Novel time-varying effects modeling and applications

Damla Senturk, Associate Professor
Department of Biostatistics
University of California, Los Angeles

Wednesday, January 31, 2018
3:30pm - 4:30pm, CHS 43-105

Refreshments served at 3:00 PM in room 51-254 CHS

ABSTRACT:

Two projects on time-varying effects modeling with applications to brain imaging and nephrology will be discussed. The first part of the talk will be on multidimensional modeling of electroencephalography (EEG) data. EEG data created in event-related potential (ERP) experiments have a complex high-dimensional structure. Each stimulus presentation, or trial, generates an ERP waveform which is an instance of functional data. The experiments are made up of sequences of multiple trials, resulting in longitudinal functional data and moreover, responses are recorded at multiple electrodes on the scalp, adding an electrode dimension. Traditional EEG analyses involve multiple simplifications of this structure to increase the signal-to-noise ratio, effectively collapsing the functional and longitudinal components by identifying key features of the ERPs and averaging them across trials. Motivated by an implicit learning paradigm used in autism research in which the functional, longitudinal and electrode components all have critical interpretations, we propose multidimensional functional principal components techniques which do not collapse any of the dimensions of the ERP data. The proposed methods are shown to be useful for modeling longitudinal trends in the ERP functions, leading to novel insights into the learning patterns of children with Autism Spectrum Disorder (ASD) and their typically developing peers.

The second part of the talk will be on time-dynamic profiling with application to hospital readmission among patients on dialysis. Standard profiling analysis aims to evaluate medical providers, such as hospitals, nursing homes or dialysis facilities, with respect to a patient outcome. Profiling methods exist mostly for non time-varying patient outcomes. However, for patients on dialysis, a unique population which requires continuous medical care, methodologies to monitor patient outcomes continuously over time are particularly relevant. Thus, we introduce a novel time-dynamic profiling (TDP) approach to assess the time-varying 30-day hospital readmission rate, throughout the time period that patients are on dialysis. We develop the framework for TDP by introducing the standardized dynamic readmission ratio as a function of time and a multilevel varying coefficient model with facility-specific time-varying effects. We propose estimation and inference procedures tailored to the problem of TDP and to overcome the challenge of high-dimensional parameters when examining thousands of dialysis facilities.