Assessing parameter identifiability in compartmental dynamic models using a computational approach: application to infectious disease transmission models

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The successful application of mathematical models to guide public health interventions lies in the ability to reliably estimate model parameters and their corresponding uncertainty. Here, we present a general computational method for quantifying uncertainty and assessing parameter identifiability through a parametric bootstrap approach. We demonstrate this approach through examples of compartmental epidemic models with variable complexity, which have been previously employed to study the transmission dynamics and control of various infectious diseases including pandemic influenza, Ebola, and Zika. This approach involves repeated fitting (nonlinear least squares) to simulated data sets, which are generated through repeated sampling from the best-fit model solution, and yields a distribution of parameter values for each estimated parameter. From this, we calculate confidence intervals and mean squared error of estimated parameter distributions to quantify parameter uncertainty and bias and, further, assess parameter identifiability.

References

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