Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Statistics**					
Course Name	**Probability Distributions and Statistical Inference**					
Type of Course	**DSC C**					
Course Code	**MG4DSCSTA202**					
Course Level	**200-299**					
Course Summary & Justification	Students will gain the ability to analyze probability distributions, apply statistical theorems, perform parametric and nonparametric inference, and implement statistical computations using R or Python.					
Semester	**4**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand and analyse major probability distributions and their interrelationships.	U	1
2	Apply statistical inequalities and limit theorems to study convergence of random variables.	A	1
3	Explain and apply parametric and non-parametric inferential procedures.	A	1
4	Use R/Python to implement statistical computations and non-parametric tests.	An	1
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)

Modules	Unit	Course description	Hrs	CO No.
1. Probability Distributions	1.1	Hypergeometric distribution – probability mass function, mean, variance and essential properties. (Derivations not required), simple problems	3	1
	1.2	Negative Binomial distribution – probability mass function, mean, variance; relationships to Geometric & Binomial (Derivations not required), simple problems	3	
	1.3	Gamma distribution – probability density function, derivation of mean, variance, mgf; additive property; Exponential–Gamma relationship.	5	
	1.4	Beta Type I & Type II distributions – probability density functions , derivation of mean and variance; structural relations; Harmonic Mean of Beta distributions.	5	
	1.5	Log-normal distribution- probability density function, relation between normal and log- normal distribution.	2	

2. Statistical Inequalities & Limit Theorems	2.1	Tchebycheff's inequality – statement and proof, uses, advantages & limitations.	2	2
	2.2	Weak Law of Large Numbers; Bernoulli's Law of Large Numbers – Statements and proof , examples.	4	
	2.3	Central Limit Theorem- statement ; distribution of sample mean.	2	
	2.4	Problems on Tchebycheff's inequality, WLLN and CLT	4	
3. Statistical Inference – Parametric & Nonparametric Tests	3.1	Concepts of inference; parametric vs nonparametric approaches, Hypothesis testing framework; Neyman-Pearson theorem-Statement, assumptions of parametric tests	2	3
	3.2	Tests for mean, variance and proportion- One sample and two samples	6	
	3.3	Sign test and Wilcoxon signed-rank test	3	
	3.4	Mann–Whitney U test, Runs test; advantages & limitations.	4	
4. Data Analysis using R/Python (A practical record with minimum 5 problems have to be submitted).	4.1	Random number generation for Module 1 distributions	8	4
	4.2	Implementation of parametric tests, Sign, Wilcoxon, Mann–Whitney U, Runs test in R/Python using datasets	22	
5. Teachers' specific Content				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning, Interactive Instruction, Seminar, Group Assignments, Authentic learning, Presentation by students by group.

Assessment Types	MODE OF ASSESSMENT

A. Continuous Comprehensive Assessment (CCA) – Theory: 25 Marks
Components
a. Quiz
b. Assignments
c. Written tests
d. Viva Voce
Practical: 15 Marks **Components:** Lab involvement, Practical Record, Viva voce.

B. End Semester Evaluation (ESE)
Theory : 50 marks-1.5 hours. i) Short answer type questions: Answer any 7 questions out of 10 (7*2=14). ii) Short essay type questions: Answer any 4 questions out of 6 (4*6=24). iii) Essay type questions: Answer any 1 question out of 2 (1*12=12). **Practical: 35 marks-1 hour.** Problem solving skills: 30 marks Record: 5 marks

References:

1. Rohatgi V.K. and Saleh, A.K. Md.E. (2009): An Introduction to Probability and Statistics.2nd Edn. (Reprint)John Wiley andSons.

