APPLICATION OF SINGULAR SPECTRUM ANALYSIS (SSA) FOR FORECASTING ETHEREUM CRYPTOCURRENCY PRICES

Undergraduate Thesis

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APPLICATION OF SINGULAR SPECTRUM ANALYSIS (SSA) FOR FORECASTING ETHEREUM CRYPTOCURRENCY PRICES

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DECLARATION

I hereby declare that the Undergraduate Thesis for Undergraduate Student Qualification to be awarded is my work. It has not previously been submitted for assessment and completion of any undergraduate qualification to another University or another qualification.

Jakarta, 25th June 2025

Vega Ivanka Viana

PREFACE

Praise and gratitude to God Almighty for the completion of the author's undergraduate thesis entitled *Application of Singular Spectrum Analysis (SSA) for Forecasting Ethereum Cryptocurrency Prices*. This thesis is a result of the research process, and would not have been possible without the support of the following individuals:

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Though this thesis may not be perfect, it is the product of teamwork and support. I welcome any feedback from those who read it, hoping it can be of value to them.

ABSTRACT

The rapid growth and volatility of cryptocurrency markets, especially Ethereum, present both opportunities and challenges for investors and traders. This study explores the application of Singular Spectrum Analysis (SSA) for forecasting Ethereum's daily closing prices in USD. SSA is a powerful, non-parametric time series analysis method capable of decomposing data into trend, seasonal, and noise components without requiring strong statistical assumptions. Using Ethereum price data from February 3 to April 23, 2025, the study divides the dataset into in-sample (75%) and out-of-sample (25%) segments. The decomposition and reconstruction processes successfully identify distinct trend and seasonal structures. Forecasting was performed for the next 20 days using the Linear Recurrent Formula (LRF), and model accuracy was evaluated using the Mean Absolute Percentage Error (MAPE). The results demonstrate SSA's effectiveness in short-term cryptocurrency forecasting, with a low MAPE indicating high predictive accuracy. The findings suggest that SSA is a viable alternative to traditional models in volatile financial environments and can support better-informed decision-making for crypto investors.

Keywords: Singular Spectrum Analysis (SSA), Ethereum, time series forecasting, cryptocurrency, price prediction.

ABSTRAK

Pertumbuhan pesat dan volatilitas pasar cryptocurrency, khususnya Ethereum, memberikan peluang dan tantangan bagi para investor dan trader. Penelitian ini mengeksplorasi penerapan Singular Spectrum Analysis (SSA) untuk meramalkan harga penutupan harian Ethereum dalam USD. SSA adalah metode analisis deret waktu non-parametrik yang kuat yang mampu mendekomposisi data menjadi komponen tren, musiman, dan noise tanpa memerlukan asumsi statistik yang kuat. Menggunakan data harga Ethereum dari 3 Februari hingga 23 April 2025, penelitian ini membagi dataset menjadi segmen dalam-sampel (75%) dan luar-sampel (25%). Proses dekomposisi dan rekonstruksi berhasil mengidentifikasi struktur tren dan musiman yang jelas. Peramalan dilakukan untuk 20 hari berikutnya menggunakan Linear Recurrent Formula (LRF), dan akurasi model dievaluasi menggunakan Mean Absolute Percentage Error (MAPE). Hasil penelitian menunjukkan efektivitas SSA dalam peramalan cryptocurrency jangka pendek, dengan MAPE yang rendah menunjukkan akurasi prediksi yang tinggi. Temuan ini menunjukkan bahwa SSA merupakan alternatif yang layak dibandingkan model tradisional dalam lingkungan keuangan yang volatil dan dapat mendukung pengambilan keputusan yang lebih baik untuk investor crypto.

Kata kunci: Singular Spectrum Analysis (SSA), Ethereum, peramalan deret waktu, cryptocurrency, prediksi harga.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

KEMENTERIAN PENDIDIKAN, KEBUDAYAAN, RISET DAN TEKNOLOGI
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