

Mathematical Modeling and Analysis of COVID-19 Epidemic with Vaccination

Coronaviruses belong to a family of viruses that can cause mild to moderate respiratory illnesses and severe acute respiratory infections. The new coronavirus is called SARS-CoV-2, and the pandemic is popularly known as COVID-19. The spread of COVID-19 started in December 2019 in Hubei Province, China and quickly spread globally, causing loss of life and economic losses. In an attempt to control the disease, various types of vaccines, including the mRNA, viral vector, and traditional vaccines, have been approved for implementation and being administered globally. This research work develops deterministic and stochastic models with multiple vaccines in a community to understand the population dynamics using modified SEIR model. The reported data for Bogota City and New York City were used to estimate the model parameters using maximum likelihood estimation, and the proposed model is validated through simulations. In addition, we also analyze the efficacy of vaccination for controlling the spread of viruses along with comparison of the spread of infection in the two cities.