Title of the research project

Real-time multi-scale estimation and uncertainty quantification in infectious disease models

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Name, affiliation, and contact information for the supervisor and co-supervisor

Supervisor I:
Jane Heffernan (JH)
Department of Mathematics and Statistics, York University, jmheffer@yorku.ca,
`https://scholar.google.com/citations?user=st35hykAAAAJ&hl=en`
416-736-2100 X33943

Supervisor II:
Hanna Jankowski (HJ)
Department of Mathematics and Statistics, York University, hkj@yorku.ca,
`https://www.yorku.ca/hkj/`
416-736-2100 X22596

Co-supervisor:
Quazi Abidur Rahman (QR)
Department of Computer Science, Lakehead University, quazi.rahman@lakeheadu.ca,
`https://www.lakeheadu.ca/users/R/qrahman1/node/52510`
+1 (807) 343-8230

Abstract

Infectious disease models rely heavily on input of biological parameters such as the serial interval, the incubation and infectious periods, and the recovery time. Methods which are too computationally intensive are undesirable as pandemic responses require real-time answers. Furthermore, simpler approaches are easier to communicate to public health officials. The successful applicant will work with Professors Heffernan (mathematical biology), Jankowski (statistics), and Rahman (computing and applied machine learning) as well as public health collaborators to develop real-time multi-scale estimation methods for key infectious disease modelling parameters. "Multi-scale" means that the methods should be applicable in both large and small scales: e.g. the methods should work on both a (for example) national or provincial level, and these results used to inform and obtain revised estimates for subcommunities (e.g. gender and/or sex, racialized, age, municipal). Our methods will be made widely available via appropriate computing packages and online tools. A further crucial component of the work will be to ensure that the uncertainty resulting from parameter estimation is quantified, and well-communicated to public health and policy makers.

A list of qualifications of suitable candidates

Suitable candidates are required to have a PhD in Statistics or a related discipline, as well as good communication and writing skills. Familiarity with computing/programming in R (at a minimum), differential equations, and stochastic processes will be considered an asset. Candidates will also be evaluated based on their experience and/or potential for excellence in teaching; research ability, and independence.

Interdisciplinary/applied experience

The successful applicant will work with Professors Heffernan (mathematical biology), Jankowski (statistics), and Rahman (computing and applied machine learning) on an interdisciplinary research project. Heffernan and Jankowski are members of the Canadian Centre for Disease Modelling (CDM), housed at York University, and the successful applicant will be immersed in the disease modelling research environment present at York as a result, as well as any organized activities (summer schools, research days, collaborative training programs, and other network training initiatives). Several components of the research rely on data acquisition, software development, and communication best practice development. As part of this, the successful applicant will be involved with the CDM collaborative network, which includes public health agencies within different provincial and national jurisdictions.

Teaching/training/education

Teaching: the successful candidate will teach two half-courses (3.0 credits each) at York University. The courses will be assigned based on availability as well as the candidate's expertise. The successful candidate will receive additional training and teaching support through the Teaching Commons at York University (see `https://www.yorku.ca/teachingcommons/`). York University is also home to a large mathematics education undergraduate program, and the PDF will have the opportunity to interact with this group (e.g. by giving guest lectures in an upper year undergraduate course).

Outreach: the successful candidate will be expected to design a one-hour outreach activity geared towards high school students. Dissemination and organization will be aided by the CDM and/or York University's Science Speakers Bureau.

Mentoring of the postdoctoral fellow

Technical training: An important aspect of this proposal is its multi-disciplinary nature. The PDF will receive training and participate in research in mathematical biology and modelling, statistics, computer science and applied machine learning, thereby gaining invaluable technical skills in a variety of disciplines. In addition, the proposal deals with best practice software and communication development, through which the PDF will gain additional professional skills.

Professional training: the PDF will participate in at least one mentoring workshop (i.e., CV and proposal writing, job interviews) for junior researchers organized either by the Society of Mathematical Biology, MITACS, or the Career Centre at York University.

Mentoring experience: the PDF will gain valuable mentoring experience. The PDF will aid in mentoring junior trainees in the research groups of the supervisors, through co-supervision of undergraduates and Masters students on small projects.

Professional development: The CDM organizes numerous activities annually, such as workshops, research days, and/or summer schools. The successful candidate will be expected to participate in the organization at least one such activity during their tenure. Throughout the two year tenure, the PDF will be expected to give at least four technical talks at various workshops, seminars, or conferences.

EDI considerations: All three supervisors are strongly committed to equity, diversity, and inclusion, and cultivate research environments which respect each member's cultural, religious, and sexual orientations. The PDF will receive EDI training either through York University's POLARIS training modules, or CANSSI's training modules.

Proposed schedule for postdoctoral fellowship

Please note that timing may vary depending on start date and the state of the pandemic. We will also work with the successful candidate to consider specific needs and interests when finalizing the schedule.

Proposed schedule for year 1:

- Term 1: begin research program at York University, participate in CDM activities
- Term 2: continue research, teach 0.5 course at York (3 credit), participate in CDM activities
- Term 3: continue research at Lakehead University, help with organization of at least one CDM activity (remotely)
- Research presentations at a subset of SSC, SMB, CAIMS, CMS, or CDM Annual or Winter Meetings
- Publication - draft manuscripts (submit for publication when ready)

Proposed schedule for year 2:

- Term 1: continue research, teach 0.5 course at York (3 credit), help with organization of at least one CDM activity
- Term 2: continue research at Lakehead University
- Term 3: continue research at York University
- Research presentations at a subset of SSC, SMB, CAIMS, CMS, or CDM Annual or Winter Meetings
- Publication - finalize all manuscripts and submit for publication