SCOR Chair on mortality research

Workshop 1

April 4-5, 2024, Paris

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Executive summary

Context

- Scor Foundation for science is currently funding a chair of research on mortality with researchers of the Interdisciplinary Center on Population Dynamics (Cpop).
- The objective of the chair project is to initiate research actions in the fields of demography and actuarial science applied to the analysis of mortality and longevity.
- This first workshop is hosted under this partnership.

Description

- **Date**: **April 4-5, 2024**
- **Hybrid event:**
  - on site event: **Paris 50LP L1D2** meeting room (18 seats)
  - and **remote event** (through Microsoft Teams)
- **Free** and **open to all internally** (through Microsoft Teams)
- Thematic:
  - Day 1 Morning**: Cpop presentations**
  - Day 1 Afternoon : **SCOR presentations**
  - Day 2 Morning : **Guest presentations**

Communication

- Internal via emailing and deeptalks invitation

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Program Day 1 – April 4

Timing	Topic	Speakers	Confirmed
10am – 10.15am	Welcome address	Philippe Trainar (SCOR)	✓
10.15am – 10.30am	Round table presentation and short introduction	Trifon I. Missov (CPop)	✓
10.30am – 11.15am	Cause of death dependencies: effect on length of life and impact of their hypothetical disruptions	Elizaveta Ukolova (CPop)	✓
11.15am – 12pm	Mortality Regularities in a Dependent Competing-Risk Setting	Trifon I. Missov (CPop)	✓
12pm – 1.45pm	Lunch break		
1.45pm – 2.30pm	A new look at mortality models with Generalized Linear Models	Antoine Burg (SCOR)	✓
2.30pm – 3.15pm	Prospective mortality modelling by cause of death: A study on risk diversification	Agne Ulcinaite and Julien Tomas (SCOR)	✓
3.15pm – 3.30pm	Discussion and concluding remarks	Trifon I. Missov (CPop)	✓
3.30pm – 3.45pm	Coffee break		
3.45pm – 4.45pm	Steering Committee Meeting		

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Program Day 2 – April 5

Timing	Topic	Speakers	Confirmed
10am – 10.45am	Using Sequences of Life-Events to Predict Human Lives	Germans Savčišens (DTU)	✓
10.45am – 11.30am	Coherent Cause-Specific Mortality Forecasting via Constrained Penalized Regression Models	Carlo G. Camarda (INED)	✓
11.30am - 12pm	Modelling Age-Space Mortality Dynamics in Small Areas	Jacob Martin (INED)	✓
12pm – 12.15am	Concluding remarks	Julien Tomas (SCOR)	
12.15pm – 2pm	Lunch break		

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Abstracts

Abstracts

Elizaveta Ukolova CPop, University of Southern Denmark

Cause of death dependencies: effect on length of life and impact of their hypothetical disruptions

The analysis of underlying causes of death offers only a partial understanding of mortality risks, as 80-90% of deaths result from a combination of various health conditions. We measure the dependencies between causes of death with odds ratios. We identify leading cause of death pairs and introduce disruptions to establish independence within these pairs. We study how this affects the dependence among all other disease pairs. Additionally, we measure how these dependencies evolve with age. We use the age-specific probabilities of death from a pair of diseases to measure the effect of dependencies on length of life by using multiple-decrement life tables and pattern-of-failure life tables.

Abstracts

Trifon I. Missov CPop, University of Southern Denmark

Mortality Regularities in a Dependent Competing-Risk Setting

Death takes place when the first among several competing risks strikes. We propose a model that disaggregates adult mortality into three components: senescent, background, and behavioral. We assume the latter captures the interaction of one's inclination to act risky and the associated damage. The suggested model is quite general and can incorporate unobserved heterogeneity, as well as dependencies among the components. For overall and cause-specific mortality, we estimate the age-specific share of deaths pertaining to each component.

