



Course Syllabus: Functional Data Analysis - STAT 360

Division	Computer, Electrical and Mathematical Sciences & Engineering
Course Number	STAT 360
Course Title	Functional Data Analysis
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	09:00 AM - 10:30 AM Sun Wed

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Hernando Catequista Ombao	hernando.ombao@kaust.edu.sa	+966128080213	4126, 1, Al-Khawarizmi (bldg. 1)	Sundays 10:30 - 11:45 AM Mondays 9:00 - 10:00 AM Wednesdays 3:30 - 4:30 PM

Teaching Assistant(s)	
Name	Email
TBD	TBD

Course Information	
Comprehensive Course Description	The class will cover statistical models and methods for analyzing data that consists of groups of curves. Parametric and non-parametric (functional) mixed effects models will be discussed.
Course Description from Program Guide	This course will be a broad overview of the analysis of data of multiple curves that may be considered to arise from smooth functions. The course is intended to prepare the students for methodological research in this area and to train them on cutting-edge methods for analyzing functional data. The primary topics covered include visualization of curves and data exploration, nonparametric smoothing (including splines and wavelets), functional principal components analysis, mixed effects models and functional mixed effects models.
Goals and Objectives	To have a solid mastery of the statistical models and methods for analyzing curve and functional data. To apply these knowledge on the analysis of group(s) of curve data.
Required Knowledge	Knowledge in linear regression, analysis of variance, mixed effects models, estimation and hypothesis testing are all required. Students are expected to know R and/or matlab.
Reference Texts	Harezlak, Rupper and Wand (2018). Semiparametric Regression with R. Springer. Verbeke and Molenberghs (2000). Linear Mixed Effects Models for Longitudinal Data. Springer. Silverman and Ramsay (1997). Functional Data Analysis. Springer.
Method of evaluation	50.00% - Research Project 20.00% - Midterm exam 30.00% - Homework /Assignments

Nature of the assignments	<p>Homework and Assignments: There will be a total of 4-5 throughout the entire semester. One of these will be an in-depth exploration of a special topic with class presentation.</p> <p>Midterm Exam: This will be a 3-hour in-class exam to be scheduled in the evening. Closed book and closed notes. A formula sheet will be allowed.</p> <p>Research Project: This will be graded in phases. The first is a proposal (5%); followed by a draft consisting of review of literature, exploratory analysis and preliminary modeling (15%); final paper and class presentation (25%).</p>
Course Policies	<p>Attendance: students are expected to attend all lectures and discussions.</p> <p>Late HW and projects will not be accepted.</p>
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 01/27/2019 Wed 01/30/2019	Overview of linear models, estimation and hypothesis testing.
2	Sun 02/03/2019 Wed 02/06/2019	Modeling a single curve. Parametric and nonparametric models for the mean function. Time series models for the random fluctuation.
3	Sun 02/10/2019 Wed 02/13/2019	Parametric mixed effects models for groups of time series curves - two stage model.
4	Sun 02/17/2019 Wed 02/20/2019	Parametric mixed effects models for groups of time series curves - general linear mixed effects models.
5	Sun 02/24/2019 Wed 02/27/2019	Parametric mixed effects models for groups of time series curves - inference for the marginal model.
6	Sun 03/03/2019 Wed 03/06/2019	Parametric mixed effects models for groups of time series curves - inference for the random effects.
7	Sun 03/10/2019 Wed 03/13/2019	Splines, basis systems. Least squares estimation.
8	Sun 03/17/2019 Wed 03/20/2019	Penalized splines.
9	Sun 03/24/2019 Wed 03/27/2019	Spring Break
10	Sun 03/31/2019 Wed 04/03/2019	Semiparametric Regression Analysis of Grouped Data.
11	Sun 04/07/2019 Wed 04/10/2019	Principal Components for Functional Data.
12	Sun 04/14/2019 Wed 04/17/2019	Special topics - Part I.
13	Sun 04/21/2019 Wed 04/24/2019	Special topics - Part II.
14	Sun 04/28/2019 Wed 05/01/2019	Special topics - Part III.
15	Sun 05/05/2019 Wed 05/08/2019	Functional linear mixed models - Part I.
16	Sun 05/12/2019 Wed 05/15/2019	Functional linear mixed models - Part II.
17	Sun 05/19/2019 Wed 05/22/2019	Final Exam Week

Note

The instructor reserves the right to make changes to this syllabus as necessary.