DPG Institute of Technology and Management

Sector 34, Gurugram HR 122004

Lesson Plan

Course Name: Applied Computational Statistics

Faculty Name: Dr. Leena Chawla

No. of Lecture Hours/Week	**3**	**Exam Hours**	**3**
Total No. of Lecture Hours	**41**	**Exam Marks**	**75**
Course Code:	**BSC-MATH-253G**	**Semester**	**3**

COURSE OBJECTIVES:

1. Understand the basics of data, exploratory data analysis, statistics and hypothesis testing in problem solving.
2. Illustrate multivariate data analysis methods to solve the problems.
3. Understand the concepts of classification methods to analysis and representation of multivariate data in real world.
4. Understand and illustrate the stochastic process to solve real world problems.

S. No	Topics to be covered	Teaching Methodology	Class Activity/Event	Remark/CO
SECTION A	**Unit 1**			
1	Types of Data (Quantitative, Qualitative, Logical)	Chalk &Talk		
2	Exploratory Data Analysis (Histogram, Scatter plots, Box plot	Chalk &Talk		
3	Fundamentals of Descriptive Statistics	Chalk &Talk		
4	Moments- Measures of Central Tendency,	Chalk &Talk		
5	Overview of Probability and Combinatorics,	Chalk &Talk		
6	Measure of spread, Measure Shape	Chalk &Talk	Quiz/MCQ	
7	Estimations (Point and Intervals- Confidence intervals with means, sample proportions)	Chalk &Talk		**C01**
8	Inferential Statistics (Normal Distribution, Statistic Sampling)	Chalk &Talk		
9	Central Limit Theorem	Chalk &Talk		
10	Hypothesis Testing: Introduction	https://youtu.be/	Group Discussion	

		8oNGkvuRP60?si=r5vzHxRjiu88eN1v		
11	Confidence Intervals, Critical Value based approach	Chalk &Talk		
12	P-value base approach, ZTests,	Chalk &Talk	Assignment	
13	TTests ,the $\chi 2$ distribution	Chalk &Talk		
14	ANOVA/ANCOVA.	PPT		
SECTION B	**Unit 2**			
15	Multivariate Analysis: Multivariate distributions	Chalk &Talk		
16	Multivariate normal distribution and its properties	Chalk &Talk		
17	Distributions of linear and quadratic forms	Chalk &Talk		
18	Tests for partial and multiple correlation coefficients and regression coefficients and their associated confidence regions.	Chalk &Talk		
19	Data analytic illustrations.	Chalk &Talk		
20	Wishart distribution (definition, properties)	https://youtu.be/nkTZ7XdIp-A?si=lXYILemT9MOJ3W5o		C02
21	Construction of tests,	Chalk &Talk	Assignment	
22	union-intersection and likelihood ratio principles	Chalk &Talk		
23	Inference on mean vector, Hotelling's T2	Chalk &Talk		
24	MANOVA- Inference on covariance matrices.	Chalk &Talk		
SECTION C	**Unit 3**			
25	Classification methods: Discriminant analysis	Chalk &Talk	Quiz/MCQ	
26	principal component analysis	Chalk &Talk		
27	Factor analysis	https://youtu.be/n3y3xLNoPk4?si=24Bqc49Niv66a5nF		C03
28	Canonical Correlation analysis, Correspondence Analysis	Chalk &Talk		
29	Multidimensional Scaling	Chalk &Talk	Group Discussion	
30	Cluster analysis. Nonparametric methods of multivariate analysis	Chalk &Talk		
31	Robust methods of multivariate analysis	PPT		

32	Graphical representation of multivariate data	Chalk &Talk		
SECTION D	**Unit 4**			C04
33	Stochastic Process: Markov chains with stationary transition probabilities	https://youtu.be/4uRATAPWKOU?si=UaLR8pLqxlr_f_sw		
34	Properties of transition functions	Chalk &Talk	Group Discussion	
35	Classification of states	PPT		
36	Stationary distribution of a Markov chain	Chalk &Talk		
37	Existence and uniqueness	Chalk &Talk	Assignment	
38	Convergence to the stationary distribution	Chalk &Talk		
39	Methods based on Markov chains for simulation of random vectors	Chalk &Talk		
40	MCMC algorithm. Random Walks	Chalk &Talk		
Content Beyond Syllabus				
41	Gambler's ruin problem, transient states.	NPTEL Video		

References:

1. W. Feller: An Introduction to Probability Theory and its Applications, Vol.-II.
2. S. Karlin and H. M. Taylor, A First Course in Stochastic Processes.
3. William J. Stewart, Probability, Markov Chains, Queues and Simulation.
4. A. Basilevsky, Statistical Factor Analysis & Related Methods – Theory & Applications, John Wiley & Sons
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes.
6. S. Ross, Introduction to Probability Models.
7. T. W. Anderson, An Introduction to Multivariate Statistical Analysis.
8. Ross, Introduction to Probability.

9th edition, Pearson, 2006 9. G. Jay Kerns, Introduction to Probability and Statistics Using R, 2016
10. Andy Field, An Adventure in Statistics, SAGE Publications, 2016
11. Dawn Griffiths, Head First Statistics, O'Reilly media Inc., 2019
12. Timothy C Urdan, Statistics in Plain English, Taylor and Francis Publisher, 2010
13. Brian.S. Everitt, Torsten Hothorn, Handbook of Statistical Analyses Using R, Chapman & Hall/CRC 2006
14. C.R. Kothari, Research Methodology, New Age Publishers, 2004
15. Marley W. Watkins, A step by Step Guide to Exploratory Factor Analysis with R and R Studio, Tylor & Francis Group, 2021
16. Josheph F. Hair, William C. Black et.al., Multivariate Data Analysis, 7th ed.
17. Deniel J. Denis, Univariate, Bivariate and Multivariate Statistics Using R, John Wiley & Sons, 2020

Course Outcomes:

At the end of the course, the student will be able:

C205.1	To understand the basics of data, exploratory data analysis, statistics and hypothesis testing in problem solving.
C205.2	To illustrate multivariate data analysis methods to solve the problems.
C205.3	To understand the concepts of classification methods to analysis and representation of multivariate data in real world.
C205.4	To Understand and illustrate the stochastic process to solve real world problems.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	2	1	1		1	1						3	2	1	2
CO2	2	1	3	2	2		1		2	2	2	3	2	2	2
CO3	2	1	3	2	2		1		2	2	2	3	2	2	2
CO4	2	1	3	2	2		1		2	2	2	3	2	2	2

Signature of Staff In-charge

Dr. Leena Chawla

Signature of HOD

Dr. Simpi Mehta