APPLIED MATHEMATICS

Testing of multivariate random variables with special variance structures.
supervisor: RNDr. Daniel Klein, PhD. (daniel.klein@upjs.sk)
study form: full time
Annotation: In recent years, especially biomedical research required investigation of multivariate and high-dimensional data structures. Since corresponding distributions have high number of parameters to be estimated, many researchers seek the reduction of their number by means of special variance structures. This approach subsequently requires possibility to test the presence of such structures in the data and adjustment of existing standard tests of mean values or development of new ones. The aim of the doctoral work will be to enlarge the pallette of existing methods in this area and compare their practical applicability by means of simulations.

Test statistics in special multivariate models.
supervisor: prof. RNDr. Ivan Žežula, CSc. (ivan.zezula@upjs.sk)
study form: full time
Annotation: Investigate properties and practical applications of tests in multivariate statistical models with special variance structures, especially of those which can be represented as product of beta distributions.

Detecting Anomalies Using Statistical Distances of Nonadditive Measures.
supervisor: doc. Mgr. Jozef Kiseľák, PhD. (jozef.kiselak@upjs.sk)
study form: full time
Annotation: The aim of the work is to introduce metrics of nonadditive normalized measures as an analogy of distances of probability distributions, e.g. Radon, Wasserstein, or Kantorovich metrics. One possibility is to use the Donsker-Varadhan representation of divergences. Within the project, the task is also to study their properties, the relationship with convergence in the appropriate space and the practical implications for applications in the field of anomaly detection.

Mathematical Tools for Music Analysis.
supervisor: doc. RNDr. Ondrej Hutník, PhD. (ondrej.hutnik@upjs.sk)
study form: full time
Annotation. Mathematical theory of tone systems is a multidisciplinary area of research requiring not only mathematical knowledge but also non-trivial knowledge of musicology. Both disciplines benefit from their interconnection: tone systems gave rise to several mathematical areas (e.g. the time-frequency analysis) and, conversely, a detailed study of musical structures and a mathematization of compositional procedures led to the creation of a qualitative chord analysis. In this work we focus on the design of new models for musical representation based on topological, geometric and analytical approaches, which allow the creation of simple and informative visualizations.