



Prediction of Telecommunication Service Providers' Stock Prices in Indonesia to Support the Digital Economy

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ABSTRACT

Telecommunication services are one of the most important aspects to support the sustainable development of the digital economy. The study aims to predict the stock price of the two largest companies in Indonesia in the telecommunications sector during the pandemic. The statistical method used to determine stock price prediction is based on Monte Carlo simulations. From the results, if the MAPE values are less than 10% are said to be accurate and can be used as consideration for investors to support telecommunications service providers in Indonesia.

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I. INTRODUCTION

In the era of globalization, developed countries use intellectuals as an economic driver through technology, creativity, science, and innovation [1]. The intensification of digital economy development leads to a higher transformation of the telecommunications industry. The telecommunications industry in Indonesia continues to develop and shows a positive trend [2]. In 2020, the Coronavirus Disease-19 (Covid-19) pandemic in Indonesia had an impact on various sectors of life and disrupted the country's development to achieve the Sustainable Development Goals (SDG's). According to the International Monetary Fund (IMF), the economic crisis due to Covid-19 is worse than the economic crisis in 2009, and the Asian economic crisis in 1998 [3].

The telecommunications industry has a very vital role in the economic digitization process during the pandemic. The keys to corporate funding are debt and equity. The company uses funds from debt and equity to increase the company's ability to capital expenditure, project development, and company expansion [4]. In the telecommunications industry, stock prices are an indicator of the performance of the companies. The stock prediction is important to find out the

Company's performance in the future and the investors' strategy vest in the two companies.

A statistical approach that can be used to determine stock price predictions during the Covid-19 pandemic is the Monte Carlo simulation. This is because, during a pandemic, stock movements are difficult to predict due to the intense price fluctuations during that time. Therefore, the advantage of Monte Carlo simulation is that powerful in calculating the value of a variable that is dependent on a number of random input variables [5].

In this study, stock price predictions will be more specific to the stocks of telecommunications service providers in Indonesia. Thus, this study predicts the stock prices of telecommunications companies in Indonesia based on fluctuations in the stock prices of Telkom Indonesia Inc and Indosat Inc during the Covid-19 pandemic. This research is expected to help related parties in making decisions by looking at predictions of telecommunication company stock prices and minimizing losses during the Covid-19 pandemic.

II. PRELIMINARIES

A. Indonesia Telecommunications Service

One of the economic developments in Indonesia is influenced by the growth of the telecommunications industry. The telecommunications industry continues to experience growth and shows a growth trend. In Indonesia, there are various

telecommunications companies and there are two largest companies in terms of a number of users and market share; Telkom Indonesia Inc with Telkomsel and Indosat Inc with Indosat Ooredoo as prepaid SIM card products.

Telkom Indonesia Inc is a state-owned enterprise that is engaged in information and communication technology services and telecommunications networks in Indonesia [6]. In February 2022, Telkom received the first rank award for Indonesia's Most Valuable Brand 2021, where Telkom's brand valuation can exceed the value of other company brands in Indonesia [7]. Telkom's stocks are traded on the Indonesia Stock Exchange (IDX) with the code "TLKM" and the New York Stock Exchange (NYSE) with the code "TLK" [8].

Indosat Inc was established in Indonesia on November 10, 1967, as a foreign investment company providing international telecommunications services in Indonesia. Indosat or known as Indosat Ooredoo Hutchison is a telecommunications network provider company in Indonesia [9]. In early 2022, Indosat and Hutchison 3 Indonesia completed the business merger and expanded the service network [10]. Indosat's stock is traded on Indonesia Stock Exchange (IDX) with the code "ISAT" [11].

B. Monte Carlo Simulation

The definition of Monte Carlo simulation is all statistical sampling techniques used to estimate solutions to quantitative problems. Monte Carlo simulation has been applied to various fields, including; project management, transportation, computer design, finance, meteorology, biology, and biochemistry [12]. The basis of the Monte Carlo simulation is the probability element experiment using a random sample. This method is divided into 5 steps [13]:

1. Determine the probability distribution.
2. Calculate cumulative probability distribution.
3. Set a random number interval for each variable.
4. Generate random numbers.
5. Make a simulation of a series of experiments.

