KLINGLER
College of Arts & Sciences
MARQUETTE UNIVERSITY

Department of Mathematical and Statistical Sciences
Colloquium Talk

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Interpretable PCA for Multilevel Multivariate Functional Data

1-2 pm, Fri Nov 19, 2021

In-person talk, Cudahy Hall Rm 401

(Live-stream on Teams at https://bit.ly/3qk0Bk1)

Abstract: Many studies collect functional data from multiple subjects that have both multilevel and multivariate structures. An example of such data comes from popular neuroscience experiments where participants' brain activity is recorded using modalities such as EEG and summarized as power within multiple time-varying frequency bands within multiple electrodes, or brain regions. Summarizing the joint variation across multiple frequency bands for both whole-brain variability between subjects, as well as location-variation within subjects, can help to explain neural reactions to stimuli. This article introduces a novel approach to conducting interpretable principal components analysis on multilevel multivariate functional data that decomposes total variation into subject-level and replicate-within-subject-level (i.e. electrode-level) variation, and provides interpretable components that can be both sparse among variates (e.g. frequency bands) and have localized support over time within each frequency band. Smoothness is achieved through a roughness penalty, while sparsity and localization of components are achieved by solving an innovative rank-one based convex optimization problem with block Frobenius and matrix L1-norm based penalties. The method is used to analyze data from a study to better understand reactions to emotional information in individuals with histories of trauma and the symptom of dissociation, revealing new neurophysiological insights into how subject- and electrode-level brain activity are associated with these phenomena.