DeSIRE tenure track position #13: Life course epidemiology: modelling resilience society

University: Eindhoven University of Technology

Faculty: Faculty of Mathematics and Computer Science

Responsible Professor: Prof. Dr. Edwin van den Heuvel

Description:
Life course epidemiology (LCE) aims to understand how exposures and risk factors, that operate across an individual's life and possibly across generations, interact with each other over time and how they simultaneously affect the development of health and disease outcomes. Within LCE, several concepts (e.g. accumulation of risk, sensitive and critical periods) have been developed to quantify aspects of this dynamic behavior of health and disease. Observational studies show substantial differences between subjects (subject diversity or heterogeneity), indicating that some subjects are more frail or vulnerable to risk factors and exposures, while others are being vital or resilient. These types of concepts in medical sciences have not been well defined in terms of mathematics yet. On the other hand, it is well known that differences in subjects can only be understood when we would study the dynamic trajectories and pathways of risk factors and exposures at an individual level simultaneously over the life course. This means the utilization of sophisticated longitudinal data analysis methods that are capable of modeling the causal relations between time-dynamic variables and health. The methodological aspects of this position reflect the mathematical modeling notions, required when trying to capture patterns, actions, and interactions of autonomous agents and their effect on resilience of complex systems. Therefore, this tenure track position will deliver an important contribution to the understanding and modelling of resilience of various Social-Technological-Environmental systems.

In this tenure track position, the research will focus on the development of statistical and other data analytic methods that can capture the time dynamics of many variables over time and that can also relate them to health and disease outcomes at later life. The two most promising data analytical methods would be network analysis (in the form of directed acyclic graphs) and latent variable models. Directed acyclic graphs can construct and formalize the causal relations as pathways, while latent variable models would describe trajectories of risk factors and exposures (e.g. as smooth time profiles) and connect them to survival end points. These data analytic methods will be used to formalize and quantify resilience and to determine methods of analysis that can investigate what characterizes resilience. The main research challenge that needs to be addressed concerns the development of integrated data analytic methods that incorporate both marginal approaches (i.e. formulations on population level captured by the network analysis) and subject specific methods captured by the latent variable model. For the proposed analysis, the researcher will be provided (at M&CS, TU/e) access to the data of the longitudinal Framingham Heart Study, containing 30 follow-up times on more than 5000 subjects over a period of 60 years.

Position in framework of the programme (please delete what is not applicable):
- Approaches/discipline: mathematical modelling / cross-cutting methodologies / Resilient societies
- Scale/application area: Health care

Synergy with other tenure track position(s):
- Operational Measures for the Assessment of Resilience and Sustainability of Complex Adaptive Systems (WUR, Plant Sciences)