UNDERGRADUATE THESIS

PERFORMANCE ANALYSIS OF LSTM ALGORITHM IN HISTORICAL DATA BASED BITCOIN PRICE PREDICTION WITH MULTI PRECIOUS METAL PRICE COMPARISON VARIABLES

MUHAMMAD DIAZ SYAHMI OKTAVIAN
NPM 22081010039

THESIS ADVISORS
Dr. Rizky Parlika, S.Kom., M.Kom
Dr. Firza Prima Aditiawan, S.Kom., M.TI

MINISTRY OF HIGHER EDUCATION, SCIENCE, AND TECHNOLOGY
UNIVERSITAS PEMBANGUNAN NASIONAL VETERAN JAWA TIMUR
FACULTY OF COMPUTER SCIENCE
INFORMATICS STUDY PROGRAM
SURABAYA
2026

APPROVAL SHEET

PERFORMANCE ANALYSIS OF LSTM ALFORITHM IN HISTORICAL DATA BASED BITCOIN PRICE PREDICTION WITH MULTI PRECIOUS METAL PRICE COMPARISON VARIABLES

By:
MUHAMMAD DIAZ SYAHMI OKTAVIAN
NPM. 22081010039

Has been defended before, and accepted by, the Board of Assessors of the Thesis Examination of the Informatics Study Program, Faculty of Computer Science, Universitas Pembangunan Nasional Veteran Jawa Timur, on Mei 12, 2026:

Approved,

Dr. Rizky Parlika, S.Kom., M.Kom
NIP. 19840518 202121 1 003 .... **(Advisor I)**

Dr. Firza Prima Aditiawan, S.Kom., M.TI
NIP. 19860523 202121 1 003 .... **(Advisor II)**

Made Hanindia Prami Swari, S.Kom., M.Cs
NIP. 19890205 201803 2 001 .... **(Head Assesor)**

Budi Mukhammad Mulyo, S.Kom., M.T
NIP. 19891118 202406 1 003 .... **(Assessor I)**

Acknowledge by,

Dean of the Faculty of Computer Science

Prof. Dr. Ir. Novirina Hendrasarie, MT.
NIP. 19681126 199403 2 001

APPROVAL SHEET

PERFORMANCE ANALYSIS OF LSTM ALFORITHM IN HISTORICAL DATA BASED BITCOIN PRICE PREDICTION WITH MULTI PRECIOUS METAL PRICE COMPARISON VARIABLES

By:
MUHAMMAD DIAZ SYAHMI OKTAVIAN
NPM. 22081010039

Approved to proceed to the Thesis Examination

Approved by,

Coordinator of Informatics Study Program
Faculty of Computer Science

Dr. Intan Yuniar Purbasari, S.Kom. MSc.

NIP. 19800602 202521 2 029

STATEMENT OF ORIGINALITY

I am the undersigned:

Student Name	:	Muhammad Diaz Syahmi Oktavian
NPM	:	22081010039
Degree Program	:	Bachelor (S1)
Study Program	:	Informatics
Faculty	:	Faculty of Computer Science

Hereby declares that this undergraduate thesis contains no part of any other scientific work that has been submitted to obtain an academic degree at any higher education institution. Furthermore, it does not contain any work or opinions previously written or published by others, except for those which are explicitly cited in this thesis and listed completely in references.

And I declare that this scientific document is free from elements of plagiarism. If in the future indications of plagiarism are found in this Thesis, I am willing to accept sanctions in accordance with the applicable laws and regulations.

Thus, I made this statement without any coercion from anyone and to be used as it should.

Surabaya, Mei 12, 2026
Declarant,

Muhammad Diaz Syahmi Oktavian
NPM. 22081010039

ABSTRACT

Student Name / NPM:	Muhammad Diaz Syahmi Oktavian/22081010039
Thesis Title:	Performance Analysis of LSTM Algorithm in Historical Data Based Bitcoin Price Prediction With Multi Precious Metal Price Comparison Variables
Supervisor:	1. Dr. Rizky Parlika, S.Kom., M.Kom. 2. Dr. Firza Prima Aditiawan, S.Kom., M.TI.

The extreme volatility of Bitcoin prices at high frequencies demands a highly responsive forecasting system. Traditionally, cryptocurrency fluctuations are solely associated with gold as a safe-haven asset; however, this approach often experiences a lagging phenomenon when responding to micro-market anomalies. This study aims to analyze the performance of the Long Short-Term Memory (LSTM) algorithm in predicting Bitcoin prices by comparing two architectures: a Bivariate scenario (utilizing Bitcoin and Gold variables) and a Multivariate scenario (integrating Multi-Precious Metal variables including Gold, Silver, Platinum, Palladium, and Rhodium). The evaluation was executed using time-series data with a 60-minute computational observation window. The experimental results indicated that the Bivariate model achieved an accuracy of 99.77% with a Mean Absolute Error (MAE) of 181.12 USD. In contrast, the Multivariate model demonstrated its superiority by increasing the accuracy to 99.84% and suppressing the MAE value to 130.24 USD (an error gap reduction of 50.88 USD). This reduction in computational error provides empirical confirmation that industrial metals (Platinum Group Metals) carry crucial predictive feature weights regarding cross-asset correlation. For operationalization, the algorithmic model was successfully implemented into a web-based Decision Support System using the Flask framework. This integrated system is capable of automating asynchronous API data fetching, facilitating interactive forecasting computation, and providing dynamic backtesting features to validate algorithmic transparency in real-time.

