R. Clifton Bailey Statistics Seminar Series

Empirical Frequency Band Analysis of Nonstationary Time Series

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Abstract: The time-varying power spectrum of a time series process is a bivariate function that quantifies the magnitude of oscillations at different frequencies and times. To obtain low-dimensional, parsimonious measures from this functional parameter, applied researchers consider collapsed measures of power within local bands that partition the frequency space. Frequency bands commonly used in the scientific literature were historically derived from manual inspection and are not guaranteed to be optimal or justified for adequately summarizing information from a given time series process under current study. There is a dearth of methods for empirically constructing statistically optimal bands for a given signal. The goal of this talk is to discuss a standardized, unifying approach for deriving and analyzing customized frequency bands. A consistent, frequency-domain, iterative cumulative sum based scanning procedure is formulated to identify frequency bands that best preserve nonstationary information. A formal hypothesis testing procedure is also dedicatedly developed to test which, if any, frequency bands remain stationary. The proposed method is used to analyze heart rate variability of a patient during sleep and uncovers a refined partition of frequency bands that best summarize the time-varying power spectrum.

Bio: Robert Krafty is Associate Professor of Biostatistics at the University of Pittsburgh. He received his undergraduate degree in Mathematics and Dance from SUNY Stony Brook, his MA in Mathematics and his PhD in Biostatistics from the University of Pennsylvania. Dr. Krafty's methodological work explores methods for extracting interpretable information from high-dimensional and complex time series, functional and longitudinal data, including image, physiology and mobile health data. His research is transdisciplinary and conducted in close collaboration with researchers across a variety of fields to better understand biological pathways connecting stress, sleep and behavior to long-term and acute health.