

## Applied Mathematics

### **Algorithms in game theory**

supervisor: prof. RNDr. Katarína Cechlárová, DrSc.

study form: full time

Annotation: The doctoral student will have an opportunity to get acquainted with the newest trends in the area of Computational Social Choice and solve the newest open problems in voting theory, resource allocation or matching under preferences. We intensively use the language and methods of graph theory; the most relevant areas of theoretical computer science are the design and analysis of exact and approximate algorithms and the analysis of their computational complexity. The topic is suitable also for graduates in Informatics.

Literatúra:

F. Brandt, V. Conitzer, U. Endriss, J. Lang, A. D. Procaccia, H. Moulin, Handbook of Computational Social Choice, Cambridge University Press, 2016.

### **Volatility Estimation by Fourier Expansion**

supervisor: doc. RNDr. Ivan Žežula, CSc.

consultant: RNDr. Jozef Kiseľák, PhD.

study form: full time

Annotation: Volatility is a key parameter in financial engineering. Empirical evidence has shown that constant volatility is too restrictive. Time-varying volatilities are therefore a first step to adjust the Black–Scholes model to real data. Estimation of volatility variations in the long range (month scale) is generally done by assuming an a priori model of stochastic volatility. The choice of this model is a difficult matter. Experimental evidence of market evolution at an intra-day scale indicates that there exists no general model reasonably fitting data: as a consequence, one has to switch to non-parametric Statistics. The “statistical population” then has to be considered as the mass of information collected in time. Possible procedure could be to split the time into subsequent intervals, each containing at least a certain number of quotations. The methodology of Fourier series can be considered as a refinement, avoiding any information splitting and nevertheless being able to decipher abrupt variations in time of the historical volatility. The doctoral student will intensively use theory of stochastic processes, stochastic calculus techniques, Fourier series analysis and its numerical implementation.

Literatúra:

Malliavin, P. and Thalmaier, A. (2005). Stochastic Calculus of Variations in Mathematical Finance. Springer, Berlin.