley.
3. Kleinbaum, D. G., & Klein, M. (2012). Survival Analysis: A Self-Learning Text (3rd ed.). New York: Springer.
4. Dalgaard, P. (2008). Introductory Statistics with R (2nd ed.). New York: Springer.

References

1. Pagano, M., & Gauvreau, K. (2018). Principles of Biostatistics (2nd ed.). Boca Raton, Florida: CRC Press.
2. Rosner, B. (2015). Fundamentals of Biostatistics (8th ed.). Boston, Massachusetts: Cengage Learning.
3. Diggle, P., Heagerty, P., Liang, K. Y., & Zeger, S. (2002). Analysis of Longitudinal Data (2nd ed.). Oxford, United Kingdom: Oxford University Press.
4. Carlin, B. P., & Louis, T. A. (2009). Bayesian Methods for Data Analysis (3rd ed.). Boca Raton, Florida: CRC Press.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**
Programme	**B.Sc. Statistics**
Course Name	**Vital Statistics and Index Numbers**
Type of Course	**DSC E(Major)**
Course Code	**M24ST4DSE201**
Course Level	**200**
Course Summary & Justification	By combining theoretical knowledge of vital statistics, mortality and fertility measurement, population growth, and index numbers with practical applications using spreadsheet, this course equips students with the skills and understanding necessary for proficient demographic analysis and decision-making in various fields.

Semester	4	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	60
		4		0		60
Pre-requisites	Level 100 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the sources of vital statistics including census, registration, adhoc survey and hospital records.	U	1, 4
2	Determine the measurement of mortality including Crude Death Rate, Specific Death Rate, Infant Mortality Rate and Standardized Death Rate.	U, E	1,2
3	Understand complete and abridged life tables and its characteristics and construction.	U, A	1,3,4
4	Determine the measurement of fertility including Crude Birth Rate, General Fertility Rate, Age Specific Fertility Rate, Total Fertility Rate, Gross Reproduction Rate and Net Reproduction Rate.	U, E	1,2
5	Obtain the measurement of Population Growth including Crude Rates of Natural Increase, Pearl's Vital Index.	An, E	1,2
6	Understand the concepts of Index numbers including Price, Quantity and Value indices.	U	1, 4
7	Understand the Construction, Uses, limitations of index numbers.	U	1,3,4
8	Explain the tests for index numbers, various formulae and their comparisons.	U,A & E	1,2,4

9	Calculate Chain-Index Numbers, Consumer Price Index, Wholesale Price Index and Index of Industrial Production.	A &,An	1,2,4
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	**Hours**	**CO No.**
Module 1	**Sources of Vital Statistics and Mortality Measures**	**10**	
1.1	Introduction and sources of collecting data on vital statistics.		1
1.2	Census, registration, adhoc surveys, hospital records.		1
1.3	Crude Death Rate (CDR) and Specific Death Rate (SDR)-Age Specific Death Rate, Cause Specific Death Rate, Maternal Mortality Rate and Infant Mortality Rate (IMR).		2
1.4	Standardized Death Rates -Direct and Indirect Methods		2
	Practicum Problems based on computation of Mortality Measures and standardisation using direct and indirect methods		
Module 2	**Life Tables**	**25**	
2.1	Complete life tables and its characteristics.		3
2.2	Abridged life tables and its characteristics.		3
2.3	Principal methods of construction of Abridged life tables, Reed Merrel's Method, Greville's Method.		3
	Practicum		

	Problems based on construction of complete and abridged life table.		
Module 3	**Measurement of fertility and Population Growth.**	**15**	
3.1	Crude Birth Rate, General Fertility Rate, Age-Specific Fertility Rate, Total Fertility Rate.		4
3.2	Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR).		4
3.3	Measurement of Population Growth-Crude rates of natural increase and Pearl's Vital Index.		5
	Practicum Problems based on computation of Fertility Measures.		
Module 4	**Index Numbers**	**10**	
4.1	Price, Quantity and Value indices.		6
4.2	Construction, Uses and Limitations of Index Number.		7
4.3	Tests for index numbers, various formulae, and their comparisons.		8
4.4	Chain-Index Numbers.		9
4.5	Formulae and uses of some Important Indices: Consumer Price Index, Wholesale Price Index and Index of Industrial Production		9
	Practicum Problems based on computation of Index Numbers-Price, Quantity and Value, Tests on consistency of Index Numbers, Chain Indices, Consumer price Index Numbers		
Module 5	**Teacher Specific content.**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom/computer lab under the strict guidance of teachers. A minimum of 10 problems is to be solved using spreadsheet and a record should be submitted to the teacher concerned.

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar and Practicum Record B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Gupta, S.C. and. Kapoor, V.K. (2018). Fundamentals of Applied Statistics, Sultan Chand & Co. New Delhi.
2. Srivastava, O.S. (1983). A Text Book of Demography, Vikas Publishing House, New Delhi.
3. Parimal Mukhopadhyay. (2005). Applied Statistics. Books & Allied (p) Ltd

References:

1. Goon, A.M. Gupta, M.K. and Das Gupta, B. (2016): Fundamentals of Statistics, Vol. II, World press, Calcutta.
2. Newsholme, A. (2021). The Elements of Vital Statistics, Routledge, Taylor & Francis Group.
3. Keyfitz, N, and Beekman, J.A. (2010), Demography through Problems, (1st Edn.), Springer- Verlag.

4. Jhingan, M.L., Bhatt, B.K. and Desai, J.N. (2016). Demography, (3rdEdn.) Vrinda Publications (P) Ltd, Delhi.
5. Benjamin B (1960). Elements of Vital Statistics, Quadrangle Books.
6. Whipple, G.C. (2022). Vital Statistics: An Introduction to the Science of Demography, Legare Street Press.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Mathematics**					
Course Name	**Statistical Inference Using R/Python**					
Type of Course	**DSC(Minor)**					
Course Code	**M24ST4DSC202**					
Course Level	**200**					
Course Summary & Justification	This course covers key concepts in Statistics including sampling distribution, estimation of parameters, testing of parametric hypotheses and non-parametric tests. Emphasis is given to practical applications using R or Python.					
Semester	4	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75

Pre-requisites	Level 100 knowledge in Statistics

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	Program Outcome
1	Understand the concept of sampling distribution	U	1, 4
2	Apply proper estimation methods to propose a point estimate for the parameter under study	A, S	2, 3, 4
3	Apply interval estimation methods to propose a confidence interval for the parameter under study	A, S	2, 3, 4
4	Apply hypothesis testing procedures for testing research hypothesis under study	A, S	2, 3, 4
5	Understand the basics of computer programming	A, S	1, 5
6	Conduct statistical analyses using R/Python	A, S	1,2,4, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

Syllabus – Module wise

Units	Course Description	Hours	CO No.
Module 1	**Sampling Distribution**	**10**	
1.1	Statistic, Parameter		1
1.2	Distribution of sample mean and sample variance		1
1.3	Normal distribution as a sampling distribution, Student's t-distribution		1
1.4	Chi- Square distribution and F distribution		1
1.5	Interrelationship between Normal, t, Chi-Square, and F distributions		1
Module	**Estimation of Parameters**	**15**	

2			
2.1	Theory of point estimation, comparison of point estimation and interval estimation		2,3
2.2	Desirable properties of a good estimator		2
2.3	Methods of point estimation: MLE and method of moments- Binomial, Poisson, gamma, and Normal distributions		2
2.4	Theory of interval estimation, confidence intervals for mean, difference in means, variance, proportion, difference in proportions and odds ratio.		3
Module 3	**Testing of Hypothesis**	**20**	
3.1	Testing of hypothesis- Statistical test, null and alternative hypotheses, simple and composite hypothesis, types of errors, significance level, power, critical region, p-value, Neyman-Pearson test approach (Statement with one or two examples only)		4
3.2	Parametric test: Test for mean (One sample and two samples), test for variance, test for proportion (one sample and two samples), test for correlation and test for odds ratio.		4
3.3	ANOVA (one way only)		4
3.4	Non- Parametric Tests: Chi-Square tests, Sign test, Wilcoxon Signed rank test, Mann-Whitney test, Kruskal Wallis H test		4
Module 4	**Data analysis Using R /Python**	**30**	
4.1	Introduction to computer programming- algorithm, flow chart, variables, types of variables, constants, scope of variables, functions, control statements, looping statements, conditional statements, comments. Comparison of traditional programming languages with Python/R		5
4.2	Introduction to Python/R- Installing, interface, basic syntax rules, data types, data structures, manipulating data types, built in functions, installing and loading packages		5
4.3	Descriptive and inferential statistical analysis using R/Python: Data visualisation, descriptive measures, correlation and		6

	regression, Statistical tests, random number generation		
Module 5	**Teacher Specific Content**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar and Practical Record Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text books:

1. Rohatgi, V.K. and Saleh, A.K.MD.E. (2015). An Introduction to Probability and Statistics, 3rd Edition, John Wiley & Sons Inc.
2. Gupta, S.P. (2021) Statistical Methods, 46th Edition, Sultan Chand and Sons: New Delhi.
3. Davies, T. M. (2016). The Book of R: A First Course in Programming and Statistics. United States: No Starch Press.
4. McKinney, W. (2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython. United States: O'Reilly Media.

References

1. Gupta, S.C. and Kapoor, V.K. (2020). Fundamentals of Mathematical Statistics, 12th Edition. Sultan Chand & Sons, New Delhi.
2. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Data Analytics Using Gretl**					
Type of Course	**VAC**					
Course Code	**M24ST4VAC200**					
Course Level	200					
Course Summary & Justification	To make the students proficient in the open-source statistical data analysis software Gretl					
Semester	4	Credits			3	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45
		3		0		45
Pre-requisites	Level 100 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Familiarize with the open-source data analysis software Gretl	U	1, 4, 5
2	Apply data manipulation techniques to real life datasets in Gretl	A, S	2, 4, 5

3	Apply numerical optimization techniques in Gretl	A, S	2, 4, 5
4	Apply statistical methods to time series data in Gretl	A, S	1, 2, 4, 5
5	Predict the future values of a time series using forecasting methods in Gretl	A, S	1, 2, 4, 5
6	Apply regression modelling for predictive analyses in Gretl	A, S	1, 2, 4, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

Unit	Course description	Hrs	CO No.
1	**Title- Introduction to Gretl**	**15**	
1.1	Basics of Gretl, features of Gretl, installing Gretl		1
1.2	Data types in Gretl, menus in Gretl, data files, modes of working, graphics in Gretl, matrix manipulation, dataset handling, creating/modifying variables		1,2
	Practicum		1, 2
2	**Title- Intermediate Gretl**	**15**	
2.1	Joining data sources, real-time data, temporal disaggregation		2
2.2	loop constructs, user-defined functions, numerical methods		3
	Practicum		2,3
3	**Title-More with Gretl**	**15**	
3.1	Univariate time series models- ARIMA, Forecasting		4,5

3.2	Linear regression, Logit and probit models, multinomial logit model		**6**
	Practicum		**4,5, 6**
4	**Teacher specific content**		

Practicum	
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom/ computer lab under the strict guidance of the teachers. Suggested Activity: On a suitable time series data, perform statistical analyses and forecasting using Gretl, prepare a report and submit it.	
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar and Practicum Report **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text books

1. Cottrell, A., & Lucchetti, R. (2012). Gretl user's guide. Distributed with the Gretl library.

2. Anderson T. W. (2010) An Introduction to Multivariate Statistical Analysis (3rd ed.) John Wiley.
3. Agresti, A. (2012). Categorical data analysis (Vol. 792). John Wiley & Sons.
4. Cowpertwait, Paul, S.P., and Andrew V. Metcalfe. (2009). Introductory time series with R. Springer Science & Business Media.

References

1. Johnson R.A. and Wichern DAV. (2008) Applied Multivariate Statistical Analysis, (fiedn) Pearson education.
2. Box, George EP, et al. (2015). Time series analysis: Forecasting and Control. John Wiley & Sons.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B. Sc. Statistics**					
Course Name	**Statistics for Competitive Examinations**					
Type of Course	**SEC**					
Course Code	**M24ST4SEC200**					
Course Level	**200**					
Course Summary & Justification	This course is designed to prepare undergraduate students for competitive exams that include a statistical component. This course covers essential topics such as descriptive statistics, probability, inferential statistics, regression analysis, and hypothesis testing, with a focus on problem-solving techniques and exam strategies.					
Semester	4	**Credits**			3	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45
		3		0		45
Pre-requisites	Plus two level knowledge in Mathematics/ Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand and apply fundamental statistical concepts to solve exam-related problems	U, A	1,2
2	Analyse data using appropriate methods and interpret results effectively	An, A	1,4
3	Develop strategies for tackling various types of statistical questions in competitive exams.	S, A	1,5

4	Improve problem-solving speed and accuracy for statistical questions.	S, A	2,4
5	Gain confidence in their ability to succeed in competitive exams with a statistical component.	A, Ap	1,6
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	**Hours**	**CO No.**
Module 1	**Basic Statistics**	**25**	
1.1	Exam Strategies and Practice: Strategies for solving multiple-choice questions, Time management techniques Mock Exams and Review: Full-length mock exams Review of key concepts and problem areas Importance of Statistics in competitive exams		3, 5
1.2	Types of data: qualitative and quantitative, Interpreting tables, charts, and graphs.		1
1.3	Measures of central tendency: mean, median, mode, Measures of dispersion: range, variance, standard deviation, Measures of position: quartiles, percentiles		1
Module 2	**Logical Reasoning**	**10**	
2.1	Introduction to sets, interpreting Venn diagram, evaluating basic set operations.		2
2.2	Interpreting ratios, proportions, percentages, relative changes, etc.		2
2.3	Problems from Combinatorics Basic probability concepts Conditional probability and Bayes' theorem		2
Module 3	**Applied Statistics**	**10**	
3.1	Time Series: Components of time series, Moving averages		3, 4
3.2	Index Numbers: Construction of index numbers, Laspeyres, Paasche, and Fisher's indices, Cost of living index and inflation		3, 4
3.3	Scatter plots and correlation coefficients, Simple linear regression analysis, Interpretation of regression results		3,4
Module 4	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, and Quiz
Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Bluman, A. G. (2017). Elementary Statistics: A Step by Step Approach (10th ed.). New York: McGraw-Hill Education.
2. Agrawal, R. S. (2018). Quantitative Aptitude for Competitive Examinations (20th ed.). New Delhi, India: S. Chand Publishing.
3. Veerachamy, R. (2018). Quantitative Techniques for Competitive Examinations. Chennai, India: McGraw-Hill Education.

References

1. Levin, R. I., & Rubin, D. S. (2012). Statistics for Management (7th ed.). Boston, Massachusetts: Pearson.
2. Gupta, S. C., & Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics (11th ed.). New Delhi, India: Sultan Chand & Sons.

