

## Locf imputation for Astra Agro Lestari Tbk. (Indonesia) and Anadolu Group (Turkey) stock

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### Abstract

This study aims to apply time series graphs on stock of Astra Agro Lestari Tbk. and Anadolu Group with last observation carried forward (LOCF) imputation. The imputation was used because the data for the two companies had missing values on several dates. Missing value contained in the company Astra Agro Lestari Tbk. in Indonesia more than Anadolu Group in Turkey because of the difference in the number of holidays. Original data and data with complete dates are combined to form new data where missing values are seen on certain dates. The function used in the R program to form the graph is xts. However, the Date variable has a character class so it needs to be changed to the Date class. The xts function will error if the class is not changed. The modification also causes the horizontal axis of the graph to be replaced by the date. Based on the chart of stock prices and transaction volume of stock of the company Astra Agro Lestari Tbk. and Anadolu Group experienced increases, decreases, and is constant on several dates.

**Keywords:** missing value, R programming, stock prices, transaction volume.

**MSC2020:** 62M10, 91B84, 62-04

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## 1. Introduction

Astra Agro Lestari Tbk. represented Indonesia and Anadolu Group representing Turkey. Since more than 30 years ago, Astra Agro Lestari Tbk. entered the plantation industry in Indonesia. The company also operates palm oil refineries in West Sulawesi and Riau. The company has grown to become one of the largest oil palm plantations in Sumatra, Sulawesi and Kalimantan. This study used 2 stocks of companies that operate the agricultural or plantation sectors from different countries, namely Indonesia and Turkey. With stable business growth, the company conducted an Initial Public Offering (IPO) through the Indonesia Stock Exchange [1]. Meanwhile, the Anadolu Group company was founded more than 70 years ago. Until now, this company is still a powerhouse of Turkey's economy. This company focuses not only on agriculture but also 7 other fields such as health, sports, etc [2].

The stocks of Astra Agro Lestari Tbk. and the Anadolu Group in Yahoo Finance have missing values problem. This issue has been investigated by [3], [4], [5]. From a statistical point of view, this problem can be solved by imputing or deleting missing value data. However, removing missing value data is related to eliminating important information in the data. Therefore, this study uses imputation to solve it. In 2021, studies related to imputation on missing values have been carried out by [6], [7], [8], [9], [10], [11], [12], [13]. Furthermore, in 2022 studies related to this topic have been carried out by [14], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24]. In particular, this study used last observation carried forward before (LOCF) imputation because the form of stock data originating from Yahoo Finance is in the form of a time series. Also, this technique has been used by [25] to monitor air pollution. In addition, research with the topic of graphic analysis has also been published by [26], [27], [28], [29], [30].

Finally, this study aims to apply LOCF imputation to the missing value of Astra Agro Lestari Tbk. and Anadolu Group stocks then formed a time series graph of these results. The advantage of this research is to use the R version 4.1.3 program to perform the missing value technique and time series graph analysis. In addition, the chart has the date as the horizontal axis. This is certainly different when using the classic plot function in the R program. In this plot, the index on the horizontal axis is the order of the data.

## 2. Graph of Astra Agro Lestari Tbk.

We use stock data of Astra Agro Lestari Tbk. on Yahoo Finance from January 1, 2022 to May 31, 2022. The data from Yahoo Finance has been stored in the "D/JOURNAL/Journal 9" directory named AALI.JK with comma delimited (CSV) file type. Then the data is read by the R program with the "read.csv" function. The first row in the data is defined as the column/variable heading. Finally, the data is stored in the R program and named "AALI". Total series of stocks of Astra Agro Lestari Tbk. in that time range is 95. The head and tail sections of the data can be seen in Table 1 and Table 2. The upper part of the data displayed using the head function and the lower part of the data using the tail function.

```
R> AALI<-read.csv("D:/JOURNAL/Journal 9 -/AALI.JK.csv",header=T)
R> head(AALI)
R> tail(AALI)
```

Based on Table 1, the stock of Astra Agro Lestari Tbk. on 1, 2, 8 and 9 January 2022 not available. This event called a missing value. Likewise with Table 2 which has missing values at 26, 28 and 29. These dates are holidays in Indonesia. The Date variable class in stock data is still of character type, so it must be changed to a date class with the "as.Date" function where the date format in Yahoo Finance is year-month-day. Next, we generate the complete date data assuming the missing value has been solved by the seq function.

