

Inequalities in epidemic processes

Position type: Postdoctoral fellow

Employer: HUN-REN Rényi Institute of Mathematics

Place: Budapest, Hungary

Research theme: epidemic modeling, network science, graph theory, geometric networks, metapopulation models

Scientific directors: Dr. Márton Karsai (karsai.marton@gmail.com)

Application deadline: April 30th, 2026 (or until the position gets occupied)

Network Epidemics Group @ Rényi Institute

The Network Epidemics Group at the HUN-REN Rényi Institute of Mathematics led by Prof. Márton Karsai works on the mathematical, computational, and data-driven modelling of dynamical epidemiological processes. On one hand, the group plays special focus on the mathematical foundation of network effects on evolving spreading processes, and on the other hand, on the data-driven simulations of behavior informed epidemic processes to observe and understand real-world spreading phenomena.

Mission

This postdoctoral project focuses on developing a new generation of behavior-informed epidemic models that explores the connection between the outset and outcome inequalities observed in epidemic processes. Building on evidence from past pandemics, including COVID-19, the research starts from the hypothesis that sociodemographic differences and heterogeneous behavioral responses play a central role in shaping unequal epidemic outcomes. The aim is to establish a mathematical and computational framework that links inequalities present at the outset of an epidemic—such as differences in social mixing, exposure, health status, and adaptive capacity—to inequalities observed in infection, morbidity, and epidemic burden outcomes across populations.

Methodologically, the project combines behavioral data collection, statistical modelling, data analysis, and numerical simulation. Using data collected earlier and during the project, the work integrates large-scale survey data, mobility networks, census data, and socioeconomic indicators to capture heterogeneous behaviors and mixing patterns across social groups and urban–rural settings. During the project network-based epidemic models will be extended with stratified individual, social, and behavioral information, using synthetic populations, adaptive contact dynamics, and mobility-driven models. The project aims to deliver both fundamental scientific advances and practical tools for improved epidemic forecasting and preparedness.

Job description

The successful applicant will work in the Network Epidemics Group under the supervision of Prof. Márton Karsai at the HUN-REN Rényi Institute of Mathematics in Budapest, Hungary. The successful candidate will work on the following tasks:

- Design and carry out behavioral data collection campaigns
- Analyze behavioral survey, census, and mobility data
- Develop computational and mathematical models of epidemic processes
- Supervise PhD students and developers working on the same task in the group
- Participate in scientific publication writing and other types of dissemination
- Participate in the scientific reporting of the project

Skills and profile

Applicants should have a PhD degree in applied mathematics, physics, data science or computer science with background in data analysis and computational modelling. Background in behavioral data science, epidemic modelling, and related formal methods is expected. Good academic writing, communication and presentation skills in English are required. There are no teaching obligations. Candidates are not required to speak Hungarian.

Benefits

The postdoctoral researcher will work in a truly international environment as a member of one of Europe's leading centers in mathematics within a large research network providing opportunities for further scientific interactions. The gross salary will be 815,000 HUF per month, supplemented by a travel grant of 400,000 HUF per year.

Application materials

- Academic CV
- Motivation letter
- List of two recommenders with contacts

Additional information

Location: HUN-REN Rényi Institute of Mathematics, Budapest, Reáltanoda utca 13-15, 1053 Hungary

Duration of the contract: 1 + 2 years

Expected date of start: upon agreement

Submission: netepi@renyi.hu

Contact: Márton Karsai (karsai.marton@gmail.com)