ENVELOPES & SUBSPACE LEARNING (STA 5934 – 0002)

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Dimension reduction has always been a central statistical concept, and is a rapidly developing research field that has wide applications in data visualization, machine learning, signal/imaging processing, compressed sensing, functional and longitudinal data. Broadly speaking, dimension reduction techniques can be applied to essentially any large datasets with a large number of variables. In this course we will study advanced dimension reduction techniques in three distinct but related contexts: sufficient dimension reduction in regression and classification, envelope models and methods for multivariate efficient estimation, and tensor data analysis. Students will read and report on key papers in the literature and carry out a limited research project. Matlab and/or R will be employed for computing.

Time: MoWeFr 1:25PM - 2:15PM.

Likely Topics:

(1) Fundamentals of Sufficient Dimension Reduction:
- dimension reduction subspace;
- central subspace and central mean subspace;
- moment-based and likelihood-based subspace estimation.

(2) Noncovex Optimization in Dimension Reduction:
- generalized eigenvalue problems in high-dimensional settings;
- optimization on Stiefel and Grassmann manifolds.

(3) Envelope Models and Methods:
- response/predictor reduction in linear models;
- discriminant analysis and clustering;
- un-supervised & semi-supervised learning.

(4) Tensor Data Analysis:
- sparse low-rank decomposition;
- tensor regression/classification/clustering;
- applications in neuroimaging studies.

(5) Other Possible Topics:
- sufficient dimension reduction and prediction with neural networks;
- inverse regression modeling;
- dimension reduction in functional and longitudinal data.