

Nabídka matematické sekce

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Mathematics

- formulate mathematical models of real-life problems
- solve (theoretically or numerically) the models
- interpret and stress test the results

Mathematical models

- static vs **dynamic**
- deterministic vs **stochastic**
- explicit vs **implicit**



Goals of the mathematical models

- to model variables, systems, dependencies,...
- to better understand the problem
- to be able to predict the future evolution
- to be able to make the optimal (better) decision
- to give the optimal strategy (policy)
- to stress test the results



Department of Probability and Mathematical Statistics

- Biggest department within the School of Mathematics
- 32 employees (30 academic)
- 20 doctoral students



Mission and Excellence

- We conduct research and education in scientific fields that deal with randomness and uncertainty.
- We develop mathematical models which include random components, investigate them theoretically and apply them to solve practical problems.
- The department provides a unique combination of expertise in topics ranging from theoretical probability, statistics, and optimization to applications in finance, insurance, biomedical sciences, and industry.



Research Areas I

- **Statistics**
 - analysis of complex high-dimensional data, functional data analysis, dynamic models, time series, analysis of extremes, change-point analysis, supervised and unsupervised classification
- **Biostatistics and Bioinformatics**
 - analysis of biomedical, genetic and high-dimensional data, design of clinical studies, methods for analysis of data from observational and randomized studies
- **Stochastic Processes and Stochastic Geometry**
 - point processes, stochastic calculus, random fields, random closed sets, spatial and space-time point processes, stereology



Research Areas II

- Optimization/Operations Research
 - asset-liability management, revenue management, simulation, facility planning, scheduling, portfolio optimization, sensitivity and output analysis
- Econometric Analysis
 - volatility estimation and prediction, systemic risk, econometric analysis of cash flows in insurance companies
- Financial & Insurance Mathematics
 - risk management, credit scoring, derivatives pricing, rate-making, optimal pricing in insurance, claims reserving, stress testing, reinsurance, sustainable retirement spending, Life Tables (unisex, for pension funds)



Collaboration – We Offer

- Expertise in analysis and modeling of complex data structures, applications of stochastic models in time and/or space, solutions to optimization problems, assessment of financial and insurance products, design and analysis of randomized and observational studies
- Ability to develop creative designs for scientific and industrial experiments that save resources and increase precision; to apply advanced analytical techniques and models in order to improve decision making in diverse types of practical problems



Partnership



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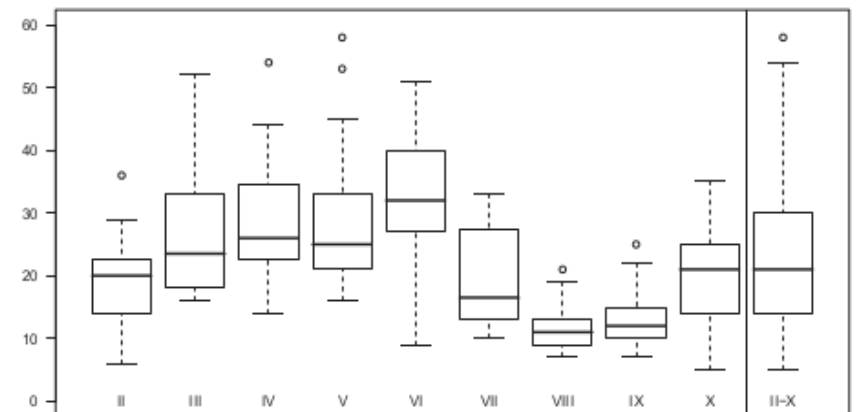
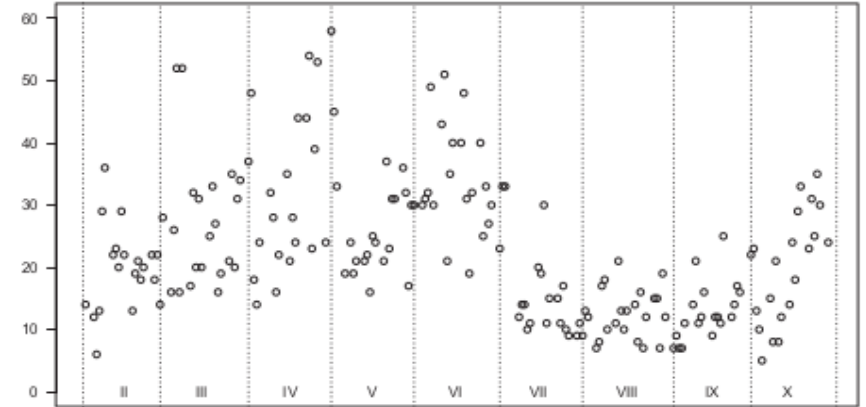
Selected Research Projects