SEMESTER V

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Predictive Analytics – I**					
Type of Course	**DSC A (Major)**					
Course Code	**M24ST5DSC300**					
Course Level	**300**					
Course Summary & Justification	This course is designed to provide undergraduate students with the knowledge and skills to apply statistical techniques to predict future outcomes based on historical data. This course covers fundamental concepts, methods, and practical applications of predictive analytics, including data pre-processing, modelling, evaluation, and implementation.					
Semester	5	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	60
		4		0		60
Pre-requisites	Level 200 knowledge in Statistics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the principles and techniques of predictive analytics.	U	1, 4
2	Pre-process and prepare data for predictive modelling.	A	1, 5
3	Build and evaluate predictive models using various algorithms.	C, E	1, 3, 5
4	Apply predictive analytics techniques to real-world problems	A, S	2, 4, 5
5	Develop the ability to interpret and communicate the results of predictive analyses effectively.	An, E	2, 6
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module 1	**Overview of Predictive Analytics**	**25**	
1.1	Definition and importance of predictive analytics, Applications in various fields, Predictive analytics process		1
1.2	Types of data: structured and unstructured, Data cleaning and pre-processing, Handling missing values and outliers		2
1.3	Identifying patterns and relationships in data		2
	Practicum		
Module 2	**Predictive Modelling Techniques**	**10**	
2.1	Simple and multiple linear regression, Assumptions of regression models, Evaluating regression models		3
2.2	Residual analysis, various types of residuals, Departures from underlying assumptions, Departures from normality.		3
2.3	Need for transformation of variables; power transformation, Box-Cox transformation, removal of heteroscedasticity and serial correlation, Leverage and influence, Effect of outliers.		3
2.4	Residual analysis, significance, and confidence intervals of regression coefficients. Mean Square error criteria, coefficient of determination, criteria for model selection		**3**
2.5	Polynomial regression models, Forward, Backward and Stepwise procedures		
	Practicum		
Module 3	**Non-Linear Regression Analysis**	**10**	
3.1	Introduction to nonlinear regression, linearity transformations, logarithmic transformation		3
3.2	Introduction to Logistic and Poisson regressions: estimation and diagnosis methods		3
3.3	Multinomial logistic regression, Random and mixed effect models, multi-collinearity, sources, effects, tests.		3

	Practicum		
Module 4	**Nonparametric Regression**	**15**	
4.1	Introduction to Nonparametric regression, Kernel regression, Loess, ridge regression, orthogonal polynomials, Robust regression.		4
4.2	Indicator variables, subset regression, stepwise regression, variable selection		4
	Practicum		
Module 5	**Teacher Specific content.**		5
Practicum			
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom under the strict guidance of teachers. Suggested Activity: On a suitable data, perform predictive analyses, prepare a report and submit it.			

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Quiz and Practicum Report
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar and Practicum Report B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Kuhn, M., & Johnson, K. (2013). Applied Predictive Modelling. New York, NY: Springer.
2. Srivastava, T. N., & Rego, S. (2012). Business Analytics and Predictive Modelling. New Delhi, India: Tata McGraw-Hill Education.

References

1. Montgomery, D. C., Peck, E. A., & Vining, G. G. (2003). Introduction to Linear Regression Analysis, John Wiley and Sons, New York.
2. Bansal, R. K., & Tiwari, M. (2014). Predictive Analytics using R. New Delhi, India: BPB Publications.
3. Pantula, S. G., & Dickey, D. A. (1998). Applied Regression Analysis (2nd ed.). New York, NY: Springer.
4. Iain Pardoe (2012) Applied Regression Modelling, John Wiley and Sons, Hoboken, New Jersy.

Department	**STATISTICS**					
Programme	**BSc Statistics**					
Course Name	**Multivariate Data Analytics-II**					
Type of Course	**DSC A (Major)**					
Course Code	**M24ST5DSC301**					
Course Level	**300**					
Course Summary & Justification	To provide the students with knowledge of the statistical concepts of multivariate data analytics and apply them to real life datasets using R/Python programming.					
Semester	5	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 200 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes	Learning Domains *	PSO No
1	Understand basics of multivariate techniques	U	1, 4
2	Apply multivariate testing procedures to real life datasets	A, S	1, 4, 5
3	Apply MDS and PCA for dimension reduction	A, S	1, 4, 5
4	Apply Factor analysis for identification of latent	A, S, C	1, 4, 5

	variables		
5	Classify the multivariate observations into groups using classification methods	A, S, An	1, 4, 5
6	Identify patterns in data using cluster and correspondence analyses.	A, S, An	1, 4, 5
7	Use R/Python programming to apply the multivariate techniques to real-life datasets	A, S	1,2,4,5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	**Hours**	**CO No.**
Module 1	**Dimension Reduction Techniques**	**15**	
1.1	Hotelling's and Mahalanobis' statistics, their properties, inter-relationships and uses. Canonical variates and canonical correlation, use, estimation, and computation.		1
1.2	Profile Analysis and the associated tests.		2
1.3	Multidimensional scaling, Principal component analysis (PCA)- Method of extraction-properties, associated tests.		3
Module 2	**Latent Variable Identification**	**10**	
2.1	Factor Analysis-Types- Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). EFA-Orthogonal model.		4
2.2	Estimation of factor loadings, factor rotations.		4
Module 3	**Statistical Machine Learning**	**20**	

3.1	Bayes' Classifier, Fishers linear discriminant function.		5
3.2	Support Vector Machine, PCA approach.		5
3.3	Classification trees and K-Nearest Neighbours (KNN) algorithm.		5
3.4	Cluster Analysis: proximity measures.		6
3.5	Hierarchical and non-hierarchical methods.		6
3.6	Correspondence Analysis.		6
Module 4	**Practical using R/Python**	**30**	
4.1	Problems from the above topics. (A practical record with minimum 5 problems has to be submitted.)		7
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks

	Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Book:

1. Johnson, R.A. and Wichern, D.W. (2013). Applied Multivariate Statistical Analysis, (6th Edn.), Pearson Education.
2. Vander Plas, J. (2022). Python Data Science Handbook: Essential Tools for Working with Data. (2nd Edn.), Shroff Publishers & Distributors Pvt. Ltd
3. Brian Everitt, Torsten Hothorn (2011). An Introduction to Applied Multivariate Analysis with R, Springer New York, NY.

References:

1. Anderson, T.W. (2009). An Introduction to Multivariate Statistical Analysis,(3rd Edn.), John Wiley.
2. VanderPlas, J. (2022). Python Data Science Handbook: Essential Tools for Working with Data. (2nd Edn.), Shroff Publishers & Distributors Pvt. Ltd.
3. Rencher, A.C. (1998). Multivariate Statistical Inference and Applications ,(1st Edn.), Wiley-Inderscience.
4. Seber G. F. (2004). Multivariate Observations, (1st Edn.), John Wiley & Sons.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**
Programme	**B.Sc. Statistics**
Course Name	**Operations Research**

Type of Course	**DSC A (Major)**					
Course Code	**M24ST5DSC302**					
Course Level	300					
Course Summary & Justification	This course aims to introduce the Operation Research concepts like Linear Programming Problems, Assignment Problems, Transportation Problems and Network Analysis, which are of great importance in managerial decision making.					
Semester	5	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	60
		4	0	0		60
Pre-requisites	Level 200 knowledge of Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the origin of Operations Research as a discipline and various models and different solution methods.	U	1,4
2	Understand the role of Linear Programming Problem in finding solution to complex real-life situations.	U	1,4
3	Formulate real-life decision-making problems as linear programming problems	C	1,2
4	Solve linear programming problems using graphical and simplex method2	A &S	2
5	Understand the various methods to find the initial basic feasible solutions of transportation problem.	U	1,4
6	Solve transportation problems using MODI method and stepping stone methods	A & S	1,4

7	Understand thoroughly the application of assignment problems and solve them.	A & S	1,4
8	Explain how to draw a network diagram of a project and calculate project completion time using CPM and PERT.	A & E	1,3,4
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	**Hours**	**CO No.**
Module 1	**Operations Research and LPP**	**15**	
1.1	Origin and Development of OR, Objectives of OR, Modelling and types of models in OR.		1
1.2	Introduction to Linear Programming Problem, structure of LPP.		2
1.3	Mathematical formulation of LPP.		3
1.4	Graphical and Simplex methods for solving LPP.		4
	Practicum Problems based on mathematical formulation of LPP, Graphical and Simplex methods using spreadsheet.		
Module 2	**Artificial Variables Technique**	**15**	
2.1	Two phase method.		4
2.2	Big M-method.		4
2.3	Concept of Duality in L.P.P, Dual simplex method,		4

	Concept of Sensitivity analysis.		
	Practicum Problems based on Two Phase method, Big M Method, Dual Simplex Method using spreadsheet.		
Module 3	**Transportation and Assignment Problems**	**20**	
3.1	General transportation problem, Methods for finding initial basic feasible solutions by North West corner rule, Least cost method and Vogel's Approximation Method (VAM).		5
3.2	MODI and stepping stone method to find the optimal solution of TP, Unbalanced transportation problem and degeneracy (definitions and simple problems only).		6
3.3	Assignment problem-Hungarian method to find optimal assignment.		7
	Practicum Problems based on Transportation and Assignment problems using spreadsheet.		
Module 4	**Network Analysis**	**10**	
4.1	Drawing the Network Diagram.		8
4.2	Analysis of Network- Calculation of Critical Path - Expected Project completion time.		8
4.3	PERT-Expected Completion Time and its Variance.		8
	Practicum Problems based on analysis of network using CPM and PERT.		

Module 5	**Teacher Specific content.**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom under the strict guidance of teachers. A minimum of 10 problems is to be solved using spreadsheet and a record should be submitted to the teacher concerned.

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar and Practicum Record B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Kanti Swarup, Gupta P.K., Man Mohan (2010): Operations Research, Sultan Chand and Sons, New Delhi.
2. Taha, H.A. (2019). Operations Research, (10th Edn.), Pearson Education Publication.

References

1. Gupta R.K. (2020): Operations Research, Krishna Prakashan Media (P) Ltd., Meerut.
2. Kapoor,V.K .(2012).Operation Research, Sultan Chand & Co. New Delhi.

3. Mahajan, M. (2016): Operations Research, Dhanpat Rai & Co.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**
Programme	**B. A. ECONOMICS**
Course Name	**Statistical Methods for Economic Analysis –I**
Type of Course	**DSC A- Major**
Course Code	**M24ST5DSC303**

Course Level	**300**					
Course Summary & Justification	This course provides students with a strong foundation in mathematical modelling and its applications in economic analysis.					
Semester	5	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practicum**	**Others**	40+35
		3		2		75
Pre-requisites	Plus 2 level knowledge in Statistics/Mathematics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains
CO1	Understand the basics of compiling economic data and evaluating the its basic parameters using descriptive statistics	U, E
CO2	Compute and interpret measures of central tendency and dispersion, enabling them to analyze and communicate key characteristics of datasets in diverse practical contexts.	U, E & An
CO3	Familiarize the basic quantitative and statistical concepts for economic applications in correlation and regression.	U & A
CO4	Get an idea about the Index numbers and time series that are needed for understanding economic structure of a nation	U

COURSE CONTENT

Syllabus – Module wise

	Course Description	Hours	CO No.
Module 1	**Descriptive Statistics**	**10**	
1.1	Statistics, Meaning. Collection and presentation of data.		1

1.2	Concept of primary and secondary data. quantitative and qualitative data, Nominal, ordinal and time series data, discrete and continuous data		1
1.3	Designing a questionnaire,		1
1.4	Concepts of statistical population and sample from a population, Different sampling and non-sampling methods.		1
1.5	Presentation of data by table and by diagrams, frequency distributions by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods) and ogives.		1
	Practicum Problems based on construction of frequency distribution and presentation by various graphs and diagrams.		
Module 2	**Measures of Central Tendency and Dispersion**	**10**	
2.1	Overview of measures of Central tendency- Mean, Median, Mode, Geometric Mean and Harmonic Mean		2
2.2	Measures of dispersion. Range, QD, MD, SD, CV		2
2.3	Lorenz curve and Gini coefficient.		2
	Practicum Problems based on measures of central tendency and dispersion.		
Module 3	**Correlation and regression analysis.**	**15**	
3.1	Types of correlation		3
3.2	Methods of measuring correlation, scatter diagram, Karl Pearson‘s coefficient of correlation, Rank correlation.		3
3.3	Regression, simple linear regression model,		3
	Practicum Problems based on correlation and regression analysis.		
Module 4	**Index Numbers and Time Series Analysis.**	**10**	
4.1	Index numbers-uses, weighted and unweighted index numbers, types of index numbers, tests of index numbers		4
4.2	Time series analysis- Introduction and examples of time series from various fields, Components of times series, Additive and Multiplicative models.		4
4.3	Trend: Estimation of trend by free hand curve method, method of semi averages, method of moving averages and OLS method		4

	Practicum Problems based on index numbers and time series.		
Module 5	**Teacher Specific content.**		
Practicum			
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom under the strict guidance of teachers. A minimum of 10 problems is to be solved and a record should be submitted to the teacher concerned.			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar, Practicum Record B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text books:

1. Spiegel, M. R., & Stephens, L. J. (2010). Statistics (4th ed.). Schaum's Outline Series, McGraw-Hill, New York, New York.
2. Vohra, N. D. (2017). Business Statistics. McGraw-Hill, New Delhi, India.
3. Gupta, S. P. (2020). Statistical Methods. Sultan Chand and Sons, New Delhi, India.

References

1. Weiss, N. A. (2015). Introductory Statistics (10th ed.). Pearson Education, Boston, Massachusetts.
2. Aczel, A. D., Sounderpandian, J., Saravanan, P., & Joshi, R. (2012). Complete Business Statistics (7th ed.). Tata McGraw-Hill, New Delhi, India.

3. Lind, D. A., Marchal, W. G., & Wathen, S. W. (2008). Statistical Techniques in Business and Economics (13th ed.). Tata McGraw-Hill, New Delhi, India.
4. Anderson, D. R., Sweeney, D. J., & Williams, T. A. (2016). Statistics for Business and Economics (11th ed.). Cengage Learning, Boston, Massachusetts.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**
Programme	**B.Sc. Statistics**
Course Name	**Clinical Data Analytics**
Type of Course	**DSE (Major)**

Course Code	**M24ST5DSE300**					
Course Level	**300**					
Course Summary & Justification	The course introduces the fundamentals of a clinical trial. Methods and tools for analysis of clinical data are discussed and implemented on real-life datasets using statistical software.					
Semester	5	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	60
		4		0		60
Pre-requisites	Level 200 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes	Learning Domains *	PSO No
1	Understand basic principles of clinical trials	U	1
2	Understand various phases in a clinical trial	U, A	1, 4
3	Identify various aspects of clinical trials that need special attention like ethical issues and data management	U, A	1, 4, 6
4	Understand the basic components of survival analysis	U	1, 4
5	Apply suitable parametric methods and models to real life survival data	A, S, An	1, 4, 5
6	Apply suitable non-parametric methods and models to real life survival data	A, S, An	1, 4, 5
7	Use suitable statistical software to apply the survival analysis techniques to real-life datasets	A, S	1,2, 4, 5

*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Syllabus – Module wise

	Course Description	Hours	CO No.
Module 1	**Fundamentals of clinical trials**	**15**	
1.1	Introduction to clinical trials and study protocols, brief overview of study protocol features, research questions/hypotheses (FINER criteria), intervention and study endpoints (primary, secondary, & surrogate), study population		1
1.2	Overview of Phase I studies, overview of Phase II studies, introduction to Phase III trials, protocol development guidelines		2
1.3	Important procedures in clinical trials and ethics in clinical trials: Randomization, intent-to-treat concept, blinding/masking, placebo controls		1, 2
1.4	Ethical issues in clinical trials, International harmonization conference & good clinical practice, informed consent guidelines, regulatory environment; roles of IRB, OHRP, FDA		3
1.5	Data management and coordination: Clinical research forms & data collection, data management & quality assurance, role of a data and safety monitoring board (DSMB), introduction to interim analysis, early termination		3
Module 2	**Survival Analysis**	**15**	
2.1	Basic quantities and models in Survival Analysis - survival function, hazard function, mean residual life function.		4
2.2	Common parametric models for survival data; censoring and truncation - right censoring, left and interval censoring, truncation, likelihood construction for censored and truncated data, counting processes.		5
	Practicum		7

Module 3	**Inference Procedures**	**15**	
3.1	Nonparametric estimation of basic quantities for right censored and left censored data, pointwise confidence intervals for the survival function, estimators of the survival function for left-truncated and right-truncated data; Estimating the hazard function		6
3.2	Hypothesis testing - One-sample tests, tests for two or more samples.		5, 6
	Practicum		7
Module 4	**Advanced Methods**	**15**	
4.1	Semiparametric proportional hazards regression with fixed covariates – Coding covariates, partial likelihoods for distinct-event time data, partial likelihoods when ties are present, model building using the proportional hazards model, estimation for the survival function		
	Regression diagnostics - Cox-Snell residuals for assessing the fit of a Cox model, graphical checks of the proportional hazards assumption, deviance residuals.		
	Practicum		7
Module 5	**Teacher Specific content.**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom/ computer lab under the strict guidance of the teachers.