C. Mean Absolute Percentage Error (MAPE)

Mean Absolute Percentage Error (MAPE) is one of the most widely used measures in measuring the accuracy of estimates because it is superior in calculating scale independence and interpretability [14]. MAPE is used to calculate the total forecasting error by measuring the suitability between existing data and forecasting data. MAPE is not scale-dependent and easy to interpret, which has made it popular among industry practitioners [15]. The MAPE value can calculate by the following formula:

$$MAPE = \frac{\sum_{i=1}^n \frac{|y_i - \hat{y}_i|}{y_i}}{n} \times 100\%$$

Description:

y_i : actual value

\hat{y}_i : prediction value

n : the amount of observational data

Table 1. Mape Interpretation

MAPE Value	Interpretation
< 10%	Highly accurate forecasting
10 – 20%	Good forecasting
20 – 50%	Reasonable forecasting
> 50%	Inaccurate forecasting

Based on Table 1, MAPE satisfactorily meets at least four of the criteria but is less satisfactory in meeting the validity criterion when used in evaluating the accuracy of population forecasts [15].

III. METHODOLOGY

A. Data

In this study, the data used are stock price data from Telkom Indonesia Inc and Indosat Inc during a pandemic. The data is secondary data taken from investing.com. The data that will be simulated is in the form of daily stock price data which is taken based on the closing price of stocks on that day. The data is distributed into 7 classes

B. Research Variable

The variables used in this study are data that will be used in the Monte Carlo simulation.

Table 2. Research Variable

Variable Type	Variable Name
Continuous	Daily stock of Telkom Indonesia Inc
Continuous	Daily stock of Indosat Inc

Based on Table 2, the research variable is used to divide the prediction results with the Monte Carlo simulation, where the two data types are continuous independent. The number of each data variable is 443 and taken from March 2020 to January 2022.

C. Analysis Procedure

The steps of data analysis of this study are as follows:

1. Performing a Monte Carlo simulation
 - a. Distribute the data into several classes and create a range for each class.
 - b. Generate random numbers for prediction results.
2. Calculate the MAPE value
 - a. Accumulate the value using the MAPE formula.
 - b. Interpret the MAPE prediction value.
3. Determine which prediction results are better based on MAPE of both data

IV. MAIN RESULTS

A. Monte Carlo Simulation

1) Predicting Telkom Indonesia Inc Stock Prices

By using the steps of the Monte Carlo simulation, the following results are obtained:

- a. Distribute the data to several classes and fill the Monte Carlo probability table

**Table 3. Telkom Indonesia Inc Frequency Distribution
Table 6. Indosat Inc Prediction Results**

<i>Class</i>	<i>Median</i>	<i>Freq</i>	<i>Prob</i>	<i>Cum</i>	<i>Range</i>
2500 – 2759	2630	28	0.06	0.06	1 – 6
2760 – 3019	2890	44	0.1	0.16	6 – 16
3020 – 3279	3150	148	0.33	0.49	16 – 49
3280 – 3539	3410	147	0.33	0.82	49 – 82
3540 – 3799	3670	37	0.08	0.9	82 – 90
3800 – 4059	3930	17	0.04	0.94	90 – 94
4060 – 4319	4190	22	0.05	0.99	94 - 100

Based on Table 3, several data are obtained which are then distributed into seven classes, with the class length is 260. The median value of each class is taken as the predicted variable.

b. Generate random numbers for prediction results

Table 4. Telkom Indonesia Inc Prediction Results

<i>Date Prediction</i>	<i>Random Number</i>	<i>Prediction Value</i>
3 January 2022	96	4190
4 January 2022	91	3930
5 January 2022	87	3670
6 January 2022	53	3410
7 January 2022	64	3410
10 January 2022	88	3670
11 January 2022	98	4190

Based on Table 4, we will predict stock values for the next seven days. Then generate the random value seven times and match it with the class range to obtain prediction results. From the Monte Carlo results, we have a prediction mean 3781.

