ODTÜ METU

UME

IAM

ANKARA-ISTANBUL STOCHASTIC DAYS

Institute of Applied Mathematics
METU, Ankara

PROGRAM

June 6

09:30-10:00: Registration and Opening Talks
10:00-10:50: Ceylan Yozgatlıgil
11:10-12:00: Berkay Anahtarcı
12:00-14:00: Lunch
14:00-14:50: Gül İnan
15:10-16:00: Şefika Kuzgun
17:30: Dinner at Central, ODTÜ Teknokent

June 7

10:00-10:50: Naci Saldı
11:10-12:00: Mehmet Öz
12:00-13:30: Lunch
13:30-14:00: Poster Session
14:00-14:50: Alperen Yaşar Özdemir (online)
15:10-15:40: Çiğdem Yerli
15:40-16:10: Büşra Temoçin
16:10-16:30: Closing Discussions

Cryptology Laboratory, Institute of Applied Mathematics, Middle East Technical University

TÜRK MATEMATİK DERNEĞİ

Ankara-Istanbul Workshop on Stochastic Days

The academic event Ankara-Istanbul Stochastic Days (a.k.a. Ankara-Istanbul Workshop on Stochastic Processes), which dates back to 2014, will take place this year in Ankara. The organization, which is to be held on 6-7 June 2024, will be hosted by the Institute of Applied Mathematics, Middle East Technical University.

The purpose of this workshop is:

- to bring together researchers in Turkey who work on stochastic problems in a broad sense as well as graduate students entering this exciting area, and
- to create a stimulating atmosphere where participants can meet and hear about each other's work, hold discussions, share ideas and hopefully initiate future collaborations.

This workshop is supported by TMD-MAD grant.

Topics of the workshop include but are not restricted to:

- Bayesian and hidden Markov models
- Diffusion and jump-diffusion models in finance
- Levy and renewal processes
- Malliavin calculus and its applications to finance
- Probabilistic approach to operator theory
- Stochastic control
- Game theory: mean-field games
- Combinatorial probability
- Time series analysis

Committees
Steering Committee
Ceren Vardar Acar
Ümit Işlak
A. Sevtap Selçuk-Kestel
Local Organizing Committee
Ümit Işlak
A. Sevtap Selçuk-Kestel
Technical Assistance
Handan İlhan-Yüksel
H. Bartu Yünüak

Ceylan Yozgatlıgil

Middle East Technical University, Statistics Dept.

Title

Comorbidity analysis through the integration of hidden Markov models and copula functions

Abstract

The study focuses on understanding how chronic diseases influence each other and share common risk factors, known as comorbidity. We propose a method to model the interaction of two or more chronic diseases in the latent space using hidden Markov theory and discrete copula functions. Specifically, a novel coupled hidden Markov model (CHMM) incorporating a bivariate discrete copula function, namely the Binomial copula, is introduced. The study calculates a complete data log-likelihood and develops necessary inference methods for model implementation. To address numerical challenges, a variational expectation maximization (VEM) algorithm is used for parameter estimation. The simulation study evaluates the proposed model's performance under different odds ratios, yielding satisfactory results. Furthermore, the model is applied to hospital appointment data from a private hospital, revealing insights into the dependency structure and dynamics of unobserved disease data. This application underscores the model's utility in exploring disease comorbidity, particularly in scenarios where only population dynamics over time are available, without access to clinical data.

Berkay Anahtarcı

Özyeğin University, Math Dept.

Title

Value Iteration Algorithm for Mean-Field Games

Abstract

This talk presents a value iteration algorithm for finding stationary mean-field equilibria in discrete-time mean-field games. In these games, strategic players within a large population base their decisions on the average behaviour of the entire population. Applicable to both discounted and average cost criteria, our approach leverages Q-functions in the value iteration process.

Gül İnan

İstanbul Technical University, Math Eng. Dept.

Title

Clustered Collaborative Learning with Stacked Ensemble Methods for Privacy-Preserving Multi-Source Data Integration

Abstract

In today's data-driven world, the integration of data from diverse sources is important for improving predictive performance and revealing deeper insights. However, privacy concerns often prevent the sharing of data sources. Moreover, the heterogeneity among data sources, arising from differences in data collection techniques, further complicates the merging process. In this study, motivated by one of the existing studies on clustered collaborative learning approach in the literature, we propose an algorithmic recipe that employs clustering and collaboration among data sources without sharing raw data. Our approach first categorizes data sources into homogeneous clusters based on similarities between the data sources and then conducts collaborative model training within each cluster. While doing so, we employ stacked ensemble techniques to improve both cluster and prediction accuracy by leveraging knowledge from different models trained on each decentralized data. Through synthetic data experiments, we demonstrate the effectiveness of our approach in accurately integrating data for both regression and classification tasks.