Suggested Activity: Perform survival analysis techniques on suitable lifetime data, using a suitable statistical software, prepare a report and submit it.	
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar and Practicum Report B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Klein J.P. and Moeschberger M.L. (2003) Survival Analysis - Techniques for censored and truncated data, Second Edition, Springer-Verlag , New York,
2. Lawless J.F (2003) Statistical Models and Methods for Lifetime Data, Second Editon,
   John Wiley & Sons, Relevant Sections of the Chapters 9.
3. Friedman, L. M., Furberg, C. D., DeMets, D. L., Reboussin, D. M., Granger, C. B. (2015). Fundamentals of Clinical Trials. Germany: Springer International Publishing.

Reference

1. Kalbfleisch J.D and Prentice, R.L. (2002) The Statistical Analysis of Failure Time Data, Second Edition, John Wiley & Sons Inc.
2. Hosmer Jr. D.W and Lemeshow S (1999) Applied Survival Analysis – Regression Modelling of Time to event Data, John Wiley & Sons. Inc.
3. Nelson. W (2003) Applied Life Data Analysis.
4. Miller, R.G. (1981) Survival Analysis, John Wiley.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**			
Programme	**B.Sc. Statistics**			
Course Name	**Statistical Reliability Analysis**			
Type of Course	**DSE (Major)**			
Course Code	**M24ST5DSE301**			
Course Level	**300**			
Course Summary & Justification	The course is aimed to provide knowledge about the basics of statistical reliability theory, life distributions, various ageing-classes, and estimation procedures for reliability.			
Semester	5	Credits	4	Total Hours

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	60
		4		0		60
Pre-requisites	Level 200 knowledge in Statistics					

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand basics of Reliability Analysis	U	1, 4
2	Apply the concepts of system reliability while designing new systems	A, Ap, S	1, 2
3	Identify suitable models for modelling lifetime of components	An, A, S	1, 2
4	Classify components based on their ageing class	An, E, S	1, 2, 4
5	Evaluate the reliability of a system	An, A, E, S	1, 2
6	Estimate reliability of stress-strength system	An, A, E, S	1, 2
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus – Module wise

	Course Description	Hours	CO No.
Module 1	**Basics of Reliability Theory**	**10**	
1.1	Basic concepts in reliability, series and parallel systems, k out of n systems and its reliability		1
1.2	Coherent systems, reliability of coherent systems, cuts and paths		1,2

1.3	Bounds on system reliability.		1
Module 2	**Life Distributions**	**15**	
2.1	Life distributions; reliability function, hazard rate and mean residual life function, one-one correspondence of these functions		3
2.2	Study of life time models viz, exponential, Weibull, Lognormal, Pareto, Gamma, Makeham, Reliegh distributions,		3
2.3	Proportional hazard models and their characteristics.		3
Module 3	**Notions of Ageing**	**20**	
3.1	Increasing failure rate (IFR), increasing failure rate average (IFRA), new better than used (NBU), decreasing mean residual life (DMRL) and new better than used in expectation (NBUE) classes and their duals; loss of memory property of the exponential distribution		4
3.2	Closures of these classes under formation of coherent systems, convolutions, and mixtures.		4
Module 4	**Reliability Estimation using MLE**	**15**	
4.1	Reliability estimation using MLE - Exponential, Weibull and Gamma distributions based on censored and non-censored samples.		5
4.2	Kaplan-Meier estimates of the distribution function.		5
4.3	Stress-strength reliability, and its estimation.		6
Module 5	**Teacher Specific Content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text books

1. Barlow R.E. and Proschan F. (1965) Mathematical Theory of Reliability, Wiley, New York.
2. Sinha S. K. (1986) Reliability and Life Testing, Wiley Eastern.

References

1. Barlow R.E. and Proschan F. (1985) Statistical Theory of Reliability and Life Testing, Holt Rinehart and Winston, New York.
2. Rao S.S. (1992) Reliability-based design, McGraw Hill, New York.
3. Lai C.D and Xie M. (2006) Stochastic ageing and dependence in reliability, Springer.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Statistical Computing using Python**					
Type of Course	**DSC E(Major)**					
Course Code	**M24ST5DSE302**					
Course Level	**300**					
Course Summary & Justification	This course aims to equip the students to use Python programming language in Statistical data investigations.					
Semester	5	Credits			4	Total Hours
Total Student Learning Time	**Learning**					45+30

(SLT)	Approach	Lecture	Tutorial	Practical	Others	
		3		2		75
Pre-requisites	Level 200 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify the role of Python programming and its packages in statistical data analysis.	U, Ap	1, 4
2	Understand the features and syntax of Python Programming.	U	1, 4
3	Use Python programming for data manipulation and for getting descriptive measures of datasets.	A, S, An	1, 2, 5
4	Implement Python in creating graphical representations of data.	A, S, An	1, 2, 5
5	Create statistical models for studying the relationship between variables, using Python.	A, C, S	1, 2, 5
6	Formulate statistical hypothesis for research problems and check the validity of the hypothesis from sample data using statistical hypothesis testing procedures in Python.	A, An, C, S	5
7	Use Python for Statistical data analytics	S	1, 2, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module 1	**Introduction to Python**	**10**	

1.1	Different Python interfaces- Python Idle, Conda, Spyder and Jupyter Notebook. Basic syntax-Importance of indentation in Python		1
1.2	Python Data types- Python numbers, string, list, tuple, dictionary and set.		1, 2
1.3	Importing packages-numpy, math, stats, random, pandas, seaborn, etc. Accessing functions from imported modules.		2
1.4	Control flow structures – if else statements, while and for loops Defining functions in python.		2
Module 2	**Introduction to Data Science Packages**		
2.1	Introduction to NumPy. Creating NumPy array from lists. Pattern and random number generation using Numpy-range(), linspace(), random() etc. Useful functions in NumPy.		3
2.2	Introduction to Pandas, Creating Panda series and Data frame from various inputs like lists, dictionary, csv files, etc. Indexing elements in Pandas objects.		3
2.3	Data Manipulation with functions and methods in Pandas. Dealing with missing values-dropna(), fillna(). Reshaping data-stack(), melt(), pivot_table() functions.	**20**	3
2.4	Joining datasets row wise and column wise. Joining tables based on key columns-inner join, outer join.		3
2.5	Matplotlib- Scatter plots, histogram, bar plots, line diagram, box plots, pie charts, etc.		4
2.6	Introduction to seaborn package. Low level plots and the corresponding high-level plots- countplot vs catplot, scatterplot vs relplot, regplot vs lmplot, etc.		4
2.7	Advanced plotting using seaborn-lmplot, stripplot, swarmplot, violinplot, boxenplot , etc.: Faceting and hue.		4
Module 3	**Data Science using Python**	**15**	

3.1	Introduction to stat module from sciPy. Random Number Generation- Uniform, Bernoulli, Binomial, Normal, etc. p-p plots, q-q plots, illustrating limit theorems using random number generation and various relationships. Computing probabilities and quantiles using pdf(), ppf(), isf(), etc.		5, 6
3.2	Defining new distributions. Testing of hypotheses- tests for mean, ANOVA, tests for sphericity, tests for proportion, etc. Introduction to machine learning using Scikit Learn-Principal Component Analysis, Multidimensional Scaling and Factor Analysis		5, 6
3.3	Supervised learning- Linear and logistic regression, Classification-Fisher's Discriminant, Support vector machine, KNN, Decision Tree-Classification Tree and Regression Tree.		5, 6
3.4	Unsupervised Learning: Clustering-K Means and Hierarchical, Correspondence analysis.		5, 6
Module 4	**Practical** (A practical record with minimum 5 problems has to be submitted.)	**30**	7
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar Practical Total = 15 marks Lab performance, record, field report etc.

	B. End Semester Examination Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Books

1. Vander Plas, J. (2022). Python Data Science Handbook: Essential Tools for Working with Data.(2nd Edn.), Shroff Publishers & Distributors Pvt. Ltd.
2. Gaddis, T.(2018). Starting out with Python. (4th Edn.) Pearson Education

References

1. Langtangen, H. P. (2018). A primer on scientific programming with Python (Vol.6), (5th Edn.), Springer.
2. Downey, A., Elkner, J. and Meyers, C. (2015).Learning With Python, (1st Edn.) Dreamtech Press.
3. Salaria R.S.(2019).Programming in Python, Khanna Book Publishing Co.(P) Ltd., New Delhi.
4. Grus, J. (2019). Data Science From Scratch: First Principles with Python. (2nd Edn.), Shroff Publishers & Distributors Pvt. Ltd

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Programme	**B.Sc. Statistics**					
Course Name	**Stochastic Processes**					
Type of Course	**DSE**					
Course Code	**M24ST5DSE303**					
Course Level	**300**					
Course Summary & Justification	The course explores in detail the advanced concepts stochastic processes, and their properties. This course provides a basis to introduce higher statistical theory and applications.					
Semester	5	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 200 knowledge in Statistics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the basic concepts of stochastic processes and their classifications.	U	1, 4
2	Analyse and model random phenomena using appropriate stochastic processes.	An, A	1, 4
3	Apply the theory of stochastic processes to solve real-world problems.	A, S	1, 4, 5
4	Use software tools to simulate and analyse stochastic processes.	A, S	2, 5
5	Interpret and communicate the results of stochastic process analyses effectively.	An, E	2, 6
6	Develop critical thinking skills for evaluating the applications of stochastic processes in various fields.	An, E	4, 6
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module 1	**Introduction to Stochastic Processes**	**25**	
1.1	Definition and importance, Examples of stochastic processes, Classification of stochastic processes.		1
1.2	Discrete-Time Markov Chains: Definition and properties, Transition matrices and Chapman-Kolmogorov equations, Classification of states		1, 2
1.3	Long-Term Behaviour of Markov Chains: Steady-state probabilities, Absorbing states, Applications in various fields		2, 3
1.4	Poisson Processes: Definition and properties, Inter-arrival and waiting time distributions, Applications of Poisson processes		2, 3
Module 2	**Continuous-Time Stochastic Processes**	**10**	
2.1	Definition and properties, Transition rates and Kolmogorov forward and backward equations, Birth-death processes		1, 2
2.2	Renewal Theory: Renewal processes, Renewal reward processes, Applications of renewal theory		2, 3
2.3	Brownian Motion: Definition and properties, Wiener process, Applications of Brownian motion in finance and physics		2, 3

Module 3	**Advanced Topics in Stochastic Processes**		
3.1	Martingales: Definition and properties, Martingale convergence theorems, Applications of martingales	**10**	2, 3
3.2	Branching Processes: Definition and properties, Generating functions and extinction probabilities, Applications in biology and demography		2, 3
3.3	Diffusion Processes: Definition and properties, Fokker-Planck equations, Applications in biology and finance		2, 3
Module 4	**Practical using R/Python Programming** (A practical record with minimum 5 problems has to be submitted.)	**30**	
4.1	Introduction to Stochastic Process Simulation		4, 5
4.2	Simulating Markov chains and Poisson processes, Practical sessions on Brownian motion and renewal processes		4, 5, 6
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

	Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Books:

1. Karlin, S., & Taylor, H. M. (1998). An Introduction to Stochastic Modelling (3rd ed.). San Diego, CA: Academic Press.
2. Medhi, J. (2017). Stochastic Processes (3rd ed.). New Delhi, India: New Age International Publishers.

References

1. Ross, S. M. (2014). Introduction to Probability Models (11th ed.). Amsterdam, Netherlands: Elsevier.
2. Durrett, R. (2019). Essentials of Stochastic Processes (3rd ed.). New York, NY: Springer.
3. Bhat, B. R. (2000). Stochastic Models: Analysis and Applications. New Delhi, India: New Age International Publishers.
4. Basu, A. K. (2003). Introduction to Stochastic Processes. New Delhi, India: Narosa Publishing House.
5. Prabhu, N. U. (2010). Stochastic Processes: Basic Theory and Its Applications. New Delhi, India: World Scientific Publishing Company.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B. Sc Statistics**					
Course Name	**Statistical Reporting**					
Type of Course	**SEC**					
Course Code	**M24ST5SEC300**					
Course Level	**300**					
Course Summary & Justification	This course introduces the popular document processing software Latex and the versatile reproducible document interface R Markdown.					
Semester	5	Credits			3	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45
		3		0		45
Pre-requisites	Level 100 knowledge in Statistics.					

COURSE OUTCOMES (CO)

CO	Expected Course Outcome	Learning	PO

No.		Domains *	No
1	Understand the use of Latex and R Markdown in document creation	U	1, 2, 5
2	Use Latex for creating scientific reports and articles	A, Ap, S	1, 2, 5
3	Use R Markdown for creating reproducible documents containing R codes and the corresponding outputs	A, Ap, S	1, 2, 5
*Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus – Module wise

	Course Description	Hours	CO No.
Module1	**Introduction to LATEX**	**10**	
1.1	Introduction to LateX, what is Latex, merits of LATEX over word Processors, demerits of LATEX		1
1.2	Installation of TexStudio and MikTex, understanding Latex compilation-basic Syntax, adding equations, matrices, tables and figures.		1
1.3	Creating title Page, page Numbering and headings, modifying Text etc. Using packages.		1,2
	Practicum		
Module 2	**Advanced LATEX**	**20**	
2.1	Page layout – Titles, abstract, chapters, sections, bibliography		1,2
2.2	Equation references, citation.		1,2
2.3	List making environments, table of contents, generating new commands,		1,2

2.4	Figure handling, numbering, list of figures, list of tables, generating index		1,2
2.5	Packages: Geometry, Hyperref, amsmath, amssymb, algorithms, algorithmic graphic, color, tilez listing.		1,2
2.6	Classes: article, book, report, beamer, slides. IEEtran		1,2
2.7	Applications to: Writing resume, writing question paper, writing articles/ research papers, presentation using beamer.		2
	Practicum		
Module 3	**Introduction to R Markdown**		
3.1	Introduction to the concept of reproducible documents, applying markdown syntax to format text, running code chunks in R markdown, formatting tables in R markdown, generating figures in R markdown, formatting references in R markdown	**15**	3
	Practicum		
Module 5	**Teacher Specific content.**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom/ computer lab under the strict guidance of the teachers. Suggested Activity: Create reports and presentations from the analysis of suitable datasets

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar and Practicum Report **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Lamport, L. (2001). Latex: A Document Preparation System: User's Guide and Reference Manual. United States: Addison-Wesley.
2. van Dongen, M. R. C. (2012). LaTeX and Friends. Germany: Springer Berlin Heidelberg.
3. Xie, Y., Allaire, J., Grolemund, G. (2018). R Markdown: The Definitive Guide. United States: CRC Press.
4. Xie, Y., Dervieux, C., Riederer, E. (2020). R Markdown Cookbook. United States: CRC Press.

References

1. Kottwitz, S. (2021). LaTeX Beginner's Guide: Create visually appealing texts, articles, and books for business and science using LaTeX. Packt Publishing Ltd.
2. Griffiths, D. F., Higham, D. J. (2016). Learning LaTeX. Society for Industrial and Applied Mathematics.
3. Xie, Y. (2016). Bookdown: Authoring books and technical documents with R markdown. Chapman and Hall/CRC.

