Mathematics BSc Thesis Topics under the UD–GXUFE Cooperation

Topic: Efficient markets and properties of stock prices

- Supervisor: Dr. József Mihály Gál

- Topic outline: Efficient market hypothesis is a classical problem in finance, which has important implications for the models of stock price processes. Further, several stochastic models have been developed for stock prices with special properties ('stylised feautes'). The candidate is going to choose certain markets and stocks to analyse, and the main aim is to run different tests (on the efficiency issues and other properties) and to perform (statistical) analysis of the stock price behaviour. For the analysis R language can be used for instance.

- Suggested Readings:

  1. Hull, J. C., *Options, Futures and Other Derivatives*, 8th edition, Pearson, 2012.
  2. Brealey, R. A. - Myers, S. C. - Allen, F., *Principles of Corporate Finance*, Concise edition, McGraw-Hill/Irwin, 2009.
  3. Musiela, M. and Rutkowski, M., *Martingale Methods in Financial Modeling*, second edition, Springer-Verlag, Berlin, Heidelberg, 2005.

Topic: Numerical optimization using gradient-based methods with applications in financial mathematics

- Supervisor: Dr. Borbála Fazekas

- Topic outline: This thesis investigates gradient-based optimization techniques such as gradient descent and conjugate gradient method. Their applications in financial mathematics, including portfolio optimization and risk minimization is also discussed.

- Suggested readings: To be discussed in person, following the application for the topic.

Topic: Numerical methods for the Black-Sholes equation

- Supervisor: Dr. Borbála Fazekas

- Topic outline: The Black–Scholes-model is a mathematical model for the dynamics of a financial market. It is a parabolic partial differential equation. In this thesis we examine numerical methods, mainly finite difference schemes for solving the equation.

- Suggested readings: To be discussed in person, following the application for the topic.

Topic: Properties of Production Functions

- Supervisor: Dr. Fruzsina Mészáros

- Topic outline: We study production functions, providing their definitions and presenting some of their most important properties. We introduce the two most notable production functions with constant elasticity of substitution, and then we turn to the characterization of production functions in terms of quasilinearity, quasi-sums, and homogeneity.

- Suggested Readings:

  1. Chen, B.-Y., *Classification of h-Homogeneous Production Functions with Constant Elasticity of Substitution,* Tamkang Journal of Mathematics 43 (2012): 321–328.
  2. Eichhorn, W., *Characterization of the CES Production Functions by Quasilinearity*, In Production Theory, edited by W. Eichhorn, R. Henn, O. Opitz, and R. W. Shephard, 21–33. Berlin: Springer-Verlag, 1974.
  3. Losonczi, L., Classification of h-Homogeneous Production Functions, Acta Mathematica Academiae Paedagogicae Nyíregyháziensis 26 (2010): 113–125.

Topic: Mathematical equilibrium models in economics

- Supervisor: Dr. László Kozma
- Topic outline: Mathematical models of equilibrium in economics are essential tools for analyzing how supply, demand, and prices interact to reach a stable state where there is no tendency for change. The purpose of the Thesis work is to focus specifically on the mathematical structure and properties of the Walrasian General Equilibrium model.
- Suggested Readings:

  1. Mas-Colell, Andreu, Michael D. Whinston, and Jerry R. Green, *Microeconomic Theory*, Oxford University Press, 1995.
  2. Starr, Ross M., *General Equilibrium Theory: An Introduction*, Cambridge Press, 2011

Topic: The impact of digitalization on the regions of the Chinese industry

- Supervisor: Dr. Judit. T. Kiss
- Topic outline: To be discussed in person, following the application for the topic.
- Suggested readings: To be discussed in person, following the application for the topic.

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