MATH 763: Generalized Linear Models
Fall 2022 Course Syllabus

NJIT Academic Integrity Code: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

COURSE INFORMATION

Course Description: Theoretical and applied aspects of generalized linear models. Classical linear models, nonlinear regression models, and generalized estimating equations.

Number of Credits: 3

Prerequisites: MATH 662 and MATH 665 or departmental approval.

Course-Section and Instructors:

Course-Section	Instructor
Math 763	Professor S. Dhar

Office Hours for All Math Instructors: Fall 2022 Office Hours and Emails

Required Textbook:

Title	*Generalized Linear Models: Applications in Engineering and the Sciences*
Author	Myers, et al.
Edition	2nd
Publisher	Wiley
ISBN #	978-0470454633

University-wide Withdrawal Date: The last day to withdraw with a **M** is **Monday, November 14, 2022**. It will be strictly enforced.

COURSE GOALS

Course Objectives

This course teaches theory and practice of generalized linear models (GLM), testing, estimation, and confidence intervals of parameters, regression and analysis of variance, modeling nonlinear regression diagnostics and their plots, variable selection and model selection. Practice of Box-Cox transformation method and correction to over dispersion. In addition, one studies generalized estimating equations when data are dependent and extensively use of Statistical software such as SAS and R to analyze data.

Course Outcomes

Upon successful completion of this course, the student will be able to:

1. Apply conceptual understanding of GLM and related topics.
2. Perform statistical analysis, such as estimation, hypothesis testing, and analysis of variance, under generalized linear models, nonlinear regression models and regression models, with mixed effects.
3. Apply standard statistical software to develop models and analyze data that arise from different fields. Students who successfully complete this course will be able to use SAS and R to accomplish model building.
4. Apply software to implement transformation methods such as Box-Cox, proper transformations and correct for overdispersion when present to improve the model.
5. Apply generalized estimating equations methodology.
6. Evaluate published research in GLM.

POLICIES

DMS Course Policies: All DMS students must familiarize themselves with, and adhere to, the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. DMS takes these policies very seriously and enforces them strictly.

Grading Policy: The final grade in this course will be determined as follows:

Hand-in HW	20%
Midterm Exam	25%
Course Project	25%
Final Exam	30%

*Assessment project grades use relative performance.

Your final letter grade will be based on the following tentative curve.

A	90 - 100	**C+**	75 - 79
B+	85 - 89	**C**	65 - 74
B	80 - 84	**F**	0 - 64

Attendance Policy: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the Math Department's Attendance Policy. This policy will be strictly enforced. Students

must attend all classes. Absences from class will inhibit your ability to fully participate in class discussions and problem solving sessions and, therefore, affect your grade. The class does not tolerate tardiness, as it is very disruptive for the instructor and students.

Homework Policy: Canvas announces weekly Homework assignments. Late homework not accepted.

Please submit a hardcopy of your HW solution at the beginning of class at. A graded HW file with grades out 10 points.

Exams: There will be one midterm and one final exam (see course outline). All exams will be closed - book. Calculators are allowed but should be basic and without graphing capabilities. No assignments, homework, exams will be accepted late.

Midterm Exam	October 28, 2022
Final Exam Period	December 16 – 22, 2022

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the Math Department's Examination Policy. This policy will be strictly enforced.

Makeup Exam Policy: There will be **NO MAKE-UP QUIZZES OR EXAMS** during the semester. In the event an exam is not taken under rare circumstances where the student has a legitimate reason for missing the exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the Math Department Office/Instructor that the exam will be missed. Imputed scores replace grades in case of extenuating circumstances with legitimate and a verifiable excuse. In all cases, the student must present proof for missing the exam, e.g., a doctor's note, police report, court notice, etc., clearly stating the date AND times.

Course Policy: It is required that the student read the textbook for the material already covered in class by the instructor and confirm that the basic solved problems are understood and practice solving textbook problems. More explicitly, students must workout examples and exercises and problems from the textbook on the topics already covered in class, and thus learn to solve them correctly. The student should compare his or her answers with those given at the end of the textbook or by the instructor. Instructor holds the right to modify in class exams, homework, quizzes dates in the best interest of the class. NJIT student emails or emails provided by students to NJIT as official emails are the recipients of the official announcements. Exams and quizzes allow only basic calculators without graphic capabilities.