SEMESTER VI

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B. Sc. Statistics**					
Course Name	**Design and Analysis of Experiments**					
Type of Course	**DSE (Major)**					
Course Code	**M24ST6DSC300**					
Course Level	**300**					
Course Summary & Justification	This course provides undergraduate students with a robust foundation in designing, conducting, and analysing experiments. The course combines theoretical knowledge with practical applications, preparing students to apply experimental design techniques to real-world problems.					
Semester	6	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	
		4				60
Pre-requisites	Level 100 knowledge in Statistics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the basic principles and concepts of experimental design.	U	1, 4
2	Develop and implement different types of experimental designs.	C, A	1, 3, 4

3	Analyse experimental data using appropriate statistical methods.	An, E	1, 4
4	Apply the principles of experimental design to solve real-world problems.	A, S	2, 4, 5
5	Use software tools to design and analyse experiments.	A, S	2, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course Description	**Hours**	**CO No.**
Module 1	**Introduction to Experimental Design**	**15**	
1.1	Overview of Experimental Design: Importance and applications,		1
1.2	Basic principles: randomization, replication, and blocking,		1
1.3	Types of experimental designs		1
Module 2	**Experimental Designs**	**10**	
2.1	Completely Randomized Design (CRD): Definition and layout, Analysis of variance (ANOVA) for CRD, Advantages and disadvantages		2, 3
2.2	Randomized Block Design (RBD): Definition and layout, Advantages and disadvantages, ANOVA for RBD		2, 3
2.3	Latin Square Design (LSD): Definition and layout, Advantages and disadvantages, ANOVA for LSD		2, 3
	Practicum		
Module 3	**Factorial and Fractional Factorial Designs**	**10**	
3.1	Factorial Experiments: Definition and layout, Main effects and interactions, ANOVA for factorial experiments		2, 3
3.2	2^k Factorial Designs: Definition and layout, Advantages and disadvantages, ANOVA for 2^k factorial designs		2, 3
3.3	Blocking and Confounding in Factorial Designs: Purpose of blocking Confounding in factorial designs, Examples and applications		2, 3

	Practicum		
Module 4	**Advanced Experimental Designs**	**25**	
4.1	Nested and Split-Plot Designs: Definition and layout, Advantages and disadvantages, Analysis of nested and split-plot designs		2, 3
4.2	Response Surface Methodology (RSM): Definition and applications, First-order and second-order designs, Optimization using RSM		4, 5
4.3	Taguchi Methods: Definition and applications, Robust design, Analysis using Taguchi methods		4, 5
4.4	Mixture Designs: Definition and applications, Simplex lattice and simplex centroid designs, Analysis of mixture experiments		4, 5
	Practicum		
Module 5	**Teacher Specific content.**		
Practicum			
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom/computer lab under the strict guidance of teachers. A minimum of 5 problems is to be solved using software and a record should be submitted to the teacher concerned.			

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar and Practicum Record

	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Montgomery, D. C. (2017). Design and Analysis of Experiments (9th ed.). Hoboken, New Jersy: Wiley.
2. Das, M. N., & Giri, N. C. (1986). Design and Analysis of Experiments (2nd ed.). New Delhi, India: New Age International Publishers.

References

1. Box, G. E. P., Hunter, J. S., & Hunter, W. G. (2005). Statistics for Experimenters: Design, Innovation, and Discovery (2nd ed.). Hoboken, New Jersy: Wiley.
2. Dean, A., Voss, D., & Draguljić, D. (2017). Design and Analysis of Experiments (2nd ed.). New York: Springer.
3. Lawson, J. (2015). Design and Analysis of Experiments with R. Boca Raton, Florida: CRC Press.
4. Gupta, S. C., & Kapoor, V. K. (2002). Fundamentals of Applied Statistics (4th ed.). New Delhi, India: Sultan Chand & Sons.
5. Chakrabarti, M. C. (1962). Mathematics of Design and Analysis of Experiments. Kolkata, India: Asia Publishing House.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Predictive Analytics-II**					
Type of Course	**DSC A (Major)**					
Course Code	**M24ST6DSC301**					
Course Level	**300**					
Course Summary & Justification	This course aims to introduce the concept of time series and its statistical analyses.					
Semester	6	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 200 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the importance of time series analysis in real life problems.	U, Ap	1, 4
2	Apply the concept of additive and multiplicative models	U, A, Ap	1, 2

	in decomposing the components of a time series data.		
3	Estimate the trend component, present in a time series.	A, An, E	1, 2
4	Estimate the seasonal and cyclical variations.	A, An, E	1, 2
5	Perform statistical modelling of a time series using the concepts of auto regression and moving average.	C, A, S	1, 2
6	Forecast future values of a time series based on past data.	A, S	1, 2
7	Use R/Python programming to apply the time series analysis techniques to real-life data.	S	1, 2, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	**Hours**	**CO No.**
Module 1	**Introduction to time series data**	**15**	
1.1	Time series, components of time series, additive and multiplicative models.		1,2
1.2	Determination of trend, analysis of seasonal fluctuations, test for trend and seasonality.		3,4
1.3	Exponential and moving average smoothing, holt-winter smoothing, forecasting based on smoothing.		4
Module 2	**Study of stationarity**	**20**	
2.1	Time series as a discrete parameter stochastic process, auto covariance and auto correlation functions and their properties, stationary processes.		5
2.2	Test for stationarity. Unit root test, stationary processes in the frequency domain, spectral analysis of lime series.		5
2.3	Detailed study of the stationary processes: Moving Average (MA) and autoregressive (AR).		5, 6

2.4	Introduction to Autoregressive moving average (ARMA) and autoregressive integrated moving average (ARIMA) models.		5, 6
Module 3	**Estimation of ARMA models**	**10**	
3.1	Estimation of ARMA models, maximum likelihood method (the likelihood function for a Gaussian AR(1) and a Gaussian MA(1)) and Least squares.		5, 6
3.2	Yule-Walker estimation for AR Processes, choice of AR and MA periods, forecasting, residual analysis and diagnostic checking.		5, 6
Module 4	**Practical using R/Python** **(A practical record with minimum 5 problems has to be submitted.)**	**30**	
4.1	Problems from the following topics to be worked out: 1. Plotting a real-life time series, and detecting various features (trend, periodic behaviours etc.). Suggested data sets: Sun spot data, Dollar-Rupee exchange rates, Stock market data, etc. 2. Fitting and plotting of mathematical curves: modified exponential curve, Gompertz curve. 3. Fitting of trend by Moving Average Method. 4. Plotting de- trended series. 5. Measurement of Seasonal indices Ratio-to-Moving Average method. 6. Plotting ACF and PACF of a given time series using Yule-Walker equation to fit AR (1) and AR (2) models to real life data. 7. Forecasting by short term forecasting methods. 8. Forecasting by exponential smoothing.		7
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Books:

1. Box, G.E.P and Jenkins, G.M., Reinsel, G.C. and Ljung, G.M. (2015) Time Series Analysis, Forecasting and Control, (5th Edn.) Wiley.
2. Chatfield, C. (2003). The Analysis of Time Series - An Introduction (6th Edn.)), Chapman and Hall.

References

1. Abraham, B. and Ledoltcr, J.C. (2005). Statistical Methods for Forecasting, (1st Edn.) Wiley.
2. Brockwell, P.J. and Davis, R.A. (2016). Introduction to Time Series and Forecasting (3rd Edn). Springer-Verlag.
3. Kendall, M.G. (1978) Time Series, (2nd Edn.), Charles Griffin and Co. Ltd.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Bayesian Analytics**					
Type of Course	**DSC (Major)**					
Course Code	**M24ST6DSC302**					
Course Level	**300**					
Course Summary & Justification	This course introduces the principles and applications of Bayesian analytics. It covers basic to advanced topics, including Bayesian inference, models, and computational methods. Students will learn how to apply Bayesian methods to real-world problems and perform statistical analysis using relevant software.					
Semester	6	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 200 knowledge in Statistics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the fundamental concepts of Bayesian probability and statistics.	U	1, 4
2	Apply Bayesian inference methods to estimate parameters and make predictions.	A	1, 3
3	Develop and interpret Bayesian models for various types of data.	C, An	1, 3, 4
4	Utilize computational techniques for Bayesian analysis, including Markov Chain Monte Carlo (MCMC).	A, S	1, 5
5	Conduct Bayesian data analysis using software such as R or Python.	A, S	2, 5
6	Critically evaluate and compare Bayesian methods with frequentist approaches.	An, E	4, 6
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

Module 1	Course Description	Hours	CO
	Introduction to Bayesian Concepts	**15**	
1.1	History and Philosophy of Bayesian Statistics		1
1.2	Bayesian vs. Frequentist Approaches, Basic Probability Theory and Bayes' Theorem		1
Module 2	**Bayesian Inference**	**15**	
2.1	Prior, Likelihood, Posterior Distributions, Conjugate Priors, Point Estimates and Interval Estimates		1, 2
2.2	Bayesian Linear Regression, Hierarchical Models.		3
2.3	Model Comparison and Model Selection		3
Module 3	**Computational Methods**	**15**	
3.1	Introduction to MCMC Methods		4
3.2	Gibbs Sampling		4
3.3	Metropolis-Hastings Algorithm		4
Module 4	**Practical: Bayesian Data Analytics**	**30**	
4.1	Bayesian Networks, Bayesian Nonparametric		3
4.2	Applications in Machine Learning		4
4.3	Bayesian Analysis in R/Python, Practical Examples and Case Studies		5
Module 5	**Teacher Specific Content** Suggested Activity: Each student has to perform the following: Comparison with Frequentist Methods: Frequentist Inference vs. Bayesian Inference Review of Key Concepts Case Studies/Real-World Applications Student Presentations on Bayesian Project Report		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Textbook:

1. Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A., & Rubin, D. B. (2013). Bayesian Data Analysis (3rd ed.). Chapman and Hall/CRC, Boca Raton, Florida.
2. McElreath, R. (2020). Statistical Rethinking: A Bayesian Course with Examples in R and Stan (2nd ed.). CRC Press, Boca Raton, Florida.

References

1. Hoff, P. D. (2009). A First Course in Bayesian Statistical Methods. Springer, New York.
2. Lunn, D., Jackson, C., Best, N., Thomas, A., & Spiegelhalter, D. (2012). The BUGS Book: A Practical Introduction to Bayesian Analysis. CRC Press, Boca Raton, Florida.
3. Kruschke, J. K. (2014). Doing Bayesian Data Analysis: A Tutorial with R, JAGS, and Stan (2nd ed.). Academic Press, San Deigo, California.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B. A. ECONOMICS**					
Course Name	**Mathematics for Economic Analysis**					
Type of Course	**DSC A- Major**					
Course Code	**M24ST6DSC303**					
Course Level	**300**					
Course Summary & Justification	This course aims to provide students with a strong foundation in mathematical modelling and its applications in economic analysis.					
Semester	6	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practicum**	**Others**	45+30
		3		2		75
Pre-requisites	A knowledge of Mathematics/Statistics at +2 level.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
CO1	Provide students with a strong foundation in mathematical modelling and its applications in economic analysis.	U	1, 4
CO2	Develop quantitative way approach in solving economic situations using matrix algebra.	A, S	1, 5
CO3	Understand the basic concepts of differential calculus, partial differentiation and maxima and minima of functions.	U, S	1, 4
CO4	Develop economic theory that can be zipped using mathematical tools in differential calculus.	A, An	1, 4
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus – Module wise

Module	Course Description	Hours	CO No.
1	**Basic Economic Functions**	**10**	
1.1	Constants, parameters and Variables		1
1.2	Sets and Functions, Types of Functions-Linear & Non-Linear (Quadratic, Logarithmic and Exponential)		1
	Practicum		

	Problems based on sets and functions.		
2	**Theory of Matrices**	**10**	
2.1	Concept and types of Matrices, Matrix Operation- Addition, subtraction, multiplication (up to 3x3)- Determinants (up to order 3 x 3), Properties of determinants.		2
2.2	Adjoint and inverse of Matrix, Matrix formulation of a problem, Matrix formulation a system of equations		2
2.3	Solution to linear equations, Cramer ‘s rule and its applications, Uses of Matrices in Economics.		2
	Practicum Problems based on matrices and determinants.		2
3	**Differential Calculus**	**15**	
3.1	Meaning and definition of differentiation, Rules of Differentiation, differentiation of an implicit function, Derivative of Logarithmic and Exponential Functions.		3
3.2	Differentiation of an implicit function, Partial Derivatives and Rules of Partial Differentiation, Higher-order Partial Derivatives		3
3.3	Increasing and decreasing functions, Maxima and Minima of Functions.		3
	Practicum Problems based on differentiation, partial differentiation and maxima and minima of functions.		
4	**Applications of Differential Calculus**	**10**	

4.1	Marginal utility, Marginal propensity to Consume, Marginal Cost, Marginal Revenue		4
4.2	Relationship between Average Revenue and Marginal Revenue-Relationship between Average Cost and Marginal Cost - Elasticity: Price elasticity		4
4.3	Maxima and Minima of functions. Economic applications: Utility Maximisation, Cost Minimisation, Profit Maximisation.		4
	Practicum Problems based on applications of derivatives.		
Module 5	**Teacher Specific content.**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom under the strict guidance of teachers. A minimum of 10 problems is to be solved and a record should be submitted to the teacher concerned.

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz

Assessment Types	A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar and Practicum Record B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Allen, R.G.D: Mathematical Analysis for Economists, Macmillan and Company Ltd.
2. Teresa, Bradley & Patton, Paul (2006): Essential Mathematics for Economics and Business. Wiley: New Delhi
3. Knut Sydsaeter, Peter Hammond and Arne Strom: Essential Mathematics for Economic Analysis, Fourth Edition, Pearson.
4. James Bradfield, Jeffrey Baldani: An Introduction to Mathematical Economics, Cengage Learning India Pvt Ltd

References:

1. Alpha C Chiang & Kevin Wainwright: Fundamental Methods of Mathematical Economics, Fourth Edition, McGraw-Hill.
2. Geoff Renshaw: Maths for Economics, Second edition, Oxford University press
3. Mike Rosser and Piotr Lis: Basic Mathematics for Economists, third Edition, Rutledge.
4. Dowling, E.T: Introduction to Mathematical Economics, 2nd Edition, Schaums Outline Series, McGraw-Hill, New York.
5. Larry J. Goldstein, David C. Lay, David I. Schneider and Nakhle H. Asmar: Calculus and its Applications, 14th edition, Pearson

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**

Programme	**B.Sc. Statistics**					
Course Name	**Business Analytics**					
Type of Course	**DSE (Major)**					
Course Code	**M24ST6DSE300**					
Course Level	**300**					
Course Summary & Justification	This course is designed to provide an in-depth understanding of the key concepts, methodologies, and tools used in the field of business analytics. It aims to equip students with the skills necessary to analyse complex business data and make data-driven decisions.					
Semester	6	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 200 knowledge in Statistics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	Program Outcome
1	Apply statistical techniques to analyse business data.	A	1, 4
2	Utilize business analytics tools and software for data-driven decision making.	A, S	2, 5
3	Interpret and present business data insights effectively.	An, E	2, 6
4	Implement predictive analytics models to forecast business outcomes.	A, S	1, 4, 5
5	Develop and apply optimization models to solve complex business problems.	C, A	1, 4
6	Understand and apply ethical practices in business analytics.	U, A	4, 6

*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Syllabus Module wise

	Course Description	Hours	CO
Module 1	**Introduction to Business Analytics**	**15**	

