

ABSTRACT

ANALYSIS OF COVID-19 DISEASE SPREAD MODELS WITH VARIATIONS IN SUSCEPTIBLE POPULATION BASED ON VACCINATION LEVELS

by

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This thesis discusses the stability analysis of a COVID-19 transmission model. The model consists of six subpopulations: susceptible individuals who have not received vaccination, susceptible individuals who have received the first and second doses of vaccination, exposed individuals, asymptomatic infected individuals, symptomatic infected individuals, and recovered individuals. The susceptible population is divided into two groups because these groups have different risks of transmission and disease severity. The basic reproduction number is calculated using the Next Generation Matrix (NGM) method, while the local stability analysis is determined using the Routh–Hurwitz criteria. Furthermore, two equilibrium points are obtained, namely the disease-free equilibrium and the endemic equilibrium. The stability of the equilibrium points is analyzed based on the basic reproduction number. The disease-free equilibrium is asymptotically stable when the basic reproduction number is less than one. As a verification of the developed dynamical model, numerical simulations are performed using data from DKI Jakarta Province as the initial conditions. Based on the simulation results, the basic reproduction number is obtained as 0.001897843854, indicating that the disease-free equilibrium is stable. This result shows that, over time, COVID-19 will eventually disappear from the population.

Keywords: COVID-19, Lyapunov method, stability analysis, vaccination, Routh-Hurwitz criterion.