Class Policy:

1. During all class times, turn off all cellular phones, beepers and other devices.
2. Do not distract the class by eating during the class or exams, wandering in and out of the classroom, etc.
3. Surfing on the internet using Laptops/computers/pads, devices, etc., are not allowed when the instructor is lecturing.

Office hours and classes are face-to-face.

All other information will be exchanged via Canvas email and other tools.

Cellular Phones: All cellular phones and other electronic devices must be switched off during all class times.

ADDITIONAL RESOURCES

Further Assistance: For further questions, students should contact their instructor. All instructors have regular office hours during the week. These office hours are listed on the Math Department's webpage for Instructor Office Hours and Emails.

Accommodation of Disabilities: The Office of Accessibility Resources and Services (OARS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Scott Janz, Associate Director of Disability Support Services at 973-596-5417 or via email at scott.p.janz@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Office of Accessibility Resources and Services (OARS) website.

Important Dates (See: Fall 2022 Academic Calendar, Registrar)

Date	Day	Event
September 5, 2022	Monday	Labor Day
September 6, 2022	Tuesday	First Day of Classes
September 12, 2022	Monday	Last Day to Add/Drop Classes
November 14, 2022	Monday	Last Day to Withdraw
November 22, 2022	Tuesday	Thursday Classes Meet
November 23, 2022	Wednesday	Friday Classes Meet
November 24 to November 25, 2022	Thursday and Friday	Thanksgiving Recess - Closed
November 26, 2022	Saturday	Saturday Classes Meet
December 14, 2022	Wednesday	Last Day of Classes
December 15, 2022	Thursday	Reading Day
December 16 to December 22, 2022	Friday to Thursday	Final Exam Period

Course Outline

Disclaimer: Look for class announcements in case there are changes to this syllabus.

Week	Sections	Topic	Assignment
1 (9/9, 9/12)	Chapter 1 and 2.1, 2.2.1	Linear regression (matrix formulation, ordinary least squares (OLS) estimator, Gauss Markov theorem.)	Read Chapter 1. Assignment due week 2

2 (9/19, 9/23)	2.2.2-2.2.5	Linear regression models (other properties of the OLS estimator, estimation and hypothesis testing)	Assignment due week 3
3 (9/26, 9/30)	2.2.6-2.5	Linear regression models (residual diagnostics, maximum likelihood estimation [MLE], generalized least squares)	Using R and SAS to perform Regression Analysis. Assignment due week 4
4 (10/03, 10/07)	2.6-2.7	Linear and nonlinear regression models (weighted least squares, estimation in nonlinear regression models)	Assignment due week 5
5 (10/10, 10/14)	3.1-3.7	Nonlinear regression models (Gauss-Newton method, inference, weighted nonlinear regression)	Assignment due week 6
6 (10/17, 10/21)	4.1-4.2.6	Logistic regression models (model description, MLE and dispersion properties, likelihood ratio inference)	Assignment due week 7
7 (10/24, 10/31)	4.2.7-4.3	Logistic and Poisson regression models (odds ratios, estimation and inference for Poisson regression)	Assignment due week 9
8		MIDTERM EXAM October 28, 2022	
9 (11/04, 11/07)	4.3, 4.4, 5.1-5.4	Overdispersion. GLM (components of a GLM, exponential family of distributions, formal structure for the class of GLMs, likelihood equations for GLMs, an algorithm for fitting GLMs, quasi-likelihood)	Assignment due week 10
10 (11/11, 11/14)	5.5-5.7	GLM (the gamma family, canonical and log links for the gamma family, a class of link functions -- the power function, inference for GLMs)	Assignment due week 11
11 (11/18, 11/21)	5.8-5.9	Examples with gamma family, Using R	Assignment due week 12
12 (11/23, 11/28)	5.10-5.11	GLM and data transformation, Modeling Processes Mean and Variance	Assignment due week 13
13 (12/02, 12/5)	5.12	Quality of asymptotic results. STUDENTS' PROJECT PRESENTATIONS	Assignment due week 14
14 (12/9, 12/12)	6.1-6.3	Generalized estimating equations (residual analysis for GLMs, layout for longitudinal studies, correlation matrix, identity link, examples) STUDENTS' PROJECT PRESENTATIONS	Assignment due week 15
15(12/15)		Review	
		Final Exam (12/16 to 12/22)	

Updated by Professor S. K. Dhar - 8/10/2022
Department of Mathematical Sciences Course Syllabus, Fall 2022