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MATHEMATICAL ANALYSIS OF A FRACTIONAL ORDER EPIDEMIC MODEL TO PREDICT THE SPREAD OF COVID-19 IN MOROCCO

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Abstract. In December 2019, a novel pandemic emerged in Wuhan, China, identified as a member of the coronavirus family, and rapidly disseminated worldwide. In this study, we examine the fractional $\mathcal{SEIRD}$ epidemic model with a general incidence rate, employing the Caputo fractional derivative to describe the dynamics of COVID-19. We establish the existence, uniqueness, positivity, and boundedness of the solution. Additionally, we demonstrate the existence of equilibrium points and investigate their local stability. Using MATLAB software, we conduct a numerical analysis based on real-world data to predict the dynamics of COVID-19 in Morocco.

Keywords. Caputo derivative; $\mathcal{SEIRD}$ model; COVID-19; Fractional differential equations; Sensitivity analysis.

AMS (MOS) subject classification: 26A33, 37C75, 92-08.

1 Introduction

In early December 2019, a new virus-caused illness was found in Wuhan, China. Scientists discovered that it's caused by a new type of virus called betacoronavirus. This virus leads to a serious lung condition called severe acute respiratory syndrome. The virus that causes lung problems, currently referred to as 2019-nCoV, SARS-CoV-2, and COVID-19, causes symptoms like fever, coughing, exhaustion, and problem breathing. Sadly, the 2019-nCoV spread too quickly in Hubei Province, and by the end of January 2020, an epidemic had developed. As a result, to stop the spreading disease, the Chinese governments enforced quarantine measures. Despite efforts to restrict international travel, they were not successful, and the disease spread worldwide.

The most useful tool for studying biological systems, natural phenomena, and even economic phenomena is the use of mathematical models. Therefore, one of the most fascinating subjects for researchers to study is how COVID-19 spreads and how to predict its transmission. In these studies, mathematical