AN ANALYSIS ON DETERMINISTIC CHAOS OF EXCHANGE RATES DURING COVID-19 OUTBREAK

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Dissertation submitted in partial fulfillment of the requirements for the degree

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DECLARATION

I declare that this is my own work and this Dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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The above candidate has carried out research for the M.Sc. in Financial Mathematics Dissertation under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of Supervisor: Dr. Naleen C. Ganegoda

Signature of the Supervisor: Date: 27/04/2023

DEDICATION

My thesis is dedicated to my dear parents and husband, whose massive support made this research a success. Further, I want to thank my two sisters, for their assistance provided in many ways.

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ABSTRACT

The COVID-19 influence has had a significant impact in a number of areas, including the economies of many nations. Exchange rates also show noticeable fluctuations during the pandemic period, hence analysis of the behaviour of these fluctuations is useful to make better decisions. This study aims to analyze the deterministic chaos of exchange rates during the COVID-19 period in 2020, using Poincare's definition and forecasting with ARIMA and ETS models, using R software. From 1st January 2016 to 31st December 2020, daily rates between the US Dollar, Euro, British Pound, and Japanese Yen and the Sri Lankan Rupee were collected from reports of the Central Bank of Sri Lanka. Data from January 2016 to February 2020 are considered for model fitting and the forecast period is considered from March 2020 to December 2020, considering the COVID-19 first wave and the beginning of the second wave in Sri Lanka. According to Poincare's definition, the properties of deterministic chaos are depicted by all four rates, hence showing deterministic chaos during the considered COVID-19 period. Forecasts using ARIMA and ETS models also determine that the USD, GBP, and Japanese Yen show clear chaotic behaviour, while Euro rates show slight chaotic behaviour at the beginning of the COVID-19 outbreak in Sri Lanka.

Keywords: Deterministic, Chaos, exchange rates, ARIMA model, COVID-19

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LIST OF ABBREVIATIONS

Abbreviation	Description
ACF	Auto-correlation Function
ARIMA	Autoregressive Integrated Moving Average
ETS	Exponential Smoothing Model
FTSE	Financial Times Stock Exchange
GARCH	Generalized Auto-regressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
IMF	International Monetary Fund
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
LKR	Sri Lankan Rupee
LLE	Largest Lyapunov Exponents
PACF	Partial Auto-correlation Function
SARIMA	Seasonal ARIMA
SSE	super spreading events
USD	US Dollar