University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Science

of

SIYING MA

BSc (East China Normal University, 2021)

"Development of a disease analytic model for estimating the hidden population using the stratified-Peterson estimator"

Department of Mathematics and Statistics

Thursday, August 1, 2024
9:00 A.M.
David Turpin Building
Room A203

Supervisory Committee:
Dr. Laura Cowen, Department of Mathematics and Statistics, University of Victoria (Supervisor)
Dr. Junling Ma, Department of Mathematics and Statistics, UVic (Member)

External Examiner:
Dr. Patrick Bown, Department of Statistical Sciences, University of Toronto

Chair of Oral Examination:
Dr. Isaac Woungang, Department of Electrical and Computer Engineering, UVic

Dr. Robin G. Hicks, Dean, Faculty of Graduate Studies

Abstract

The COVID-19 pandemic brought the need for novel disease analytic models capable of estimating the true number of infections, including those that evaded detection. Statistical methods, such as the stratified-Petersen estimator, provide effective ways in wildlife population modelling to estimate hard-to-reach population size. We developed a novel disease analytic model to estimate the levels of underreported COVID-19 cases and the true population size based on the idea of developing a Bayesian version of stratified-Petersen estimator under a state-space formulation using individual-level capture-recapture data. We obtained the capture events from medical records and treated the occurrence of positive SARS-CoV-2 diagnostic test results and 2020 COVID-19-related hospitalizations as the tagging and recapture processes. Applying this model to the data from the Northern Health Authority region in British Columbia, Canada in 2020 by using a Bayesian Markov chain Monte Carlo (MCMC) approach, we found that the estimate of the size of the COVID-19 population ($\widehat{N} = 2, 967$) is 1.58 (95% CI: (1.53, 1.63)) times greater than the observed cases (n_{obs} = 1, 880), which is a comparable result to those reported in other studies.