1.1	Overview of Business Analytics: Definition and importance, Types of analytics: Descriptive, Predictive, and Prescriptive, Business analytics life cycle		1, 2
1.2	Data Types and Sources: Types of data: Structured, Semi-structured, and Unstructured, Data sources: Internal and external data		1, 2
1.3	Data Collection and Preparation: Data collection methods Data cleaning and pre-processing, Handling missing values and outliers		1, 2
1.4	Introduction to Software: Overview of R, Python, Power BI and Tableau; Basic operations and data manipulation		2, 5
Module 2	**Descriptive Analytics**	**15**	
2.1	Exploratory Data Analysis (EDA): Summary statistics Data visualization techniques, Correlation and covariance		1, 3
2.2	Data Visualization Tools: Creating and interpreting charts and graphs; Dashboard creation using Software		2, 3
2.3	Business Case Studies: Real-world applications of descriptive analytics; Analysing and presenting case study results		1, 3
Module 3	**Predictive Analytics**	**15**	
3.1	Regression Analysis: Simple and multiple linear regression Model diagnostics and validation.		4
3.2	Classification Techniques: Logistic regression. Decision trees and random forests		4
3.3	Time Series Analysis: Components of time series, ARIMA models, Forecasting techniques		4
3.4	Machine Learning Algorithms: Supervised vs unsupervised learning; Introduction to clustering and association rules		4
Module 4	**Practical: Prescriptive Analytics**	**30**	
4.1	Optimization Techniques: Linear programming, Integer programming, Goal programming		5
4.2	Simulation Models: Monte Carlo simulation; Risk analysis and management		5
4.3	Decision Analysis: Decision trees, Utility theory and risk preferences		5
4.4	Case Studies: Applying prescriptive analytics to solve business problems		4, 5

Module 5	**Teacher Specific Content.** Suggested Activity: Each Student has to prepare a report based on Review of emerging trends in business analytics, Identify a real life business problem and bring out an appropriate analysis leading to an answer for the business problem. Apply storytelling approach while dealing with the business problem by preparing interactive visualizations. Discuss data privacy and security as well as ethical dilemmas in business analytics. Discuss drawbacks/future works possible regarding the study on the identified real life business problem.		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text books

1. Albright, S. C., & Winston, W. L. (2019). Business Analytics: Data Analysis & Decision Making. Cengage Learning, Boston. (Module 1)
2. Provost, F., & Fawcett, T. (2013). Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking. O'Reilly Media, Sebastopol, California. (Module 1)

References

1. Healy, K. (2018). Data Visualization: A Practical Introduction. Princeton University Press, Princeton, New Jersy. (Module 2)
2. Tufte, E. R. (2001). The Visual Display of Quantitative Information (2nd ed.). Graphics Press, Cheshire. (Module 2)
3. Fox, J. (2015). Applied Regression Analysis and Generalized Linear Models (3rd ed.). SAGE Publications, Inc., Thousand Oaks, California. (Module 3)
4. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). An Introduction to Statistical Learning: with Applications in R. Springer, New York. (Module 3)
5. Shumway, R. H., & Stoffer, D. S. (2017). Time Series Analysis and Its Applications: With R Examples (4th ed.). Springer, New York. (Module 3)
6. Taha, H. A. (2016). Operations Research: An Introduction (10th ed.). Pearson, Boston. (Module 4)
7. Law, A. M. (2014). Simulation Modelling and Analysis (5th ed.). McGraw-Hill Education, New York. (Module 4)
8. Hand, D. (2020). Data Science for Business Problems: A Practical Guide to Building Data-Driven Solutions. CRC Press, Boca Raton, Florida. (Module 5)
9. Knaflic, C. N. (2015). Storytelling with Data: A Data Visualization Guide for Business Professionals. Wiley, Hoboken, New Jersy. (Module 5)
10. Provost, F., & Fawcett, T. (2013). Business Analytics: The Science of Data-Driven Decision Making. O'Reilly Media, Sebastopol, California.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Econometrics**					
Type of Course	**DSE**					
Course Code	**M24ST6DSE301**					
Course Level	**300**					
Course Summary & Justification	This course is designed to provide undergraduate students with a comprehensive understanding of econometric theories and techniques used to analyse economic data. This course covers fundamental concepts, models, and applications of econometrics, including regression analysis, hypothesis testing, and time series analysis.					
Semester	6	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 200 knowledge in Statistics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand and apply basic econometric models and techniques.	U, A	1, 4
2	Perform regression analysis and interpret the results.	A, An	1, 4
3	Conduct hypothesis testing and diagnostic checking in econometric models.	An, E	1, 4
4	Analyse economic data using time series techniques.	An, A	1, 4
5	Use econometric software for data analysis and model estimation.	A, S	2, 5
6	Communicate econometric findings effectively.	A, E	2, 6
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module 1	**Introduction to Econometrics**	**25**	
1.1	Definition and importance of econometrics, Types of econometric models, Steps in empirical economic analysis		1
1.2	Simple Linear Regression: Basic concepts and assumptions, Ordinary Least Squares (OLS) estimation, Interpretation of regression coefficients		1, 2
1.3	Multiple Linear Regression: Extension to multiple predictors, Assumptions and properties of OLS estimators, Hypothesis testing and confidence intervals		1, 2, 3
Module 2	**Advanced Regression Analysis**	**10**	
2.1	Model Specification and Selection: Model specification errors, Multicollinearity, Criteria for model selection		2, 3
2.2	Heteroscedasticity: Definition and consequences, Detection methods Remedies for heteroscedasticity		3
2.3	Autocorrelation: Definition and consequences, Detection methods, Remedies for autocorrelation		3
2.4	Endogeneity and Instrumental Variables: Definition and consequences, Identification of endogeneity, Instrumental variables estimation		3
Module 3	**Volatility Models**	**10**	
3.1	Panel Data Models: Introduction to panel data, Fixed effects and random effects models ,Applications of panel data analysis		4
3.2	ARCH and GARCH models		4
3.3	Estimation and forecasting of volatility, Applications in financial econometrics		4
Module 4	**Practical** (A practical record with minimum 5 problems has to be submitted.)	**30**	5, 6
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Books:

1. Wooldridge, J. M. (2019). Introductory Econometrics: A Modern Approach (7th ed.). Boston, Massachusetts: Cengage Learning.
2. Greene, W. H. (2018). Econometric Analysis (8th ed.). New York: Pearson.
3. Stock, J. H., & Watson, M. W. (2015). Introduction to Econometrics (3rd ed.). Boston, Massachusetts: Pearson.

References

1. Gujarati, D. N., & Porter, D. C. (2009). Basic Econometrics (5th ed.). New York: McGraw-Hill Education.
2. Koutsoyiannis, A. (2001). Theory of Econometrics (2nd ed.). New Delhi, India: Palgrave Macmillan.
3. Damodar, N. G. (2017). Basic Econometrics (5th ed.). New Delhi, India: McGraw-Hill Education.
4. Pindyck, R. S., & Rubinfeld, D. L. (1998). Econometric Models and Economic Forecasts (4th ed.). New Delhi, India: Tata McGraw-Hill Education.
5. Mukherjee, C., White, H., & Wuyts, M. (1998). Econometrics and Data Analysis for Developing Countries. New Delhi, India: Routledge.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Analysis of Categorical Data**					
Type of Course	**VAC**					
Course Code	**M24ST6VAC300**					
Course Level	**300**					
Course Summary & Justification	This course introduces the fundamentals of categorical data analysis.					
Semester	6	Credits			3	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45
		3		0		45
Pre-requisites	Level 200 knowledge in Statistics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the fundamentals of categorical data analysis	U	1, 4
2	Apply inferential procedures for proportion	A, S	1, 2
3	Apply Statistical analysis techniques to contingency tables	A, S	1, 2
4	Apply inferential procedures for odds ratio	A, S	1, 2
5	Test for independence of attributes		1, 2
6	Model categorical datasets using generalized linear models and logistic regression	A, S	1, 2, 5
7	Apply model in predictive analyses	A, S	1, 2
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

Unit	Course description	Hrs	CO No.
	Categorical Response Data	10	
1.1	Categorical response data, response/explanatory variable distinction, nominal/ordinal scale distinction, statistical inference for a proportion- significance test about a binomial proportion, confidence intervals for a binomial proportion, Wald, score, and likelihood-ratio inference for binomial parameter		1, 2
1.2	Contingency tables- Probability structure for contingency tables, sensitivity and specificity in diagnostic tests, independence, binomial and multinomial sampling, comparing proportions in two-by-two tables- difference of proportions, relative risk		1, 2
1.3	Odds ratio- properties of the odds ratio, inference for odds ratios and log odds ratios, relationship between odds ratio and relative risk, types of observational studies		1, 2
2	**Testing Independence**	10	
2.1	Chi-squared tests of independence- Pearson statistic and the chi-squared distribution, likelihood-ratio statistic, tests of independence,		3
2.2	Testing independence for ordinal data- Linear trend alternative to independence. Exact inference for small samples-Fisher's exact test for 2 × 2 tables		3
3	**Generalized Linear Model**	25	
3.1	Components of a generalized linear model, generalized linear models for binary data- linear probability model, logistic regression model, probit regression model, binary regression and cumulative distribution functions,		4
3.2	Generalized linear models for count data- Poisson regression, negative binomial regression, count regression for rate data		4
3.3	Generalized linear models -Statistical inference and model checking- inference about model parameters, model comparison using the deviance, residuals comparing observations to the model fit,		4

3.4	Logistic regression-Interpreting the logistic regression model, inference for logistic regression-confidence intervals for effects, significance testing, confidence intervals for probabilities		5
Module 4	**Teacher specific content**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, and Quiz
Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books

1. Agresti, A. (2012). Categorical data analysis (Vol. 792). John Wiley & Sons.
2. Powers, D., & Xie, Y. (2008). Statistical methods for categorical data analysis. Emerald Group Publishing.

References

1. Azen, R., & Walker, C. M. (2021). Categorical data analysis for the behavioural and social sciences. Routledge.
2. Upton, G. J. (2016). Categorical data analysis by example. John Wiley & Sons.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Statistical Analyses for Actuarial Science**					
Type of Course	**SEC**					
Course Code	**M24ST6SEC300**					
Course Level	**300**					
Course Summary & Justification	This course equip the students to learn the life tables used in insurance products, to understand the concept of computation of interest and its variants, to get an idea on the concept of annuities, to explore the various related features of annuities and to get knowledge of stochastic interest rates, enhance the ideas of the computation of mortality.					
Semester	6	Credits			3	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45
		3	0	0	0	45
Pre-requisites	Level 100 knowledge of Statistics and Computer					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Discuss future life time distributions and their probabilities.	U	4
2	To compute the effective rate of interest and effective rate of discount	A, S & E	1,2
3	To get an idea about the increasing and decreasing annuities	U & A	1,4
4	Calculate the purchase prices of an annuity net of tax	A , An & E	1,2,5
5	Computation of stochastic interest rates	An & E	1,2,5
6	Computation of mortality	An & E	1,2,5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

Unit	Course description	Hrs	CO No.
Module 1	**Future Life Time Distributions**	**10**	
1.1	Future life time random variables, Force of mortality, Laws of mortality		1
1.2	De Moivre's law, Gompertz's Law (Definition only) Makeham's Law, Weibull's Law (Definition only)		1

1.3	Probabilities of survival and death, Curtate Future life time		1
	Practicum		
Module 2	**Rate of Interests and Annuities**	**10**	
2.1	Effective Rate of Interest i - Nominal Rate of Interest $i^{(m)}$- Force of Interest a - Relationships between different rates of interest - Expression for a by use of calculus.		2
2.2	Present values - Effective rate of discount d - Nominal rate of discount $d^{(m)}$.		2
2.3	Annuities - Immediate Annuity - Annuity - due - perpetuity - accumulation and Present values of Annuities - Increasing and Decreasing annuities - Annuities and interest rates with different frequencies - Continuous Annuities.		3
	Practicum		
Module 3	**Analysis of Annuity Payments**	**25**	
3.1	Analysis of Annuity payments - Capital and Interest elements included in the Annuity payments - loan outstanding after t payments - purchase price of Annuities - Annuities involving income tax - Purchase prices of an annuity net of tax.		3, 4

3.2	Stochastic interest rates - Independent annual interest annual interest rates - The definition of S_n - Mean and variance of S_n - Definition of A_n - Mean and variance of A_n - Simple problems.		5
3.3	Probabilities of living and dying - The force of mortality i_x - Estimation of i_x - Uniform Distribution of deaths - Select and Ultimate rates.		6
	Practicum		
Module 4	**Teacher Specific content.**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom/computer lab under the strict guidance of teachers. A minimum of 5 problems is to be solved using suitable software and the record should be submitted to the teacher concerned.

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz

Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar and Practicum Record **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books

1. Shailaja R. Deshmukh- Actuarial Statistics-an introduction using R, Universities Press
2. Bedford, T and Cooke, R (2001). Probabilistic risk analysis, Cambridge

References

1. Rotar, V.I. (2015). Actuarial Models – The mathematics of Insurance – Second Edition. CRC Press, New York.
2. Promislow, S.D. (2015). Fundamentals of Actuarial Mathematics- Third Edition. John Wiley & Sons, New York.
3. Bowers, N.L., Gerber, H.U., Hickman, J.C., Jones, D.A.& Nesbitt, C.J. (1997). Actuarial Mathematics, Society of Actuaries
4. Medina, P.K and Merino, S (2003). A Discrete Introduction: Mathematical Finance and Probability, Birkhauser
5. Philip, M et. al. (1999). Modern Actuarial Theory and Practice, Chapman and Hall.
6. Dickson, David C.M., Cambridge (2009). Actuarial Mathematics for Life Contingent Risks, First Edition, Cambridge University Press
7. R. Cunningham, T. Herzog, R. London (2008). Models for Quantifying Risk, 3rd Edition

SEMESTER VII

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Measure and Probability Theory**					
Type of Course	**DCC (Major)**					
Course Code	**M24ST7DCC400**					
Course Level	**400**					
Course Summary & Justification	The course explores in detail the fundamental concepts of Measure Theory and Probability, random variables, distribution functions and their properties. This course provides a basis to introduce higher statistical theory and applications					
Semester	7	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	
		4				60
Pre-requisites	Level 300 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No
1	Synthesize limit of a sequence of sets and obtain them for sequence of sets	U, A	1, 4
2	Construct sigma fields and Borel fields	C, A	1, 4
3	Understand measure theory and identify probability as a measure	U, A	1, 4
4	Compare Lebesgue, Lebesgue-Stieltjes Integral and Riemann Integrals	An, E	1, 4
5	Evaluate properties of probability	E	1, 4
6	Explain Measurable functions and identify random	U, An	1, 4

	variables as measurable function		
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course Description	**Hours**	**CO No.**
Module 1	**Measure Theory**	**15**	
1.1	Finite and countable operations on sets		1
1.2	Sequences of sets, monotone sequence and limit of a sequence of sets,		1
1.3	Field and sigma field, monotone class, generated sigma field, minimal sigma field, Borel field of R and of R^n		2
1.4	Measurable space, measure, measure space, finite and sigma finite measures, monotone and continuity properties of measures, Counting measure, Lebesgue measure and Probability measure.		3, 5
1.5	Cartheodory Extension theorem (statement only) Lebesgue Stieltjes measures and distribution functions.		3, 5
Module 2	**Measurable functions and Integration**	**15**	
2.1	Measurable functions and their properties, indicator functions, simple functions, measurable function as limit of simple functions.		6
2.2	Integrals of indicator function, simple function and measurable functions		6
2.3	Basic integration theorems. Monotone convergence theorem, Fatou's Lemma, Bounded convergence theorem and Lebesgue dominated convergence theorem,		4
2.4	Lebesgue and Lebesgue-Stieltjes Integral, comparison of Lebesgue and Riemann Integral.		4

Module 3	**Probability Theory**	**15**	
3.1	Discrete and Continuous probability spaces and their properties .monotone, continuity and other properties.		5
3.2	Conditional probability, multiplication theorem, total probability and Bayes' theorem. Independence of events.		5
3.3	Borel 0-1 criterion. Random variable, vector and sequence of random variables, properties of random variables and vectors, distribution of random variables. Distribution function and its properties.		6
3.4	Jordan decomposition theorem, Correspondence theorem (statement only), Independence of random variables.		6
3.5	Mathematical expectation, moments and its properties		5
Module 4	**Inequalities and Stochastic Convergence**	**15**	
4.1	Basic, Chebychev's, Markov's, Liaponov's, Jensen's, Cr, Cauchy-Swartz's, Holder's, Minkowski's and Chebychev's inequalities.		5
4.2	The four modes of convergence-convergence almost surely, convergence in probability, convergence in distribution and convergence in r^{th} mean of a sequence of random variables, properties, counter examples and their inter-relationships.		5, 6
4.3	Weak and complete convergence of distribution functions. Helly-Bray Lemma and Helly- Bray Theorem (statements only).		5, 6
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)**

	Theory Total = 30 marks Quiz, Test Papers, Seminar B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Ash, R.B. and Doléans-Dade, C. A. (2000). Probability and Measure Theory, Academic Press.
2. Bhat B.R (1999) Modern Probability Theory, Third Edition, Wiley Eastern Ltd, New Delhi.
3. Laha R.G. and Rohatgi V.K. (1979) Probability theory, John Wiley.