- Processing applications for consumer loans and credit cards
 - for ČSOB
- Operational risk modeling
 - for ČSOB
- Risk evaluation of option portfolios using stochastic optimization techniques
 - for Raiffeisen Bank
- Lapse modeling for life insurance policies
 - for Generali and Česká pojišťovna
- Granular loss reserving in non-life insurance
 - for Czech Insurers' Bureau



Processing Applications for Consumer Loans and Credit Cards

- Project for ČSOB
- Requests for the consumer loans and credit cards are random
- Characterize behavior of a potential client and categorize him/her
- Incorporate seasonality, advertising campaigns, situation on market, ...
- Settle the optimal number of bank's employees for processing the applications



Operational risk analysis and modeling

- Project for ČSOB
- New data about the operational losses available – request from Czech National Bank to model and predict the operational risk
- Descriptive statistics – operational risk data categorization
- Econometric models for operational risk modeling
- Predictions for various lines of operational risks
- Conclusions for operational risk management



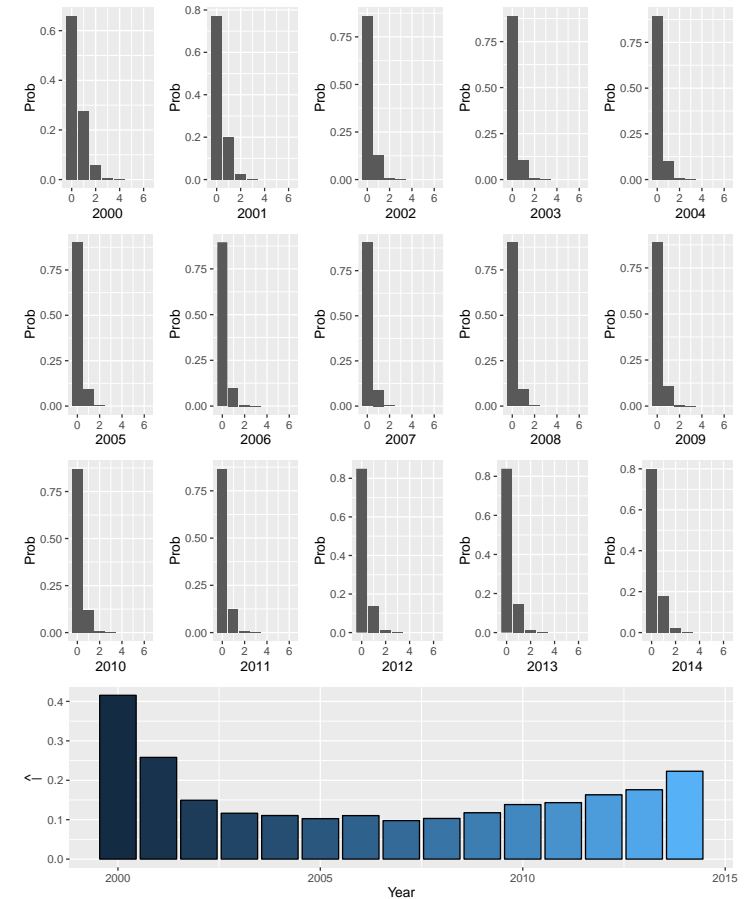
Risk evaluation of option portfolios

- Option portfolios are evaluated and analyzed using simulation techniques
- Risk of option portfolios was modeled using conditional value at risk
- To get the precise results, large number of scenarios is needed
- To save the computational time – scenario reduction techniques were applied
- At least 50% time reduction was available without losing the result precision



Lapse modeling for life insurance policies

- Determine clients, which are (and are not) somehow valuable with respect to their premium payments to the insurance company
- Zero-inflated models for survival data
- Group similar clients into common groups and select an representative
- Cluster analysis and structural equation modeling



Granular Loss Reserving in Non-life Insurance

- Insurance company puts sufficient provisions from the premium payments aside, so that it is able to settle all the future random claims that are caused by the insurance contracts
- To predict these claims reserves, which should be held by the insurer so as to be able to meet all future claims arising from policies currently in force and policies written in the past

