STA6448-2 Analysis of Object Data (AOD) **SPRING 2011**
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Days/Time/Room: MW 2:00 - 3:15pm HCB 312
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Textbook: Nonparametric Statistics on Manifolds and Their Applications (Lecture Notes will be posted online). A monograph with the same title by V. Patrangenaru will appear in 2011 in Chapman & Hall- CRC. ISBN:9781439820506.
The current version and updates of the manuscript can be found at
http://stat.fsu.edu/∼vic/6448/
Prerequisite: One of STA 5707, STA 5746, STA 5167, STA 5208 or STA 5327.
Course description: AOD extends Multivariate Data Analysis, Functional Data Analysis, Directional Data Analysis, 3D Data Analysis from Digital Images, Shape Analysis, High level Medical Imaging Data Analysis including data analysis of Diffusion Tensor Images, CT Scans and MRI, Analysis of Phylogenetic Trees, various Machine Learning data Analysis, Structural Genomics, Dialects Data Analysis, etc. From a mathematical perspective, AOD can be described as Data Analysis on Sample Spaces with a Manifold Stratification.
This course is concerned with the statistical theory for describing and analyzing data on manifolds with a perspective on its extension to data analysis on stratified spaces, as well as with applications of this theory. Students will be provided with the supporting knowledge necessary for studying object data, selecting appropriate techniques, and making inferences from such data.
A manifold is an abstract metric space that looks locally, but not globally, like a numerical space $\mathbb{R}^p$. Since manifolds are nonlinear spaces, fundamental statistical indices of a probability distribution on a manifold, such as mean and covariance have to be redefined in this general context, and their estimation is naturally approached from a nonparametric perspective. The foundation of nonparametric statistics on manifolds, large sample theory on manifolds, principal component analysis, MANOVA, density estimation on manifolds and other techniques on manifolds are the main objective of this class, helping the graduate student analyze 21st century data in its full complexity.

Maximal course contents

- Data on Manifolds
- Review of Basic Multivariate Analysis.
- Manifolds, Embeddings, Riemannian Structures.
- Consistency of Fréchet moments on manifolds.
- Asymptotic and bootstrap distributions of Fréchet Sample Means.
- Nonparametric inference for two samples on manifolds.
- Nonparametric Statistics on Positive Semidefinite Matrices.

- Nonparametric Statistics on Hilbert Spaces.
- Analysis on complex projective spaces.
- Analysis on spaces of congruences of k point - configurations.
- Analysis on Stiefel manifolds.
- Analysis on real Grassmann manifolds.
- Analysis on products of real projective spaces.
- Directional Data Analysis.
- Direct Similarity Shape Analysis on Kendalls Shape Spaces.
- A Projective Shape Analysis of Planar Contours.
- A Kendall Shape Analysis of Planar Contours.
- Reflection Shape Analysis with Applications.
- Affine Shape Analysis and Applications.
- Diffusion Tensor Imaging Analysis.
- Planar Projective Shape Analysis.
- Mean Glaucomatous Projective Shape Change Detection From Stereo Pair Images.
- Persistent Homology.
- Sample Spaces with a Manifold Stratification.
- Data Analysis on Euclidean Folded Models of Phylogenetic Tree Spaces.
- Data Analysis on Euclidean Folded Models of Cerebral Blood Flow Tree Spaces.

Attendance policy and Grading: Active attendance adds up to 5 bonus points. The course grade will be calculated on the basis of attendance (10%), homework (20%), a midterm exam (35% each) and a final project (35%).
Note. This is a tentative course syllabus. Deviations might be necessary