References

1. Basu A.K. (2012). Measure Theory and Probability, Second Edition, PHI Learning Pvt. Ltd, New Delhi.
2. Billingsley P. (2012) Probability and Measure, Anniversary edition,Wiley Eastern ltd.
3. Loeve M. (1977) Probability Theory, Fourth edition, Springer-Verlag.
4. Rohatgi V.K. and SalehM. (2015) An introduction to probability and statistics, Third edition, Wiley.
5. Robert G. Bartle (2001), A Modern Theory of Integration, American Mathematical Society (RI)

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Advanced Distribution Theory**					
Type of Course	**DSC A (Major)**					
Course Code	**M24ST7DCC401**					
Course Level	**400**					
Course Summary & Justification	This course explores in detail the advanced concepts of probability distributions, and their properties. This course provides a basis to introduce higher statistical theory and applications.					
Semester	**7**	**Credits**			**4**	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	60
		4	0	0	0	60
Pre-requisites	Level 300 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Synthesize various modes of Probability Distributions,	U& An	1,4
2	Explore various properties of Discrete distributions	U & An	1,3
3	Investigate various continuous distributions and their relevance in statistics	A & An	1,2.4
4	Understand functions of random variables their distributions	U & A	1,4
5	Derive various sampling distributions	A	3
6	Understand Order statistics and derive their distributions	A & An	1,3
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module1	**Probability Distributions-Discrete**	**15**	
1.1	Probability Generating functions, Moment generating functions Characteristic functions and their properties		1

1.2	Discrete Distributions - Bernoulli, Binomial, Geometric, Poisson, Negative binomial and Hypergeometric, Power series		2
1.3	Odd family of distributions- Definition, Identification of members.		1
Module 2	**Probability Distributions-Continuous**	**20**	
2.1	Rectangular, Exponential, Weibull, Beta, Gamma, Pareto		3
2.2	Normal, Lognormal, Cauchy, Laplace, Logistic, Inverse Gaussian		3
2.3	Pearson family and Exponential family of distributions – Definition and Identification of members.		3
Module 3	**Functions of Random Variables**	**10**	
3.1	Functions of Random variables and their distributions. Probability integral transform, Distributions of sums, products and ratios of independent random variables		4
3.2	Truncated distributions, Compound distributions.		4
Module 4	**Sampling Distributions**	15	
4.1	Sampling distributions - Chi-square, t and F distributions (central and non-central forms),		5
4.2	Order statistics and their distributions - joint and marginal distributions; Distributions of sample median, range and mid–range (Exponential and		6

	Uniform), Quantiles and QQ plot.		
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, and Quiz
Assessment Types	MODE OF ASSESSMENT A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Gupta S.C. and Kapoor V.K. (2000) Fundamentals of Mathematical Statistics, S. Chand & Co, New Delhi.
2. Hogg R.V and Craig A.T. (2013) Introduction to Mathematical Statistics, Mac Millian publishing company.

References:

1. Arnold B.C, Balakrishnan N. and Nagaraja H.N. (1992) A first Course in Order Statistics.

2. Biswas S. and Srivastava G.L (2008) Mathematical Statistics: A textbook, Alpha Science International Ltd.

3. Johnson N.L, Kotz S. and Balakrishnan N. (1991) Continuous Univariate distributions I & II, Wiley.

4. Johnson N.L, Kotz S. and Kemp A.W. (1992) Univariate discrete distributions, Wiley.

5. Kotz S, Balakrishnan N. and Johnson N.L. (2000) Continuous Multivariate distributions, Wiley.

6. Rohatgi V.K. and Saleh M. (2015) An introduction to probability and Statistics, Third edition, Wiley.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Advanced Multivariate Distributions**					
Type of Course	**DSC A Major**					
Course Code	**M24ST7DCC402**					
Course Level	**400**					
Course Summary & Justification	The course explores in detail the advanced concepts Multivariate Distributions, and their properties, This course provides a basis to introduce higher statistical theory and applications					
Semester	7	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 300 knowledge in Statistics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the theoretical foundations of multivariate distributions.	U & An	PSO1
2	Apply multivariate distributions to model complex data.	An & E	PSO2
3	Analyse multivariate data using appropriate statistical	A & E	PSO3

	techniques.		
4	Evaluate the properties and interrelationships of different multivariate distributions.	C	PSO2
5	Analyse the distribution of quadratic forms and correlation coefficients.	An & E	PSO1
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus-Module wise

	Course description	**Hours**	**CO No.**
Module1	**Bivariate Distributions**	**15**	
1.1	Notions of bivariate distributions, Gumbel's bivariate exponentials and basic properties		1
1.2	Bivariate normal distribution- marginals and conditionals, independence of random vectors,		2
1.3	Multinomial distribution and its basic properties.		2
Module 2	**Multivariate Normal Distribution, Wishart Distribution.**	**20**	
2.1	Multivariate normal (singular and non-singular), characteristic function, marginals, and conditionals–		3
2.2	Properties, characterizations of Multivariate normal distribution		3
2.3	estimation of mean vector and dispersion matrix, independence of sample mean vector and sample dispersion matrix		3
2.4	Jacobian of matrix transformations of Y= AXB; Y= AXA'; X=TT'		4
2.5	Matrix variate gamma and beta distributions.		4

2.6	Wishart distribution and its basic properties, characteristic function		4
2.7	Generalized variance and its distribution.		4
Module 3	**Quadratic Forms**	**10**	
3.1	Quadratic forms and their distributions (both scalar and vector forms),		5
3.2	Independence of quadratic forms, Cochran's theorem.		5
3.3	Simple, partial, and multiple correlation distributions, properties and their interrelationships, tests.		5
3.4	Null and non-null distribution of simple and partial correlations, null distribution of multiple correlation.		5
Module 4	**Practical**	**30**	
4.1	Practical record with minimum 5 problems has to be submitted.		**5**
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination**

	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Books:

1. Johnson, R. A., & Wichern, D. W. (2018). Applied Multivariate Statistical Analysis (6th ed.). Upper Saddle River, New Jersey: Pearson.
2. Mardia, K. V., Kent, J. T., & Bibby, J. M. (1979). Multivariate Analysis. London, England: Academic Press.
3. Anderson, T. W. (2003). An Introduction to Multivariate Statistical Analysis (3rd ed.). Hoboken, New Jersey: Wiley.
4. Kotz, S., Balakrishnan, N., & Johnson, N. L. (2000). Continuous Multivariate Distributions, Volume 1: Models and Applications (2nd ed.). New York, New York: Wiley.

References

1. Giri, N. C. (2004). Multivariate Statistical Analysis. New Delhi, India: Academic Publishers.
2. Rao, C. R. (2008). Linear Statistical Inference and Its Applications (2nd ed.). New Delhi, India: Wiley Eastern Limited.
3. Kshirsagar, A. M. (1972). Multivariate Analysis. New York: Marcel Dekker.
4. Srivastava, M. S., & Khatri, C. G. (1979). An Introduction to Multivariate Statistics. New Delhi, India: North Holland.
5. Mathai A.M. (1996): Jacobins of Matrix Transformations and functions of Matrix Argument, Singapore: World Scientific Publisher.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B. A. ECONOMICS**					
Course Name	**Statistical Methods for Economic Analysis -II**					
Type of Course	**DSC**					
Course Code	**M24ST7DCC403**					
Course Level	**400**					
Course Summary & Justification	This course explores in detail the basic concepts of probability, integration and some basic probability distributions.					
Semester	7	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practicum**	**Others**	45+30
		3		2		75
Pre-requisites	Level 300 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Provide students with a strong foundation in probability and its applications in economic analysis.	U, A	1, 4
2	Understand the concept of Integration	U, S, E	1, 4
3	Develop quantitative way approach in solving economic situations using integration	A, An	1, 4, 5
4	Describe Random Variables and properties	U	1, 4
5	Understand Basic Distributions and its applications in real life situations	A, An	1, 4, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

Syllabus – Module wise

	Course Description	Hours	CO No.
Module 1	**Probability**	**15**	
1.1	Basic probability concepts, meaning of probability		1
1.2	Mutually exclusive and exhaustive events. Independent events.		1
1.3	Approaches to assigning probabilities, classical probability, empirical probability, subjective probability.		1

1.4	Rules for computing probabilities, additive rule, multiplicative rule		1
1.5	Bayes' theorem		1
	Practicum		
2	**Integration**	**15**	
2.1	Indefinite Integral-rules of integration		2
2.2	Integration by substitution, integration by parts		2
2.3	Definite integrals, Area under a curve		2
2.4	Difference equations and differential equations (basic concepts only)		2
2.5	Improper integrals-Beta and Gamma integrals		2
2.6	Applications in Economics		3
	Practicum		
3	**Random Variables**	**10**	
3.1	Meaning and definition. Discrete and continuous random variables (only concepts)		4
3.2	Probability mass function, cumulative distribution function		4
3.3	Expectation of a random variable, Mean and variance using expectation (discrete and continuous random variable).		4
	Practicum		

4	**Basic Distributions**	**20**	
4.1	Binomial distribution, properties and uses		5
4.2	Poisson distribution, properties and uses		5
4.3	Normal distribution, standard normal distribution-properties and calculation of probabilities using standard normal table		5
	Practicum		
Module 5	**Teacher Specific Content.**		

Practicum	
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom under the strict guidance of teachers. A minimum of 5 problems is to be solved and the record should be submitted to the teacher concerned.	
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz

Assessment Types	A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Rohatgi V.K. and Saleh, A.K. Md.E. (2009): An Introduction to Probability and Statistics. 2nd Edn. (Reprint) John Wiley and Sons.
2. Gupta, S.P. Statistical Methods. Sultan Chand and Sons: New Delhi.
3. S.C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons

References:

1. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.John E Freund, Mathematical Statistics, Pearson Edn, New Delhi
2. McClave, Benson and Sincich (2012): A First Course in Business Statistics, 8th Ed, Prentice Hall.
3. Moore, McCabe, Alwan, Craig and Duckworth (20111a): The Practice of Statistics for Business and Economics H Freeman and Company.
4. Lind A. Douglas, Marchal G. William and Wathen A. Samuel (2016)- Basic Statistics for Business and Economics, 7th Ed, McGraw Hill International Edition.
5. Mendenhall William, Beaver J. Robert and Beaver M. Barbara (2014) - Introduction to Probability and Statistics – 12th Ed, Thomson Books/Cole publishers

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Sampling Techniques**					
Type of Course	**DCE (Major)**					
Course Code	**M24ST7DCE400**					
Course Level	**400**					
Course Summary & Justification	This course is designed to provide undergraduate students with a thorough understanding of various sampling methods and their applications in statistical analysis. This course covers fundamental concepts, methods, and practical applications of sampling techniques, including simple random sampling, stratified sampling, cluster sampling, and systematic sampling.					
Semester	7	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	
		4				60
Pre-requisites	Level 300 knowledge in Statistics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the basic principles and concepts of sampling techniques.	U	1, 4
2	Apply various sampling methods to collect data.	A	2, 5
3	Analyse and interpret sample data using appropriate statistical techniques.	An, A	1, 4
4	Evaluate the efficiency and accuracy of different sampling methods.	E, A	4, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module 1	**Basic Concepts and Simple Random Sampling.**	**20**	
1.1	Census and sampling, types of sampling: probability and non-probability sampling, advantages and disadvantages.		1
1.2	Principal steps in a sample survey, sampling and non-sampling errors, organizational aspects of sample survey.		1
1.3	Simple random sampling with and without replacement (SRSWR and SRSWOR), procedures of selecting a sample, unbiased estimates of the population mean and population total-their variances and estimates of the variances, confidence interval for population mean and total, simple random sampling for attributes.		1, 2, 3
Module 2	**Stratified Random Sampling**	**15**	
2.1	Stratified random sampling, estimation of the population mean and population total: their variances and estimates of the variances.		2, 3
2.2	Proportional allocation and Neyman allocation of sample sizes, cost function: optimum allocation, comparison with simple random sampling.		2, 3
Module 3	**Systematic Random Sampling**	**15**	
3.1	Linear and circular systematic sampling, estimates of the population mean and population total.		2, 3
3.2	Comparison of systematic sampling, SRS and stratified random sampling for a population with a linear trend.		2, 3, 4
Module 4	**Cluster sampling and Multistage sampling.**	**10**	
4.1	Cluster sampling, clusters with equal sizes, estimation of population mean and total: their variances and estimates of the variances.		2, 3
4.2	Multistage sampling, estimation of the population mean and its standard error.		2, 3
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Cochran, W. G. (1977). Sampling Techniques (3rd ed.). New York: Wiley.
2. Lohr, S. L. (2019). Sampling: Design and Analysis (2nd ed.). Boca Raton, Florida: CRC Press.
3. Thompson, S. K. (2012). Sampling (3rd ed.). Hoboken, New Jersy: Wiley.