Keywords: Bitcoin, Crypto Price, Decision Support System, Deep Learning, LSTM, Multi-Precious Metal, , Web Dashboard.

ACKNOWLEDGEMENTS

All praise and gratitude to Allah SWT for all His grace, guidance, and blessings bestowed upon the author, enabling the successful completion of this thesis entitled *"Performance Analysis of LSTM Algorithm in Historical Data-Based Bitcoin Price Prediction with Multi-Precious Metal Price Comparison Variables"*. Therefore, the author would like to express the deepest gratitude to:

1. Prof. Dr. Ir. Novirina Hendrasarie, M.T., as the Dean of the Faculty of Computer Science, Universitas Pembangunan Nasional "Veteran" Jawa Timur.
2. Dr. Intan Yuniar Purbasari, S.Kom., M.Sc., as the Head of the Informatics Study Program, Faculty of Computer Science, Universitas Pembangunan Nasional "Veteran" Jawa Timur.
3. Dr. Rizky Parlika, S.Kom., M.Kom., as the Primary Advisor, who always spared his time to provide guidance, in-depth technical discussions, and invaluable advice during the preparation of this thesis.
4. Dr. Firza Prima Aditiawan, S.Kom., M.TI., as the Co-Advisor, for all the input, thoroughness, and guidance that helped perfect this research.
5. Made Hanindia Prami Sari, S.Kom., M.Cs., as the First Examiner, for all the corrections and input to improve this research.
6. Budi Mukhammad Mulyo, S.Kom., M.Kom., as the Second Examiner, for all the input and directions to improve this research.
7. All Lecturers of the Informatics Study Program, who have provided extraordinary knowledge, insights, and experiences during the author's college years.
8. My beloved mother, Nur Hazizah, S.Pd., who never tires of praying, giving her blessing, and showing infinite love in every step the author takes. To my late father, Abdul Hamid, who is always a role model and the author's biggest reason to persevere in completing this education; may Allah SWT always place him in the most glorious place by His side. And to Om Fendi, who has sincerely accompanied and provided full support that is highly meaningful for the author in making important decisions.

9. The mentors and professional colleagues at Saygon Park (PT. Duta Putri Bersaudara). Thank you for the guidance, technical direction, and collaborative work environment that indirectly shaped the author's critical thinking and problem-solving skills to this day.
10. My fellow comrades and best friends who were always there to exchange ideas, share grievances, and strengthen each other in facing various obstacles during college and the preparation of this final project.
11. Titis Fitria Hartini, who always provides extra encouragement, understanding, and constantly accompanies the author's learning process.
12. All parties whom the author cannot mention one by one, who have contributed no matter how small for the smooth completion of this thesis.

The author realizes that there are still many shortcomings in the preparation of this thesis. Therefore, constructive criticism and suggestions from all parties are highly expected for the perfection of this thesis writing. Finally, with all the limitations the author possesses, it is hoped that this report can be useful for all parties in general and the author in particular.

Surabaya, Mei 12th 2026

Muhammad Diaz Syahmi Oktavian

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF NOTATIONS

Symbol		Description
x_t	:	Input data at time step t
h_{t-1}	:	Output (hidden state) from the previous time step
h_t	:	Output (hidden state) at time step t
C_{t-1}	:	Cell state from the previous time step
C_t	:	New cell state at time step t
$\tilde{C}_t$	:	Candidate value for the new cell state
f_t	:	Forget gate
i_t	:	Input gate
o_t	:	Output gate
W	:	Weight matrix
b	:	Bias vector
σ	:	Sigmoid activation function
tanh	:	Hyperbolic Tangent activation function
N	:	Total number of data samples (Samples)
T	:	Length of the time window (Time Steps)
F	:	Number of feature variables (Features)
x'	:	Data value after normalization
min(x)	:	Minimum value of the training data
max(x)	:	Maximum value of the training data
n	:	Number of testing data
Y_i	:	Actual Bitcoin price value
$\hat{Y}_i$	:	Predicted Bitcoin price value
MAE	:	Mean Absolute Error
RMSE	:	Root Mean Squared Error
MAPE	:	Mean Absolute Percentage Error