Semester-IV/ Semester-II

Discipline Specific Core (DSC) Course

Discipline-Specific Core (DSC) Course 4a: Generalized Linear Models

Structure 1: PG Curricular Structure with only Course Work
Structure 2: PG Curricular Structure with Course Work + Research

Course Title & Code	Credits	Credit Distribution of the Course			Eligibility Criteria	Prerequisite of the course (if any)
		Lecture (45 Hours)	Tutorial (15 Hours)	Practical (00 Hours)		
DSC 4a: Generalized Linear Models	4	03	01	00	NIL	Basic knowledge of Linear Models

Course Objectives:

- To equip students with the ability to learn and use linear and generalized linear models for normal and non-normal responses.

Course Learning Outcomes: After the successful completion of this course, the student will be able to:

- Use linear models, apply data transformations, and appreciate the need of generalized linear models.
- Use logistics and Poisson regression models.
- Understand the concept of deviance, analysis of deviance, Lack-of-Fit tests in Logistic and Poisson regression, and the concept of overdispersion.
- Use Log linear models for contingency tables, and likelihood ratio tests for various hypotheses testing,
- Understand complete independence, marginal and conditional independence, and partial association.
- Understand graphical and non-graphical models.
- Use the concepts of Generalized Linear Models in real life problems.
- Understand and apply Quasi likelihood.

Unit I (8 Hours)

Review of linear regression models, ML estimation, Residual analysis, Transformation of response variable- Box-cox method, Introduction to generalized linear models (GLMs).

Unit II (9 Hours)

Logistic and Poisson regression- Logistic regression model, ML estimation, Goodness-of-Fit tests (Concept of deviance), analysis of deviance, Lack-of-Fit tests in logistic regression. Concept of overdispersion in logistic regression. Poisson regression, MLE for Poisson regression, applications in Poisson regressions.

Unit III (14 Hours)

Log linear models for contingency tables- interpretation of parameters, ML estimation of parameters, likelihood ratio tests for various hypotheses including independence, marginal and conditional independence, and partial association. Graphical and decomposable models.

Unit IV (14 Hours)

Family of Generalized Linear Models- Exponential family of distributions, Formal structure for the class of GLMs, Link functions, Likelihood equations for GLMs, Important distributions for GLMs, A class of link functions- the power function, Inference and residual analysis for GLMs, Quasi likelihood.

Tutorial

Tutorial sessions will include at least one activity such as group discussion/presentation/ problem solving exercise based on the material covered in the lectures along with scholastic work related to the conceptual understanding of the subject.

Essential Readings:

1. Christensen, R. (2025). *Log-linear Models and Logistic Regression*, Springer.
2. McCullagh, P. and Nelder, J.A. (1989). *Generalized Linear Models*, Chapman and Hall.
3. Myers, R.H., Montgomery, D.C., Vining, G.G., and Robinson, T. J. (2012). *Generalized Linear Models with Applications in Engineering and the Sciences*, John Wiley & Sons.
4. Zelterman, D. (2006). *Models for Discrete Data,* Oxford University Press Inc.

Suggested Readings:

1. Agresti, A. (2002). *Categorical Data Analysis*, John Wiley & Sons.
2. Bates. D.M. and Watts, D.G. (2007). *Nonlinear Regression Analysis and its Applications*, Wiley-Interscience.
3. Collett, D. (2003). *Modeling Binary Data*, Chapman and Hall.
4. Dobson, A.J. and Barnett, A.G. (2018). *Introduction to Generalized Linear Models*,

Chapman and Hall/CRC.

5. Green, P.J. and Silverman, B.W. (1994). *Nonparametric Regression and Generalized Linear Models*, Chapman and Hall.
6. Hastie, T.J. and Tibshirani, R.J. (1990). *Generalized Additive Models*, Chapman and Hall.
7. Hosmer, D.W., Lemeshow, S. and Sturdivant, R.X. (2013). *Applied logistic regression*, John Wiley & Sons.
8. Lindsey, J. K. (1997). *Applying generalized linear models*, Springer.
9. McCulloch, C.E. and Searle, S.R. (2004). *Generalized, Linear and Mixed Models*, John Wiley & Sons.