References

1. Levy, P. S., & Lemeshow, S. (2013). Sampling of Populations: Methods and Applications (4th ed.). Hoboken, New Jersy: Wiley.
2. Des Raj. (1972). The Design of Sample Surveys. New Delhi, India: McGraw-Hill Education.
3. Sukhatme, P. V., Sukhatme, B. V., Sukhatme, S., & Asok, C. (1984). Sampling Theory of Surveys with Applications (3rd ed.). Ames, Iowa: Iowa State University Press.
4. Murthy, M. N. (1967). Sampling Theory and Methods. Kolkata, India: Statistical Publishing Society.
5. Singh, D., & Chaudhary, F. S. (1986). Theory and Analysis of Sample Survey Designs. New Delhi, India: New Age International Publishers.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Analytical Tools for Statistics-I**					
Type of Course	**DCE**					
Course Code	**M24ST7DCE401**					
Course Level	**400**					
Course Summary & Justification	This course provides a comprehensive foundation in mathematical concepts that are not only essential for understanding higher-level mathematics but also have wide-ranging applications in various scientific disciplines. The inclusion of sets, sequences, series, functions, and uniform convergence ensures a well-rounded understanding of mathematical structures and their significance.					
Semester	7	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	60
		4		0		60
Pre-requisites	Plus 2 level knowledge in Mathematics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the basic elements of Real analysis	U	1, 3, 6
2	Understand the important properties of sets	U	1, 3, 6
3	Test for the convergence of sequences	A, S	1, 3, 6
4	Test for the convergence of a series	A, S	1, 3, 6
5	Use the various concepts and results associated with continuity to create mathematical proofs	A, C, S	1, 3, 6
6	Test for uniform convergence of sequences and series of functions	A, S	1, 3, 6
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	Hours	CO No.
Module 1	**Sets and sequences**	**20**	
1.1	Sets-Bounded and unbounded sets, supremum and infimum.		1
1.2	Neighbourhood of a point, limit point of a set, derived set, Bolzano-Weierstrass theorem (without proof), open and closed sets.		1, 2
1.3	Sequences-Convergence and divergence of sequences, Bolzano-Weierstrass theorem (without proof), limit inferior and limit superior (Definitions and examples only), Cauchy's general principle of convergence, Cauchy sequences. Limits of some special sequences such as $r^n, (1+\frac{r}{n})^n$ and $n^{\frac{1}{n}}$.		3

1.4	Algebra of sequences, Sandwich theorem, Cauchy's first and second theorems on limits, Monotonic sequences, Monotone convergence theorem.		3
Module2	**Infinite Series**	**15**	
2.1	Definition, positive term series, tests for convergence: comparison test, Cauchy's root test, D'Alembert's ratio test, Raabe's test, logarithmic test.		4
2.2	Alternating series, Leibnitz test for the convergence of alternating series.		4
2.3	Absolute convergence and conditional convergence.		4
Module3	**Functions of a Single Variable**	**20**	
3.1	Limits of a function, continuous functions, continuity at a point and continuity in an interval, discontinuous functions, types of discontinuity, functions continuous on closed interval.		5
3.2	Uniform continuity and absolute continuity.		5
3.3	Derivatives, derivability at a point, derivability in an interval.		5
3.4	Darboux's theorem (without proof), intermediate value theorem for derivatives.		5
3.5	Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean value theorem.		5
Module4	**Uniform convergence of sequences and series of functions**	**5**	
4.1	Sequence of functions, Point wise convergence, uniform convergence, M_n test for uniform convergence (Without Proof).		6
4.2	Series of functions, Point wise convergence, uniform convergence, Weierstrass's M-Test (Without Proof).		6
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Malik, S.C. and Arora, S. (2017). Mathematical Analysis, (5th Edn.), New Age International limited, New Delhi.
2. Bali, N.P (2023). Real Analysis, (2nd Edn.) New Age International limited, New Delhi.

References:

1. Shanti Narayan and Raisinghania, M.D. (2021). Elements of Real Analysis, S.Chand & Company, New Delhi
2. Rudin,W.(2023). Principles of Mathematical Analysis, (3rd Edn.),McGraw Hill.
3. Apostal,T.M.(2002).Mathematical Analysis,(2nd Edn.)), Narosa Publishing House, New Delhi.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Population Dynamics**					
Type of Course	**DCE**					
Course Code	**M24ST7DCE402**					
Course Level	**400**					
Course Summary & Justification	This course enables the students to construct life table and to familiarize with important fertility models.					
Semester	**7**	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	60
		4				60
Pre-requisites	Level 200 knowledge of Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No
1	Understand the sources and gradation of mortality data.	U, A	1,4
2	Remember life table construction and estimation of survival probability by method of MLE.	U, S, E	1,2,4
3	Understand fertility models.	U	1,4
4	Apply population growth indices and projections.	A, An	1,4
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus – Module wise

	Course Description	Hours	CO No.
Module 1	**Mortality Measures**	**15**	
1.1	Sources of mortality data-mortality measures-ratios and proportions		1
1.2	Crude Mortality rates, Specific rates- ASDR, CSDR, IDR, IMR, MMR		1
1.3	Standardization of mortality rates, direct and indirect methods		1

1.4	Gradation of mortality data, fitting Gompertz and Makeham curves.		1
Module 2	**Life Tables**	**15**	
2.1	Life tables-complete life table-relation between life table functions, abridged life table-relation between abridged life table functions,		2
2.2	Construction of life tables, Greville's formula, Reed and Merrell's formula		2
2.3	Sampling distribution of life table functions,		2
2.4	Multivariate pgf –estimation of survival probability by method of MLE.		2
Module 3	**Fertility Models**	**10**	
3.1	Fertility models, fertility indices-relation between CBR, GFR, TFR, GRR and NRR		4
3.2	Stochastic models on fertility and human reproductive process,		4
3.3	Dandekar's modified binomial and Poisson models, Brass, Singh models		4
3.4	Models for waiting time distributions, Sheps and Perrin model.		
Module 4	**Population Growth Indices and Projections**	**20**	
4.1	Population growth indices, logistic model, fitting logistic, other growth models		5

4.2	Lotka's stable population, analysis, quasi stable population, effect of declining mortality and fertility on age structure		5
4.3	Population Projections, component method-Leslie matrix technique properties of time independent Leslie matrix-		5
4.4	Properties of time independent Leslie matrix-models under random environment- Models under random environment		5
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Textbooks:

1. Biswas S (1988) Stochastics processes in Demography and applications, Wiley Eastern.
2. Biswas S (2007) Applied Stochastic Processes-A Biostatistical and Population Oriented Approach, Second Edition, New Central Book Agency.

References

1. Keyfitz N (1977) Applied Mathematical Demography A Wiley Interscience publication.
2. Pollard J.H (1975) Mathematical Models for the growth of Human population, Cambridge University Press.
3. Ramkumar R (1986) Technical Demography, Wiley Eastern.
4. Srinivasan K (1970) Basic Demographic Techniques and Applications.

SEMESTER VIII

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Advanced Probability Theory and Sampling Techniques**					
Type of Course	**DCC**					
Course Code	**M24ST8DCC400**					
Course Level	**400**					
Course Summary & Justification	This course covers advanced topics in probability theory and sampling techniques. The aim is to provide students with a comprehensive understanding of the theoretical and practical aspects of probability and its applications in sampling. The course will also include practicum to apply the theoretical concepts learned.					
Semester	8	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practicum**	**Others**	**45+30**
		3		2		75
Pre-requisites	Level 300 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Course Outcome	Learning Domains *	PSO No
1	Understand the properties of characteristic function	U	1, 4
2	Apply law of large numbers for finding the asymptotic behaviour of sum of random variables	A	1, 4
3	Use central limit theorem for normal approximation of probability distributions	A	1, 4
4	Use ratio and regression methods for systematically doing sampling	A, S	1, 4, 5
5	Use cluster sampling, multistage sampling, and	A, S	2, 4, 5

	multiphase sampling in real-life situations		
6	Use PPS sampling in real-life situations	A, S	2, 4, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus module wise

	Course description	**Hours**	**CO No.**
Module 1	**Characteristic Function**	**10**	
1.1	Characteristic function of a random variable, properties, continuity and inversion theorems of characteristic functions.		1
1.2	Convex combinations of characteristic functions and distribution functions, characteristic function of a vector random variable		1
1.3	Uniform continuity and non-negative definiteness, statement of Bochner's Theorem		1
Module 2	**Law of Large Numbers and Central Limit Theorems**	**20**	
2.1	Law of large numbers: Weak law of large numbers - Bernoulli, Chebychev's, Poisson and Khinchine WLLN, Necessary and sufficient condition for weak law of large numbers.		2
2.2	Strong law of large numbers, Kolmogorov strong law of large numbers for iid random variables.		2
2.3	Central limit theorem, Demoivre-Laplace central limit theorem, Lindberg-Levy central limit theorem, Liaponov's central limit theorem, Lindberg-Feller central limit theorem (Without proof), Statement of Multivariate central limit theorem.		3
	Practicum		
Module 3	**Ratio and Regression Methods of Estimation**	**25**	
3.1	Ratio method of estimation, estimation of population ratio, mean and total.		4
3.2	Bias and relative bias of ratio estimator, comparison with SRS estimation. Unbiased ratio type estimators- Hartley- Ross estimator, Regression method of		4

	estimation. Comparison of ratio and regression estimators with mean per Module method,		
3.3	Cluster sampling, single stage cluster sampling with equal and unequal cluster sizes, estimation of the population mean and its standard error.		5
3.4	Two- stage cluster sampling with equal and unequal cluster sizes		5
3.5	Multistage and Multiphase sampling (Basic Concepts), estimation of the population mean and its standard error.		5
	Practicum		
Module 4	**PPS Sampling**	**20**	
4.1	Varying probability sampling, PPS sampling with and without replacement		6
4.2	Cumulative total method, Lahiris method, Midzuno-Zen method and its inclusion probabilities, estimation of the population total and its estimated variance under PPS with replacement sampling		6
4.3	Ordered and unordered estimators of the population total under PPS wor, Horwitz – Thomson estimator and its estimated S. E.		6
4.4	Des-Raj's ordered estimator, Murthy's unordered estimator (properties of these estimators for n=2 only). Inclusion probability proportional to size Sampling Procedures		6
	Practicum		
Module 5	**Teacher Specific content.**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills.

The practicum component is to be done in the classroom under the strict guidance of teachers. A minimum of 5 problems is to be solved and a record should be submitted to the teacher concerned.	
Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar and Practicum Record B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Casella, G., & Berger, R. L. (2002). Statistical Inference (2nd ed.). Duxbury Press, Pacific Grove, California.
2. Cochran, W. G. (1977). Sampling Techniques (3rd ed.). John Wiley & Sons, New York.
3. Mukhopadhyay, P. (1998). Theory and Methods of Survey Sampling. Prentice-Hall of India, New Delhi, India.

References

1. Lohr, S. L. (2019). Sampling: Design and Analysis (2nd ed.). Chapman & Hall/CRC, Boca Raton, Florida.
2. Devore, J. L. (2015). Probability and Statistics for Engineering and the Sciences (9th ed.). Cengage Learning, Boston, Massachussetts.
3. Ross, S. M. (2014). Introduction to Probability Models (11th ed.). Academic Press, San Diego, California.
4. Des Raj, & Chandhok, P. (1998). Sample Survey Theory. Narosa Publishing House, New Delhi, India.

5. Sukhatme, P. V., & Sukhatme, B. V. (1970). Sampling Theory of Surveys with Applications. Indian Society of Agricultural Statistics, New Delhi, India.

Department	**STATISTICS**					
Programme	**B.Sc. Statistics**					
Course Name	**Advanced Estimation Theory**					
Type of Course	**DCC**					
Course Code	**M24ST8DCC401**					
Course Level	**400**					
Course Summary & Justification	This course explores in detail the advanced concepts of estimation theory, their properties, and provides a basis for higher statistical theory and applications.					
Semester	8	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practicum**	**Others**	**45+30**
		3		**2**		**75**
Pre-requisites	Level 300 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No

1	Synthesize various concepts of estimation theory and obtain the estimates of parameters	U & E	1,4
2	Explore various properties of Estimators	An & E	3
3	Apply and evaluate various methods of estimation	A & E	1,2,4
4	Construct confidence intervals	C	1,3
5	Explore Bayesian Inference	An & E	1, 4
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus – Module wise

	Course description	**Hours**	**CO No.**
Module 1	**Point Estimation and Fisher Information Measure**	**25**	
1.1	Point estimation-properties of estimators – unbiasedness - consistency, sufficient condition for consistency – Sufficiency, minimal sufficiency		1
1.2	Completeness, Bounded Completeness, Fisher-Neymann Factorization Theorem		2
1.3	Exponential families, UMVUE estimators and their characterization		2
1.4	Rao-Blackwell theorem, Lehmann – Scheffe theorem, Ancillary statistics, Basu's theorem.		1

1.5	Fisher information measure and its properties, Fisher information matrix		1, 2
1.6	Lower bound to the variance of an unbiased estimator, Cramer - Rao inequality, Bhattacharyya's bounds		1
1.7	Efficiency, minimum variance		2
	Practicum		
Module 2	**Methods of Estimation**	**20**	
2.1	Method of moments, method of maximum likelihood & their properties,		3
2.2	Cramer- Huzurbazar theorem, Fisher's scoring method.		
2.3	Method of minimum chi-square and method of modified minimum chi-square-		3
	Practicum		
Module 3	**Interval Estimation**	**15**	
3.1	Interval estimation – Pivotal method of construction - shortest confidence intervals and their construction (minimum average width)		4
3.2	Construction of shortest confidence intervals in large samples		4
	Practicum		
Module 4	**Basic Elements of Bayesian Inference**	**15**	

4.1	Basic elements of Bayesian inference, Loss function and risk functions, Standard forms of loss functions,		5
4.2	Prior distribution, Bayes Theorem, Posterior distribution		5
4.3	Bayes risk, Bayes principle, Bayes estimators, Minimax estimators.		5
	Practicum		
Module 5	**Teacher Specific content.**		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom under the strict guidance of teachers. A minimum of 5 problems is to be solved and a record should be submitted to the teacher concerned.

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz.

Assessment Types	A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Rohatgi V.K. and Saleh A.K. (2015) An Introduction to Probability Theory and Mathematical Statistics, Wiley.

2. Berger J.O. (1993) Statistical Decision Theory and Bayesian Analysis, Third Edition, Springer.

3. Casella, G and Berger, R.L (2007) Statistical Inference, Second Edition,Cengage Learning.

References:

1. Hogg R. V. and Craig A. T. (2013) Introduction to Mathematical Statistics, Pearson

2. Kale B. K. (2005) A First Course on Parametric Inference, Alpha Science International.

3. Lehmann E.L. (1983) Theory of point estimation – Wiley, New York.

4. Lindgren B.W (1976) Statistical Decision Theory (3rd Edition), CollierMac Millian, New York.

5. Rao C.R (2009) Linear Statistical Inference and its Applications, John Wiley, New York.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**					
Programme	**B. A. ECONOMICS**					
Course Name	**Statistical Methods for Economic Analysis -III**					
Type of Course	**DSE**					
Course Code	**M24ST8DCE400**					
Course Level	**400**					
Course Summary & Justification	This course delves into advanced statistical methods used in economic analysis. It aims to provide students with a robust understanding of statistical techniques and their applications in economic research. The course will cover both theoretical concepts and practical applications, with the final module dedicated to hands-on practice using appropriate statistical software.					
Semester	8	**Credits**			4	**Total Hours**
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	45+30
		3		2		75
Pre-requisites	Level 300 knowledge of Statistics					

COURSE OUTCOMES (CO)

CO No.	Course Outcome	Learning Domains	PSO No
1	Understand and apply advanced statistical methods in economic analysis.	U, A	1, 4
2	Analyse economic data using various statistical techniques.	An, A	1, 4
3	Conduct hypothesis testing and interpret the results in an economic context.	An, E	1, 4
4	Proficient in using various estimation techniques to derive point estimates of population parameters.	A, S	1, 4, 5
5	Possess the skills to construct confidence intervals around point estimates, providing a range within which the true population parameter is likely to lie.	A, S	1, 4, 5
6	Employ statistical software to perform complex economic analyses.	A, S	2, 5

*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Syllabus module wise

	Course Description	Hours	CO No.
Module 1	**Estimation**		
1.1	Parameter and Statistic-Definition and examples. sampling distributions-Standard error.		1
1.2	Sampling and non-sampling errors. Determination of sample size. Sampling distributions-Chi-square, t and F distribution definition.		1
1.3	Properties and tables of distribution. Examples of statistics following Chi-square, t and F distributions	**15**	1
1.4	Estimate and estimator, point estimation, confidence interval estimation (concepts only). Properties of good estimator		1, 4, 5
1.5	Methods of Estimation-Confidence interval of Population mean when population SD is known and unknown.		4, 5
1.6	Interval Estimation-Confidence interval of Population proportion.		4, 5
Module 2	**Testing of Hypothesis**		
2.1	Hypothesis Testing-Steps in hypothesis testing, formulation of null and alternative hypothesis, Simple and Composite Hypothesis, Rejection and Acceptance Region		3
2.2	Level of significance, Type I and Type II error, P value, power of the test, One tailed and two tailed tests.	**15**	3
2.3	Parametric test: Testing of population mean (One sample and two samples) (z test, t-test), Paired t test		3
2,4	Testing of population proportion (One sample and two sample) , ANOVA(one way only)		3
2.5	Chi-Square test-Goodness of fit, Association of Attributes		3
Module 3	**Non Parametric Tests**		
3.1	Sign test, Wilcoxon Matched pairs test (Signed Rank Test)	**15**	3
3.2	Run Test		3

3.3	Mann-Whitney U Test		3
3.4	Kruskal Wallis Test		3
Module 4	**Practical Using R**		
	Introduce R Programming-Introduction to R Commander-Entering data in to R using RCommander, Exploratory Analysis using RCommander, Statistical Inference using RCommander	**30**	6
Module 5	**Teacher Specific Content.**		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, Seminar Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Textbook:

1. Rohatgi, V. K., & Saleh, A. K. Md. E. (2009). An Introduction to Probability and Statistics (2nd ed., Reprint). John Wiley and Sons, Hoboken, New Jersey.
2. Gupta, S. P. Statistical Methods. Sultan Chand and Sons, New Delhi, India.

