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A Mathematical Study of Wuhan Novel Coronavirus Epidemic Model

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Abstract: In this paper, we introduce a simplified model of the novel coronavirus pandemic (Covid-19), which appeared for the first time at Wuhan city in China. We compute the reproduction number $\mathcal{R}$, an epidemiologic index used to describe whether the disease spreads or ends. We study the model from a mathematical point of view, focusing on the local and global stability of the dynamical system by using Lyapunov functionals. We proof that for $\mathcal{R} < 1$, the disease dies and for $\mathcal{R} > 1$, the disease persists.

Keywords: *COVID-19; coronavirus pandemic; global stability; basic reproduction number; mathematical modeling; Lyapunov function.*

Mathematics Subject Classification (2010): 00A71, 34D23, 35N25, 37B25, 49K40, 60H10, 65C30, 91B70.

1 Introduction

Pandemics are large-scale outbreaks of infectious disease that can cause sudden, widespread morbidity and mortality over a wide geographic area and cause significant economic, social, and political disruption. Throughout history, there have been a lot of pandemics of diseases such as smallpox and tuberculosis. One of the most devastating pandemics was the Black Death, which killed an estimated $75-200$ million people in the 14th century. Other notable pandemics include the 1918 influenza pandemic (Spanish flu), the 2003 severe acute respiratory syndrome (SARS) pandemic, the 2009 influenza pandemic (H1N1), and the pandemic of human immunodeficiency virus/acquired immune deficiency syndrome, current HIV/AIDS. Over the past century, evidence suggests that the likelihood of pandemics has increased because of increased global travel, integration, urbanization and greater exploitation of the natural environment. These trends are likely to continue and intensify around the world with the appearance in 2019-2020

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