Multiple and Reliable Backtesting of Risk Measures

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1 Abstract

Risks arising from different business lines are currently reported and validated (i.e., backtested) separately. This work-flow hardly provides a key metric to evaluate the overall enterprise riskiness. To tackle the problem, we shall employ combined e-values along with recent advances in backtesting individual risks in order to develop a simultaneous testing metric that reflects the overall enterprise riskiness. This metric will provide statistically convincing and operationally solid arguments on whether or not the internal risk models need to be challenged.

The successful candidate will be involved in a multifaceted research project that combines theoretical and applied aspects of multiple testing using e-values within the context of insurance and financial risks. This work will require considerable advancement in a number of areas of statistics and actuarial science, and the postdoctoral fellow will work on developing this emerging technique into a new paradigm of multiple testing. The postdoc will also enjoy the opportunity to teach courses in statistics or actuarial science.

2 Interdisciplinary/applied experience

During the program, the postdoctoral fellow will interact with scholars from different related scientific fields, such as (in addition to statistics and actuarial science) weather forecasting, learning theory, insurance economics, and risk management, with contacts facilitated by the supervisor and co-supervisor, both well connected in the above fields. Some notable names of potential academic collaborators, with their expertise, are Vladimir Vovk (Royal Holloway, testing and statistical learning) , Ken Seng Tan (Nanyang Technology University, insurance), Paul Embrechts (ETH Zurich, financial risk management), Johanna Ziegel (University of Bern, forecasting), and Aaditya Ramdas (Carnegie Mellon, anytime-valid inference), who have all coauthored research papers on relevant topics with the supervisors during the past two years.

The postdoctoral fellow will also interact with insurance companies, as well as professional societies such as the Society of Actuaries (SOA) and the Canadian Institute of Actuaries (CIA). Potential collaborators in the industry include Gary Bogdani (National Sr. Collective Intelligence Lead, Unilever Canada, Toronto), Fabio Piacenza (Operational Risk Analytics and Oversight, UniCredit, Milan, Italy) and Nan Guo (General Manager of Modeling, China Bond Rating Co., Beijing, China) who have had extensive collaboration with the supervisors during the past two years. By taking part in the cooperation, the postdoc will learn about the practical work-flow of risk backtesting and hence will design tests accordingly. As internal risk models vary across insurance companies, the flexibility of multiple backtesting will be an important consideration.

Cooperation between the academic supervisors, the postdoc, other scholars, and various insurance and financial institutions will develop via modes of communication including in-person, e-mail, and virtual meetings.

3   Teaching/training/education

Plan for year 1: Teaching a three-credit one-semester course in actuarial science or statistics at the University of Waterloo.

Plan for year 2: Teaching a three-credit one-semester course in actuarial science or statistics at the University of Waterloo, or participate in CANSSI sponsored summer training programs.

4   Mentoring of the postdoctoral fellow

The postdoctoral fellow's development will be enhanced through a program of structured mentoring activities. The goal of the mentoring program will provide the skills, knowledge and experience to prepare the postdoc to excel in their career path. Specific elements of this mentoring plan are:

- co-authoring high-quality scientific research papers on statistics and actuarial science, and enhancing scientific writing and thinking skills;

- opportunity to work together with other researchers, including both established and junior scholars, possibly across different disciplines;

- networking with the scientific community via opportunities provided by the supervisor and the co-supervisor, as well as the University of Waterloo and Western University.

- seminars, workshops and individual consultations to identify research funding opportunities and write competitive proposals, offered by the writing and communication support programs of the University of Waterloo;

- seminars and workshops on teaching and learning conducted by the teaching development programs of the University of Waterloo;

- major physical conferences including the Statistical Society of Canada (SSC) Annual Meetings, International Congresses on Insurance Mathematics and Economics (IME), and the Actuarial Research Conferences (ARC), and many virtual conferences in statistics, actuarial science and risk management all over the world.

5   A list of qualifications of the candidate

- PhD in statistics, actuarial science or quantitative finance

- A strong publication record in statistics and/or actuarial science

- A high level of proficiency in mathematical and statistical analyses

- Ability to teach some courses in statistics and actuarial science at the undergraduate level in English

- Ability to independently organize workload, set goals and work effectively towards deadlines

6 Proposed schedule for postdoctoral fellowship

Schedule for year 1: The postdoc will focus on combining the concepts of e-values and ES backtesting under various *parametric* statistical scenarios with *regular* dependence assumptions and *deterministic* time of reporting. During this stage, the postdoc will be expected to prepare at least one peer-reviewed research article focusing on applications of this technique and its calibration.

Schedule for year 2: The postdoc will develop ES multiple-backtesting techniques in *nonparametric* scenarios with *complicated or absent* dependence assumptions and *stochastic* time of reporting, in light of the knowledge acquired in Schedule 1. The research outcomes are expected to result in a few peer-reviewed research articles focusing on theoretical and practical-implementation issues.