2. Gupta, S.P. (2021) Statistical Methods. Sultan Chandand Sons: NewDelhi.

3. Gupta, S.C. and Kapoor, V.K.(2020) Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

4. Sudha G Purohit, Sharad D. Gore, Shailaja Deshmukh (2019) Statistics using R, 2nd edition, Narosa Publishing House.

5. Python for Everybody: Exploring Data Using Python3, ADS 2016.

Suggested Readings:

1. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007) Introduction to the Theory of Statistics, 3rd Edition., (Reprint), Tata Mc Graw-Hill Pub. Co.Ltd.

2. John E Freund, Mathematical Statistics, Pearson Edn, NewDelhi.

3. Tilman M. Davies. (2016) The Book of R, A First Course in Programming and Statistics, No Starch Press.

4. Python for Data Analysis (2012).WesMc Kinney, O'REILLY.

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Statistics**					
Course Name	**Applied Statistical Methods**					
Type of Course	**DSC C**					
Course Code	**MG4DSCSTA203**					
Course Level	**200-299**					
Course Summary & Justification	**Students can acquire skills in core statistical methods- index numbers, time series, and non-parametric tests along with practical experience in data analysis using R or Spreadsheet or Python.**					
Semester	**4**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the concepts, types, and applications of index numbers and apply tests such as time-reversal and factor-reversal.	A	1
2	Decompose a time series into its components and estimate trends and seasonal indices. Perform forecasting and deseasonalization for time-series data.	U	1
3	Select and apply appropriate non-parametric tests for different types of data.	A	1
4	Apply statistical methods for problem-solving using R or Spreadsheet or Python, and interpret and present the results effectively.	A	1
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)

Modules	Units	Course description	Hrs	CO No.
1. Index Numbers	1.1	Definition, purpose, and uses; simple vs. weighted index numbers	4	1
	1.2	Laspeyres, Paasche, Fisher indices	4	
	1.3	Tests: time reversal, factor reversal	4	
	1.4	Applications: consumer price index, cost-of-living index; practice exercises	3	

2. Time Series Analysis	2.1	Introduction and components of a time series: trend, seasonal, cyclical, irregular	3	2
	2.2	Models of Time Series: Additive and Multiplicative; Simple Methods – Graphical, Semi-Averages, Moving Averages (with problems)	6	
	2.3	Estimating trend and seasonal variations using moving averages.	3	
	2.4	Forecasting methods, deseasonalization and hands-on exercises	3	
3. Statistical Inference – Parametric & Non-parametric Tests	3.1	Concepts of statistical inference; parametric vs nonparametric approaches, Hypothesis testing framework; assumptions of parametric tests	2	3
	3.2	Tests for mean, variance and proportion- one sample and two samples	6	
	3.3	Kruskal – Wallis H test and Fisher - Irwin test	3	
	3.4	Mann–Whitney U test, Runs test; advantages & limitations.	4	
4. Data Analysis using R/Spreadsheet/Python (A practical record with minimum 5 problems have to be submitted).	4.1	Compute Laspeyres, Paasche, and Fisher indices from given datasets and compare results.	8	4
	4.2	Implementation of parametric and non-parametric tests using R/Spreadsheet/Python,	22	
5. Teacher specific content				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning, Interactive Instruction, Seminar, Group Assignments, Authentic learning, Presentation by students by group.

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References:

1. Gupta, S.P. (2020). Statistical Methods. Sultan Chand & Sons.
2. Croxton, F.E., Cowden, D.J., & Klein, S. (2006). Applied General Statistics. Pearson.
3. Rangarajan, C. (2016). Index Numbers: Theory and Practice. Macmillan India.
4. Chatfield, C. (2016). The Analysis of Time Series: An Introduction. Chapman & Hall/CRC.
5. Brockwell, P.J., & Davis, R.A. (2016). Introduction to Time Series and Forecasting. Springer.
6. Grolemund, G., & Wickham, H. (2017). *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. O'Reilly.
7. DeVries, J., & Marathe, R. (2019). *Hands-On Programming with R for Data Analysis*. Packt Publishing.
8. VanderPlas, J. (2016). *Python Data Science Handbook.* O'Reilly.