2) *Predicting Indosat Inc Stock Prices*

By using the steps of the Monte Carlo simulation, the following results are obtained:

a. Distribute the data in several classes and fill the Monte Carlo probability table

Table 5. Indosat Inc Frequency Distribution

<i>Class</i>	<i>Median</i>	<i>Freq</i>	<i>Prob</i>	<i>Cum</i>	<i>Range</i>
1000 – 2099	1550	79	0.18	0.18	1 – 18
2100 – 3199	2650	110	0.25	0.43	18 – 43
3200 – 4299	3750	4	0.01	0.44	43 – 44
4300 – 5399	4850	10	0.02	0.46	44 – 46
5400 – 6499	5950	147	0.33	0.79	46 – 79
6500 – 7599	7050	87	0.2	0.99	79 – 99
7600 – 8699	8150	6	0.01	1	99 – 100

Based on Table 5, several data are obtained which are then distributed into seven classes, with the class length is 1100. The median value of each class is taken as the predicted variable.

b. Generate random numbers for prediction results

<i>Date Prediction</i>	<i>Random Number</i>	<i>Prediction Value</i>
3 January 2022	58	5950
4 January 2022	49	5950
5 January 2022	87	7050
6 January 2022	95	7050
7 January 2022	63	5950
10 January 2022	80	7050
11 January 2022	76	5950

Based on Table 6, we will predict stock values for the next seven days. Then generate the random value seven times and match it with the class range to obtain prediction results. From the Monte Carlo results, we have a prediction mean 6421.

B. Calculating the MAPE Value

MAPE is used as a measure of comparison value between real and predicted value in percent (%).

Table 7. MAPE of Prediction Results

<i>Telkom Indonesia</i>			<i>Indosat</i>		
<i>Prediction</i>	<i>Real</i>	<i>APE</i>	<i>Prediction</i>	<i>Real</i>	<i>APE</i>
4190	4180	0.239	5950	6425	7.393
3930	4170	5.755	5950	6250	4.8
3670	4050	9.382	7050	6150	14.634
3410	4120	17.233	7050	6300	11.904
3410	4170	18.225	5950	6300	5.555
3670	4100	10.487	7050	6200	13.709
4190	4090	2.444	5950	5950	0
MAPE (%)		9.109	MAPE (%)		8.285

It can be seen from Table 7, that the MAPE value generated based on the Monte Carlo simulation on Telkom Indonesia's Inc stock is 9.1098% and Indosat's Inc stock is 8.28531%. The interpretation results for both prediction values is highly accurate forecasting because the MAPE value less than 10%

C. Determine which prediction results are better based on the MAPE of both data

Based on Table 7, the MAPE value generated by Indosat Inc stock prediction is better than Telkom Indonesia Inc. Although the two MAPE scores are both in the very accurate category, the Monte Carlo simulation can be used for predicting the stock values. It can also be concluded that the prediction results using Indosat Inc stock data are better than Telkom Indonesia Inc stock data.

V. CONCLUSION

Based on the results of the discussion, it can be concluded that the prediction of stock value data of Telkom Indonesia Inc and Indosat Inc using Monte Carlo simulation can produce very accurate estimates. This can be seen from the MAPE value generated based on the Monte Carlo simulation on Telkom Indonesia's stock value data of 9.109%, which means that the prediction results using the Monte Carlo simulation model can produce a very accurate estimate because the

MAPE value is less than 10%. Meanwhile, the MAPE value from the Monte Carlo simulation results in the prediction of Indosat's stock value of 8.285%, which means that the prediction results using the Monte Carlo simulation model can produce a good estimate because the MAPE value is less than 10%. From the two predictions, the MAPE value of the two data is less than 10%, which means that the Monte Carlo simulation can be used to predict the stock value of Telkom Indonesia Inc and Indosat Inc. This study is used for investors to make decisions in choosing stocks while supporting telecommunications service providers in the development of the digital economy in Indonesia. The hope is for investors to choose wisely which shares to invest in to increase the country's growth and achieve the Sustainable Development Goals.

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