STT 996: Gaussian Random Fields and Spatial Statistics
Fall 2020 Syllabus

Course meeting days and time: **M W 3:00 PM – 4:20 PM**

Course location (ZOOM Meetings and E-mail (or D2L))
https://msu.zoom.us/j/95010804723
Password:

Course website address (https://d2l.msu.edu/) Course Modality (online via Zoom)

Instructor
Name: Yimin Xiao
Office: C437 Wells Hall
Office hours: M W F 10:00 AM – 11:00 AM **https://msu.zoom.us/j/7849276874** Password: If the above time slots do not work for you, please make an appointment with me.
Phone:
E-mail: xiaoy@msu.edu

Course Description

Random fields arise naturally in probability theory, statistics and in various applications. In particular, they serve as spatial or spatio-temporal models in geophysical, environmental sciences and many other scientific fields. In recent years there have been increasing interest and extensive studies on random fields.

There are several classes of random fields that are important in statistics and Gaussian random fields form the most important class due to their ubiquity (e.g., the central limit theorem) and mathematical amenability.

This course will focus on Gaussian random fields and its objective is to provide an introduction on basic theory of Gaussian random fields and their applications in statistics.

Course Overview

Students will learn some powerful tools for constructing Gaussian random fields (space-time models) and for analyzing them probabilistically and statistically. Such tools include stochastic

integration with respect to Gaussian random measures, spectral analysis, general Gaussian principles, fractal analysis, and statistical inference. Students will be exposed to the latest development in theory of random fields, as well as many open questions of either probabilistic or statistical nature.

The following is a tentative list of the topics that I intend to cover:

1. Fundamental Theory on Gaussian Random Fields
   Constructions of Gaussian random fields; weak convergence to Gaussian random fields; reproducing kernel Hilbert space; spectral methods for stationary and intrinsic random functions.

2. Regularity and Geometric Properties of Gaussian Random Fields
   Smoothness and roughness of sample functions; modulus of continuity and laws of the iterated logarithm; fractal dimensions; fractal properties of Gaussian random fields.

3. Statistics Analysis of Space-time Gaussian Models
   Stationary space-time models; spectral method for non-stationary space-time models; prediction and estimation problems; fixed-domain asymptotics.

Course Materials: Lecture notes and references will be distributed.

Learning Continuity Statement: If you have to be absent for a prolonged time period, please discuss with me. Lecture notes, videos will be available.

Grading Policy: Reading materials (journal articles) will be assigned throughout the course. Students will be asked to study some of the articles and to present in class so that all the participants can benefit. Final grades for the class will be determined from classroom activities and students' presentations.

Fall 2020 MSU Holidays and Breaks (tentative)

- *Classes Begin: Wednesday Sept. 2*
- *All In-Person instruction ends: Wednesday Nov. 25*
- *University Closed: Monday Sept. 7*
- *University Closed: Thursday Nov. 26 – Friday Nov. 27*
- *Classes End: Friday Dec. 11*
- *Final Exams: Monday Dec. 14 – Friday Dec. 18*