

---

The COVID-19 pandemic, which began in Wuhan, China, in December 2019, had profound impacts on public health, the economy, and social life globally. In Indonesia, COVID-19 cases fluctuated significantly, with West Sumatra, particularly Padang City, experiencing marked variations in case numbers during the pandemic's peak. Despite the recent downgrading of the pandemic's alert status by global health authorities, understanding disease spread dynamics remains vital for future outbreak preparedness. This research models the spread of COVID-19 in Padang City using a mathematical approach that segments the population into susceptible, infectious, and removed groups. The model was solved using the Runge-Kutta Order 4 numerical method, and the L-BFGS-B optimization algorithm was employed for parameter estimation. The findings reveal that a transmission rate of 0.906 and a recovery rate of 0.803 provide the best fit to the observed data, yielding a Root Mean Square Error (RMSE) of 74.251. This research offers a critical tool for policymakers to enhance epidemic preparedness and response strategies at the local level.

Keywords: COVID-19, SIR model, runge-kutta

---