ASA Section on Statistics and the Environment

2022 ENVR Workshop - Program

Detailed Program Information

Abstracts for individual presentations can be viewed here.

Short Course #1 - Spatial-temporal point process modeling for clustered environmental phenomena

Instructor: Frederic Schoenberg, Professor, Department of Statistics and Director of the Masters of Applied Statistics Program at University of California, Los Angeles.

Abstract: Spatial-temporal point process models are becoming increasingly useful in describing a host of environmental phenomena including earthquakes, wildfires, and disease epidemics. In particular, Hawkes models and their variants can be especially useful in describing datasets exhibiting spatial-temporal clustering. In this short course, we will begin with a review of standard methods for dealing with point process data, including fitting Poisson and Cox models, and simple summaries such as the K-function, before moving to discussing the estimation of Hawkes models and its variants such as ETAS. We will also review the recursive model for contagious diseases, a model incorporating the premise that when a disease occurs at low frequency in the population, such as in the primary stages of an outbreak, then anyone with the disease is likely to have a high rate of transmission to others, whereas when the disease is prevalent, the transmission rate is lower due to prevention measures and a relatively high percentage of previous exposure in the population. This model has been shown to fit quite well to spatial-temporal contagious disease data recently. After reviewing different models, we will cover methods of their estimation in R using both parametric and nonparametric methods. We will review a variety of parametric estimation methods, including maximum likelihood, approximated maximum likelihood using an integral approximation, E-M approximation, and other methods such as minimization of the Stoyan-Grabarnik statistic. The focus of the nonparametric estimation portion will be on the Marsan-Lengliné algorithm and its application to Hawkes processes. We will then discuss model evaluation techniques, including weighted second order statistics, super-thinning, Pearson residuals, Voronoi residuals, and Voronoi deviance residuals, and their implementation in R. We will also discuss methods for dealing with very large point process datasets. Applications will be shown throughout the lecture, particularly applications to earthquake occurrences and to datasets on the spatial-temporal spread of contagious diseases, such as Rocky Mountain Spotted Fever in California or Ebola in West Africa.

Short Course #2 - An Introduction to Deep Learning with Environmetric Applications

Instructors: Dan Pagendam, Senior Research Scientist at CSIRO and Jay Barber, Associate Professor in the School of Informatics, Computing & Cyber Systems (SICCS) at Northern Arizona University (NAU).

Abstract: Deep learning is a type of machine learning (ML) that exploits a connected hierarchical set of models/functions to predict or classify elements of complex data sets. The ML deep learning revolution is relatively recent and primarily associated with neural models such as feedforward neural networks (FNNs), convolutional neural networks (CNNs), recurrent neural networks (RNNs), and generative adversarial networks (GANs), to name a few. There are remarkable success stories associated with these approaches, such as models that can defeat experts in Go, Chess, or Shogi, and of course, there are failures as well. Statisticians should not be surprised by the success (and failure) of these deep ML methods as we have been using deep hierarchical models (HMs) for years. Indeed, many of the reasons for success and failure of deep ML and deep HMs are the same. This course will present an introduction to deep models in ML from a statistician's perspective. Topics will include an introduction to stochastic gradient optimization and concepts in regularization and dimension reduction, followed by discussion of deep FNNs, CNNs, and RNNs. We will also touch upon some recent developments that may be of particular interest to statisticians, including uncertainty quantification and evaluation of feature importance. The course will focus on concepts and modeling intuition, with primary emphasis being a hands-on implementation using the R interface to Keras, with examples from biometry, ecological, and environmental statistics.

Session #1 - Statistical Methods for Water Applications

Schedule Overview

Thursday, October 6, 2022	
8:30 AM - 12:00 PM	Short Course #1
12:00 PM - 1:30 PM	Lunch
1:30 PM - 5:00 PM	Short Course #2
7:00 PM - 9:00 PM	Opening Mixer and Post
Friday, October 7, 2022	
8:30 AM	Opening Remarks
8:45 AM - 10:15 AM	Statistical Methods for W
10:15 AM - 10:30 AM	Break
10:30 AM - 12:00 PM	Quantifying Uncertainty i
12:00 PM - 1:30 PM	Lunch
1:30 PM - 3:00 PM	Environmental Statistics
3:00 PM - 6:00 PM	Group Hike to Stewart F
Saturday, October 8, 2022	
8:30 AM - 10:00 AM	Invited Session
10:00 AM - 10:30 AM	Break
10:30 AM - 11:30 AM	Panel Discussion

- Formal and Informal Inference for Spatial Autocorrelation on Stream Networks, Dale Zimmerman, University of Iowa
- Geostatistical methods for big data from stream networks, Jay Ver Hoef, Alaska Fisheries Science Center
- Issues and Advancements in Flood-Frequency Analysis—What is the 100-Year Flood, and Will It Be the Same in the Future?, Karen R. Ryberg, US Geological Survey
- Big Data Statistical Applications to Understand Human Impacts on Water Resources, Ryan McManamay Baylor University
- The value of mixture modeling in environmental and ecological modeling, Ephraim Hanks, Penn State University

Session #2 - Quantifying Uncertainty in Natural Hazards

- Data science and climate risk, Steve Sain, Jupiter Intelligence
- Detection and Attribution of Regional Precipitation Change Using Granger Causality, Mark Risser, Lawrence Berkeley National Laboratory
- Characterizing the impacts of deep uncertainty in coastal flood risk, Tony Wong, Rochester Institute of Technology
- A combined physical-statistical approach for estimating storm surge risk, Whitney Huang, Clemson University

Session #3 - Panel Discussion on Making an Impact with Environmental Statistics

- Mandy Hering (Baylor)
- Kezia Manlove (Utah State)
- Robin Russell (FWS)
- Steve Sain (Jupiter)
- Linda Young (USDA)

Session #4 - Invited Session

- Bayesian Dynamic Variable Selection for Point Process with Spatial Homogeneity, Guanyu Hu, University of Connecticut
- Understanding rainfall process through statistics and Machine Learning approaches, Mikyoung Jun, University of Houston
- Calibration of Spatial Forecasts from Citizen Science Urban Air Pollution Data with Sparse Recurrent Neural Networks, Stefano Castruccio, University of Notre Dame
- Locally Weighted Conformal Prediction for Classification with Application to Best Management Practices Segmentation via Deep Residual U-Net, Zhengyuan Zhu, Professor, Iowa State University
- Identifying species-level vegetation cover using Sentinel-2 imagery, Henry Scharf San Diego State University
- Time-discretization approximation enriches continuous-time discrete-space models for animal movement, Joshua Hewitt, Duke University
- Trend assessment for daily snow depths with changepoint considerations, Jaechoul Lee, Northern Arizona

Session #5 - Effectively Communicating Environmental and Ecological Statistics to Diverse Audiences

- Dr. Jennifer L. Green

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