Şefika Kuzgun

University of Rochester, Math Dept.

Title

Two-point Function of KPZ with Gaussian Initial Data

Abstract

In this talk, we consider KPZ equation starting from a Gaussian process with stationary increments. Using Malliavin integration by parts, we establish the formula for two-point correlation function of the spatial derivative process in terms of the variance of the KPZ equation. This talk is based on an ongoing project with Arjun Krishnan.

Naci Saldı

Bilkent University, Math Dept.

Title

Quantum Markov Decision Processes

Abstract

In this talk, we aim to develop a quantum counterpart to classical Markov decision processes (MDPs). We first present a formulation of quantum MDPs with state and action spaces in the quantum domain, quantum transitions, and cost functions. The focus then shifts to establishing a verification theorem for Markovian quantum control policies. Subsequently, we introduce classes of open-loop and closed-loop policies and present their structural results. Finally, we develop algorithms for computing optimal policies and value functions for both open-loop and closed-loop policies

using the duality between dynamic programming and semi- definite programming formulations.

Mehmet Öz

Özyeğin University, Math Dept.

Title

Law of large numbers for branching Brownian motion among Poissonian obstacles

Abstract

In this talk, we consider the model of branching Brownian motion (BBM) among random obstacles in $\mathbb{R}^d$. Obstacles are balls of fixed radius with centers scattered according to a homogeneous Poisson point process. A specified interaction between the BBM and the obstacles yields a random process in a random environment, where the interaction is typically chosen such that the presence of obstacles tends to reduce the mass (population size) of the BBM compared to an ordinary BBM in a 'free' environment. We discuss several types of interaction, where the severity, in terms of mass-suppressing, of the trapping mechanism increases in the following order: mild obstacles with a lower but positive rate of branching, mild obstacles with zero branching, obstacles with soft killing, and finally hard obstacles. Our focus is on the reduced mass of the BBM, with particular emphasis on laws of large numbers that are valid in almost every environment with respect to the Poisson point process.

Alperen Yaşar Özdemir (online)

KTH Royal Institute of Technology

Title

Random processes and first-order limit laws

Abstract

We focus on two sequences of objects: 321-avoiding permutations and uniform attachment graphs as their sizes go to infinity. We say that the first-order limit law is satisfied if for all first-order logical sentences the limiting density for the number of objects satisfying that sentence exists. We will show why Markov chains do not apply in our examples and how other forms of random processes can be used to prove the limit law.

Çiğdem Yerli

Bartın University, Dept. of Accounting

Title

Markov-Chain Modulated Implied Liquidity: Modeling and Estimation

Abstract

This work presents a methodology for modeling the implied liquidity which is introduced through the Conic Finance theory, and considered a proxy for the market liquidity level. We propose a partial information setting in which the dynamics of implied liquidity, representing the noisy information on the unobserved true market liquidity, follow a continuous-time Markov-chain modulated exponential Ornstein-Uhlenbeck process. Model inference requires the filtering of the unobserved states of the true market liquidity, as well as the estimation of the unknown model parameters. We address the inference problem by the EM algorithm. We provide novel results on robust filters leading to maximum likelihood estimate of noise variance. We fit the proposed model to the implied liquidity series obtained from the prices of (closest to) 1-year ATM call options on the S&P 500 covering the period from January 2002 to August 2022. The data application shows that the unobserved true market liquidity follows three regimes. The implied liquidity series contains relevant information as the filtered trajectory of the underlying Markov chain moves according to the economic environment changes due to the Federal Reserve's actions, the global financial crisis of 2007-08, and the COVID-19 pandemic.

Büşra Temoçin

Middle East Technical University, Institute of Applied Mathematics

Title

Applications of the Central Limit Theorem for Pricing Cliquet-Style Options

Abstract

Cliquet-style options in different variants are basic building blocks in select products which are offered by German life insurance companies. We present both an analytical pricing approximation via the central limit theorem and a corresponding control variate Monte Carlo approach for their valuation. The control variate approach turns out to be a good alternative to the integral representation of Bernard and Li (2013). Further, it can be modified to increase the efficiency of pricing cliquet-style options in the Heston price setting.