Fall 2019

MATH 659-101: Survival Analysis

S. Subramanian

NJIT New Jersey's Science & Technology University

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 659: Survival Analysis
Fall 2019 Graduate 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: Introduction to statistical methods for modeling time-to-event data in the presence of censoring and truncation, with emphasis on applications to the health sciences. Topics include survival and hazard functions, censoring and truncation, parametric and nonparametric models for survival data, competing-risks, regression models including Cox proportional hazards model and time-dependent covariates, one and two sample tests, and use of appropriate statistical software for computations.

Number of Credits: 3

Prerequisites: MATH 665 or equivalent with Departmental approval.

Course-Section and Instructors

Course-Section	Instructor
Math 659-101	Professor S. Subramanian

Office Hours for All Math Instructors: Fall 2019 Office Hours and Emails

Required Textbooks:

Title	*The Statistical Analysis of Failure Time Data*
Author	Kalbfleisch and Prentice
Edition	2nd
Publisher	Wiley
ISBN #	978-0471363576

University-wide Withdrawal Date:The last day to withdraw with a **W** is **Monday, November 11, 2019**. It will be strictly enforced.

COURSE GOALS

Course Objectives: The course will acquaint students with various statistical techniques for analyzing censored survival or time-to-event data.

Course Outcome:

On successful completion, a student will be able to demonstrate understanding and knowledge of the following:

- Various failure time distributions
- Different censoring mechanisms
- Survival curves and their estimation from randomly censored data
- Exponential regression models and their estimation and testing
- The Cox regression model and the accelerated failure time model
- Statistical analysis such as estimation and hypothesis testing in the presence of censored data
- Application of the various survival analysis techniques

Course Assessment: Will be based on regular homework, one midterm exam and one final exam.

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:

Homework	25%
Midterm Exam	40%
Final Exam	35%

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

A	90 - 100	**C**	68 - 74
B+	85 - 90	**D**	50 - 67
B	80 - 84	**F**	0 - 49
C+	75 - 79		

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.

Homework Policy: Homework assignments are due in a week from the day they are assigned unless announced otherwise by instructor. Late homework will not be accepted.

Exams: One in-class midterm examination and one final examination will be given as shown below.

Midterm Exam	October 22, 2019
Final Exam Period	December 14 - 20, 2019

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: To properly report your absence from a midterm or final exam, please review and follow the required steps under the DMS Examination Policy found here:

- http://math.njit.edu/students/policies_exam.php

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

ADDITIONAL RESOURCES

Accommodation of Disabilities: Disability Support Services (DSS) 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 Chantonette Lyles, Associate Director of Disability Support Services at 973-596-5417 or via email at lyles@njit.edu. The office is located in Fenster Hall, Room 260. A Letter of Accommodation Eligibility from the Disability Support 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 Disability Support Services (DSS) website at:

- https://www.njit.edu/studentsuccess/accessibility/

Important Dates (See: Fall 2019 Academic Calendar, Registrar)

Date	Day	Event
September 3, 2019	T	First Day of Classes
September 13, 2019	F	Last Day to Add/Drop Classes
November 11, 2019	M	Last Day to Withdraw
November 26, 2019	T	Thursday Classes Meet
November 27, 2019	W	Friday Classes Meet
November 28-29, 2019	R-F	Thanksgiving Recess
December 11, 2019	W	Last Day of Classes
December 12, 13 2019	R & F	Reading Days
December 14-20, 2019	F - R	Final Exam Period

Course Outline

Week	Lecture	Sections	Topic
1	9/3 (T)	1.1-1.4	Failure time data; Failure time distributions; Time origins, Censoring, and Truncation; Estimation of the survival function
2	9/10 (T)	1.4-1.6	The Kaplan—Meier or Product Limit Estimator; Comparison of survival curves - The Log-Rank test; Generalizations
3	9/17 (T)	2.1-2.3	Continuous parametric failure time models; Exponential and Weibull regression models; Relative risk or Cox model
4	9/24 (T)	2.3-2.4	Accelerated failure time model; Comparison of regression models
5	10/01 (T)	3.1-3.4	Inference in parametric models - Random censoring; Large sample likelihood theory - Score statistic, Maximum likelihood estimator
6	10/08 (T)	3.4-3.6	Score tests of composite hypothesis; Likelihood ratio statistic
7	10/15	3.6-3.8	Exponential regression; Log-linear regression models

	(T)		
8	10/22 (T)		**MIDTERM EXAM**
9	10/29 (T)		Simultaneous Confidence Bands
10	11/05 (T)	4.1-4.2	Cox regression models – Estimation of regression parameters
11	11/12 (T)	4.3	Cox regression models – Estimation of baseline hazard function
13	11/19 (T)	4.4-4.8	Cox regression models (continued)
14	12/03 (T)	7.1-7.3	Linear rank tests; development and properties
15	12/10 (T)	7.3-7.5	The Accelerated Failure Time model; related regression models