Abstracts

Antoine Burg SCOR

A new look at mortality models with Generalized Linear Models

Most of standard mortality models are based on Lee and Carter's ideas. Such models are popular as they are easy to interpret and implement, but they rely on numerical optimization which can be numerically costly. Also, they model only single populations, though there are several attempts for multi-populations which require a lot of additional assumptions.

We propose here a specific GLM framework to handle mortality data. Our contribution consists in identifying multivariate distributions for which we are able to find closed-form formulas for the estimators. In addition, we show that the Age-Period-Cohort model naturally fits into this framework. This paves the way for many applications: multivariate distributions are indeed suitable for causes-of-death modelling, and our results enable the use of GLM-trees algorithms to deepen analyses and improve accuracy.

Abstracts

Agne Ulcinaite and Julien Tomas SCOR

Prospective mortality modelling by cause of death: A study on risk diversification according to the dependency structure

Insurance companies are required to produce "what-if" type of scenarios by both regulators and internal stakeholders. Using stress test scenario, regulators seek to validate internal model and to identify probable crisis situations that would threaten the viability of the company. Senior management is also particularly interested in probable scenario analysis which permits assessing business resilience to shocks, and evaluating portfolio diversification impact.

Building "what-if" type of scenarios for Mortality and Longevity risks translates into a need to create hypothetical scenarios on one or more causes of death.

In this presentation, we follow a cause of death mortality modelling within the competing risk framework introduced by Li and Lu (2019) and shows how assumptions on cause dependency structure affect future mortality projections. We observe how not taking into account the dependence between causes when modelling scenarios could yield in hypothetical gains. On the other hand, working within the competing risk framework results in more moderate gains from diversification between mortality and longevity lines of business.

Abstracts

Germans Savčišens DTU

Using Sequences of Life-Events to Predict Human Lives

Over the past decade, machine learning has revolutionized computers' ability to analyze text through flexible computational models. Due to their structural similarity to written language, transformer-based architectures have also shown promise as tools to make sense of a range of multi-variate sequences from protein-structures, music, electronic health records to weather-forecasts. We can also represent human lives in a way that shares this structural similarity to language. From one perspective, lives are simply sequences of events: People are born, visit the pediatrician, start school, move to a new location, get married, and so on. Here, we exploit this similarity to adapt innovations from natural language processing to examine the evolution and predictability of human lives based on detailed event sequences. We do this by drawing on arguably the most comprehensive registry data in existence, available for an entire nation of more than six million individuals across decades. Our data include information about life-events related to health, education, occupation, income, address, and working hours, recorded with day-to-day resolution. We create embeddings of life-events in a single vector space showing that this embedding space is robust and highly structured. Our models allow us to predict diverse outcomes ranging from early mortality to personality nuances, outperforming state-of-the-art models by a wide margin. Using methods for interpreting deep learning models, we probe the algorithm to understand the factors that enable our predictions. Our framework allows researchers to identify new potential mechanisms that impact life outcomes and associated possibilities for personalized interventions.

Abstracts

Carlo G. Camarda (Institut National d'Études Démographiques), María Durbán (Universidad Carlos III)

Coherent Cause-Specific Mortality Forecasting via Constrained Penalized Regression Models

Cause of death data provides additional insight on the future trends of mortality, as well as provide valuable information for governments and insurance companies. Models that fit and forecast by cause of death come across several methodological problems, one of them being the inconsistency between individual estimation and forecast of mortality per cause of death and an all-cause scenario.

We propose a clear-cut and fast method to obtain coherent cause-specific mortality trajectories based on Lagrange multipliers. We apply the method proposed to fit and forecast mortality of males in USA for the most five leading causes of death.

Abstracts

Jacob Martin and Carlo G. Camarda (Institut National d'Études Démographiques

Modelling Age-Space Mortality Dynamics in Small Areas

Large stochastic fluctuations due to small death counts limit understanding the true extent of geographic differences in mortality between small areas. We propose a model in a P-Spline framework that borrows strength across age and space to produce reasonable estimates of the age-specific mortality schedule in small populations. We illustrate the application of our model with provincial and municipal level mortality data for Italy.