3. Purohit, S. G., Gore, S. D., & Deshmukh, S. (2019). Statistics using R (2nd ed.). Narosa Publishing House, New Delhi, India.

References

1. Gupta, S. C., & Kapoor, V. K. Fundamentals of Mathematical Statistics. Sultan Chand and Sons, New Delhi, India.
2. Mood, A. M., Graybill, F. A., & Boes, D. C. (2007). Introduction to the Theory of Statistics (3rd ed., Reprint). Tata McGraw-Hill Publishing Co. Ltd, New Delhi, India.
3. Freund, J. E. (2018). Mathematical Statistics, 8th Edition. Pearson Education, New Delhi, India.
4. Davies, T. M. (2016). The Book of R: A First Course in Programming and Statistics. No Starch Press, San Francisco, California.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**
Programme	**B.Sc. Statistics**
Course Name	**Advanced Testing of Statistical Hypotheses**
Type of Course	**DCE**

Course Code	**M24ST8DCE401**					
Course Level	**400**					
Course Summary & Justification	This course explores in detail the advanced concepts of Testing of hypotheses, and their properties.					
Semester	8	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practicum**	**Others**	**45+30**
		3		**2**		**75**
Pre-requisites	Level 300 knowledge in Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Synthesize various concepts of Testing of hypotheses and apply these concepts	U & A	1,4
2	Explore Neyman -Pearson method of testing	A & An	1,2.3
3	Analyse MLR property	An	1,3
4	Explore GLR test	A &An	1,2,3

5	Analyse similar region tests and its relevance	An	1,3
6	Construct UMP and UMPU similar size-tests;	E & C	1,3,5
7	Construct confidence sets	C	1,3,5
8	Explore SPRT method and analyse its properties	A & An	1,2,3
9	Explore Hotelling T-square and apply	A	1.4
10	Crucially examine Fisher- Behren problem	An & E	3,4
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus – Module wise

	Course description	**Hours**	**CO No.**
Module 1	**Basic Concepts in Statistical Hypotheses Testing**	**15**	
1.1	Basic concepts in statistical hypotheses testing- simple and composite hypothesis, critical regions, Type-I and Type-II errors, Significance level, p-value, and power of a test		1

1.2	Neyman-Pearson lemma and its applications, Construction of tests using NP lemma- Most powerful test, uniformly most powerful test.		2
	Practicum		
Module 2	**Likelihood Ratio Test Procedure & Similar Region Tests**	**25**	
2.1	Monotone Likelihood ratio and testing with MLR property; Testing in one-parameter exponential families-one sided hypothesis,		3
2.2	Unbiased and Uniformly Most Powerful Unbiased tests for different two-sided hypothesis; Extension of these results to Pitman family when only upper or lower end depends on the parameters.		4
2.3	Similar regions tests, Neyman structure tests, Likelihood Ratio (LR) criterion and its properties,		5
2.4	LR tests for testing equality of means and variances of several normal populations. Testing in multi-parameter exponential families-tests with Neyman structure		4
2.5	UMP and UMPU similar size-tests;		6
2.6	Confidence sets, UMA and UMAU confidence sets, Construction of UMA and UMAU confidence sets using UMP and UMPU tests respectively.		7
	Practicum		
Module 3	**Sequential Probability Ratio Tests (SPRT)**	**20**	

3.1	Sequential Probability Ratio Tests (SPRT), Properties of SPRT, Determination of the boundary constants		8
3.2	Construction of sequential probability ratio tests, Wald's fundamental identity		8
3.3	Operating Characteristic (OC) function and Average Sample number (ASN) functions for Normal, Binomial, Bernoulli's, Poisson and exponential distribution.		8
	Practicum		
Module 4	**Hotellings-T^2 and Mahalnobis-D^2**		
4.1	Notion of likelihood ratio tests, Hotellings-T2 and Mahalnobis-D2 statistics-Their properties, inter-relationships and uses,		9
4.2	Null distributions (one sample and two sample cases), Testing equality of mean vectors of two independent multivariate normal populations with same dispersion matrix,	**15**	9
4.3	Problem of symmetry, Multivariate Fisher- Behren problem.		10
	Practicum		
Module 5	Teacher Specific content. This can be classroom teaching, practical session, field visit etc. as specified by the teacher concerned. This content will be evaluated internally.		

Practicum
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom under the strict guidance of teachers. A minimum of 5 problems is to be solved and a record should be submitted to the teacher concerned.

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar and Practicum Record B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Books:

1. Rohatgi V.K. (1976) An Introduction to Probability Theory and Mathematical Statistics, John Wiley & Sons, New York.
2. Anderson T.W. (1984): An introduction to multivariate statistical analysis, Second edition, John Wiley

References

1. Casella G. and Berger R.L. (2002) Statistical Inference, Second Edition Duxbury, Australia.
2. Lehman E.L. (1998) Testing of Statistical Hypothesis. John Wiley, New York.
3. Wald A. (1947) Sequential Analysis, Wiley, Doves, New York.
4. Parimal Mukhopadhyay (2006): Mathematical Statistics, 3/e, Books and Allied (P) Ltd, Kolkata.
5. Rao C.R. (1973) Linear Statistical Inference and its Applications, Wiley

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**
Programme	**B.Sc. Statistics**
Course Name	**Analytical Tools for Statistics-II**
Type of Course	**DCE**
Course Code	**M24ST8DCE402**
Course Level	**400**
Course Summary & Justification	This course introduces calculus of finite differences, interpolation and numerical integration, complex analysis, functions of several variables, and Riemann integral collectively form a foundation for advanced

	mathematical understanding and applications in various fields.					
Semester	8	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practicum**	**Others**	45+30
		3		2		75
Pre-requisites	Level 300 knowledge of Statistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the basic operators in calculus of finite differences including Delta, E, Nabla and divided differences and their properties.	U	1, 3
2	Solve interpolation problems using Newton's forward and backward formula, Lagrange's formula, Newton's divided difference formula, Stirling's formula, Bessel's formula and Everett's formula.	An,E	1, 2, 5
3	Compute numerical integration using Trapezoidal rule, Simpson's one-third and three-eighth and Weddle's rule.	An,E	1, 2

4	Understand the concepts and theorems of analytical function including Cauchy-Riemann equations, Cauchy's integral formula, and fundamental theorem of algebra, poles, and singularities.	U,A	3, 4
5	Understand the concepts of maxima and minima and method of Lagrangian multipliers and Reimann Integral.	U,A	3, 4
6	Understand Fourier transform and Laplace transform, its application to Differential equations and Fundamentals of Calculus.	U,A	1, 2, 3, 5
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course description	**Hours**	**CO No.**
Module 1	**Calculus of Finite Differences , Interpolation and Numerical Integration**	**25**	
1.1	Operators E, Delta, backward difference operator, central difference operator and their basic properties.		1, 2, 3
1.2	Separation of symbols, Divided differences.		1, 2, 3
1.3	Newton's forward and backward interpolation formulae		1, 2,

			3
1.4	Lagrange's formula, Newton's divided difference formula.		1, 2, 3
1.5	Central difference formulae- Stirling's, Bessel's and Everett's formulae		1, 2, 3
1.6	Numerical quadrature- Trapezoidal rule, Simpson's 1/3rd and 3/8th rules and Weddle's rule.		1, 2, 3
	Practicum		
Module 2	**Complex Analysis**		
2.1	Analytic functions , Cauchy Riemann equations.		4
2.2	Complex Integration – Cauchy' theorem, Cauchy's integral formula, Morera's theorem, Liouville's theorem.	**20**	4
2.3	Poles and singularities Cauchy' residue theorem (Statement only of all the theorems).		4
	Practicum		
Module 3	**Functions of several variables**		
3.1	Maxima and minima, Method of Lagrangian multipliers.		5, 6
3.2	Laplace transform and its application to Differential equations, Fourier transforms.	**15**	5, 6
	Practicum		

Module 4	**Riemann Integral**	**15**	
4.1	Definition and examples of Riemann integral, Properties of Riemann integral, Integral as a limit of sums, Integrability of continuous and monotonic functions, Integration and differentiation.		5
4.2	Fundamental Theorem of Integral Calculus (without proof), First Mean Value Theorem of Integral Calculus (without proof).		6
	Practicum		
Module 5	**Teacher Specific content.**		
Practicum			
Practicum is designed to provide supervised practical application of theoretical knowledge and skills. Its purpose is to encourage creativity and develop problem solving skills. The practicum component is to be done in the classroom under the strict guidance of teachers. A minimum of 5 problems is to be solved and a record should be submitted to the teacher concerned.			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practicum and Quiz
Assessment Types	A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, Seminar and Practicum Record B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Text Book:

1. Saxena, H.C. (2010). Finite Differences and Numerical Analysis, S.Chand, New Delhi.
2. Shanti Narayan and Raisinghania, M.D. (2021). Elements of Real Analysis, S.Chand & Company, New Delhi.
3. Rudin, W. (1976). Principles of Mathematical Analysis. McGraw-Hill Education, New York.

References:

1. Tyagi, B.S. (2020). Functions of a Complex Variable, Kedar Nath Ram Nath Educational Publishers, New Delhi.
2. Malik, S.C. and Arora, S. (2017). Mathematical Analysis, (5th Edn.), New Age International limited, New Delhi.
3. Apostal, T.M.(2002). Mathematical Analysis,(2nd Edn.), Narosa Publishing House, New Delhi.
4. Spivak, M. (2008). Calculus. Publish or Perish, Inc., Houston.

Mar Athanasius College (Autonomous), Kothamangalam

FYUGP SYLLABUS

Department	**STATISTICS**
Programme	**B.Sc. Statistics**
Course Name	**Advanced Operations Research**
Type of Course	**DCE**
Course Code	**M24ST8DCE403**

Course Level	**400**					
Course Summary & Justification	This course explores in detail the advanced topics in Operations Research such as Queuing Theory, Inventory Management, Game Theory etc.					
Semester	8	Credits			4	Total Hours
Total Student Learning Time (SLT)	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	**45+30**
		3		**2**		**75**
Pre-requisites	Level 300 knowledge in Operations Research					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Apply the knowledge of game theory concepts to articulate real-world decision situations.	U & A	1,4
2	Demonstrate solution methods including graphs and linear programming to analyse and solve the Two-person Zero-sum games	An & S	1,2,4
3	Identify the goals and objectives of inventory management and describe the importance of stocks in an organization and the reasons for holding stock.	U & A	3

4	Understand the various selective inventory control techniques and its applications.	U & A	1,2,4
5	Explore the capability to develop deterministic inventory models: economic order quantity and its extensions	U & S	1,2,4
6	Understand Queueing models and various Queueing systems	U & A	1,4
*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate I, Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Syllabus Module wise

	Course Description	**Hours**	**CO No.**
Module 1	**Game Theory**	**10**	
1.1	Introduction to Game Theory, Principles of decision making, Saddle points, Mixed Strategies, Fundamental theorem		1
1.2	Solving Two-person zero-sum game problems using graphical method and linear programming technique.		2
Module 2	**Inventory Management**	20	

2.1	Introduction to Inventory Systems- Analytical structure of Production and Inventory problems. Objectives of Inventory management -Factors influencing inventories, Inventory related costs, Properties of Inventory systems, Selective Inventory control techniques and its applications. Concept of Lead time. Introduction to Just in Time (JIT) and Vendor Managed Inventory (VMI).		3,4
2.2	Deterministic Inventory Models: Deterministic inventory models, economic order quantity and its extensions: without and with lead time, Finite replenishment rate		5
2.3	Inventory models without and with planned shortages, Inventory models with partial backlogging and lost sales		5
2.4	Discrete demand Model, Multi-item Inventory models with constraints, Quantity discounts: All units and incremental. Joint and Individual Ordering Policies.		5
Module 3	**Queuing Theory**	**15**	
3.1	Basic concept of Stochastic Processes, Markov Chains and Markov Processes		6
3.2	Introduction to Queueing Models, Characteristics of Queueing Systems, Arrival process and Departure process, System Performance Measures, Queueing Simulation: Data Generation and Book-Keeping.		6
3.3	Markovian Queueing Systems: General Birth-Death Processes, Single-Server Queues (M/M/1), Multi-server Queues (M/M/c), Queues with finite capacity (M/M/c/K), Erlang's Loss Formula (M/M/c/c),		6
3.4	Queues with Unlimited Service (M/M/∞), Finite-Source Queues, Queues with State-Dependent Service, Queues with Impatience (M/M/1 Balking and M/M/1 Reneging), Transient behavior of queues.		6
Module 4	**Practical**	**30**	

4.1	Introduction to TORA software		1, 2, 3, 4, 5, 6
4.2	Practical sessions on Inventory management, Queuing theory game theory using any statistical software.		1, 2, 3, 4, 5, 6
	(A practical record with minimum 5 problems has to be submitted)		
Module 5	**Teacher Specific content.**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct instruction, Brain storming session, E-learning, Group Discussion, Seminar, Assignments, Practical and Quiz
Assessment Types	A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

Text Books:

1. Hadley, G., & Whitin, T. M. (1963). Analysis of inventory systems. Prentice-Hall, Englewood Cliffs, New Jersey.
2. Bhat, U. N. (2008). An introduction to queueing theory: Modelling and analysis in applications (Statistics for Industry and Technology). Birkhäuser, Boston, Massachusetts.
3. Cox, D. R., & Smith, W. L. (1991). Queues. Chapman and Hall/CRC, Boca Raton, Florida.
4. Kanti Swarup, Gupta, P. K., & Man Mohan. (2010). Operations Research. Sultan Chand and Sons, New Delhi, Delhi.
5. Taha, H. A. (2019). Operations Research (10th ed.). Pearson Education, London, United Kingdom.

References

1. Axsäter, S. (2015). Inventory control (3rd ed.). Springer, Cham, Switzerland.
2. Johnson, L. A., & Montgomery, D. C. (1974). Operations research in production planning, scheduling and inventory control. Wiley, New York.
3. Naddor, E. (1966). Inventory systems. Wiley, New York.
4. Silver, E. A., Pyke, D. F., & Peterson, R. (1998). Inventory management and production planning and scheduling (3rd ed.). Wiley, New York.
5. Cooper, R. B. (1981). Introduction to queueing theory (2nd ed.). North Holland, Amsterdam, Netherlands.
6. Gross, D., Shortle, J. F., Thompson, J. M., & Harris, C. M. (2008). Fundamentals of queueing theory (4th ed.). Wiley, Hoboken, New Jersey.
7. Kleinrock, L. (1975). Queueing systems (Volume 1): Theory. Wiley, New York.

8. Medhi, J. (2002). Stochastic models in queueing theory (2nd ed.). Academic Press, San Diego, California.
9. Prabhu, N. U. (2012). Foundations of queueing theory (International Series in Operations Research & Management Science). Springer, New York.
10. Satty, T. L. (1983). Elements of queueing theory with applications. Dover Publications, New York.