The data is in daily form following the stock data of Astra Agro Lestari Tbk. at Yahoo Finance. The date starts on January 3, 2022 because it is illogical if we generate a date from January 1, 2022 but there is no data on December 31, 2021 to solve the missing value problem on January 1 and 2, 2022. The date data is then formed into a data frame format using the data.frame function . Finally, we combine the stock data of Astra Agro Lestari Tbk. (AALI) and date using the merge function based on the “Date” variable.

Table 1. Head of Astra Agro Lestari Tbk. stock

Date	Open	High	Low	Close	Adj.Close	Volume
2022-01-03	9500	9700	9500	9575	9313.599	839600
2022-01-04	9625	9725	9525	9575	9313.599	1172900
2022-01-05	9575	9700	9550	9575	9313.599	1065700
2022-01-06	9575	9725	9575	9675	9410.869	1447700
2022-01-07	9700	10000	9675	9950	9678.361	2664600
2022-01-10	9950	10075	9825	9875	9605.409	2940400

Table 2. Tail of Astra Agro Lestari Tbk. stock

Date	Open	High	Low	Close	Adj.Close	Volume
2022-05-23	13150	13150	12300	12325	12325	3199800
2022-05-24	12325	12550	12125	12250	12250	1991700
2022-05-25	12250	12500	12000	12000	12000	1370700
2022-05-27	12050	12350	12050	12225	12225	1029600
2022-05-30	12275	12350	12200	12350	12350	917200
2022-05-31	12400	12425	12000	12000	12000	4194800

```
R> AALI$Date<-as.Date(AALI$Date,"%Y-%m-%d")
R> Date<-seq(as.Date("2022/1/3"),as.Date("2022/5/31"),"days")
R> Date<-data.frame(Date)
R> AALI<-merge(x=Date,y=AALI,by="Date",all=TRUE)
```

We use the zoo package for LOCF imputation. We have activated the package with a library function. Next, we carry out the LOCF imputation process on Astra Agro Lestari Tbk. stock data using the na.locf function. We export the results of the imputation process to the D/JOURNAL/Journal 9 directory named “AALI.LOCF”. The file has a CSV extension. So that the data and results of the imputation process are available in Table 3-Table 7. Based on these tables, the missing value has been resolved with the previous stock data (eq. (1)).

$$x_i^* = \begin{cases} \text{if complete then } x_i^* = x_i \\ \text{if missing then } x_i^* = x_{i-1} \end{cases} \quad (1)$$

where  $x_i$  i-th data.

```
R> library(zoo)
R> AALI<-na.locf(AALI)
```

```
R> write.csv(AALI,"D:/JOURNAL/Journal 9 -/AALI.LOCF.csv", row.names = FALSE)
```

Table 3. Data and result of imputed stock of Astra Agro Lestari Tbk. in January 2022

Date	Open	High	Low	Close	Adj.Close	Volume
2022-01-03	9500	9700	9500	9575	9313.599	839600
2022-01-04	9625	9725	9525	9575	9313.599	1172900
2022-01-05	9575	9700	9550	9575	9313.599	1065700
2022-01-06	9575	9725	9575	9675	9410.869	1447700
2022-01-07	9700	10000	9675	9950	9678.361	2664600
2022-01-08	9700	10000	9675	9950	9678.361	2664600
2022-01-09	9700	10000	9675	9950	9678.361	2664600
2022-01-10	9950	10075	9825	9875	9605.409	2940400
2022-01-11	9875	10200	9825	10125	9848.584	2089100
2022-01-12	10125	10200	9825	9875	9605.409	2187600
2022-01-13	9875	9975	9850	9925	9654.044	1382900
2022-01-14	9925	10000	9875	9975	9702.679	757200
2022-01-15	9925	10000	9875	9975	9702.679	757200
2022-01-16	9925	10000	9875	9975	9702.679	757200
2022-01-17	10000	10000	9700	9800	9532.456	1013500
2022-01-18	9800	9800	9575	9675	9410.869	1318200
2022-01-19	9675	9850	9600	9700	9435.187	1155100
2022-01-20	9700	9850	9700	9825	9556.774	879200
2022-01-21	9850	9975	9800	9925	9654.044	878800
2022-01-22	9850	9975	9800	9925	9654.044	878800
2022-01-23	9850	9975	9800	9925	9654.044	878800
2022-01-24	9925	10100	9850	9875	9605.409	1285600
2022-01-25	9875	9875	9575	9575	9313.599	2144300
2022-01-26	9600	9850	9500	9800	9532.456	1047200
2022-01-27	9850	9875	9675	9725	9459.504	792400
2022-01-28	9750	9825	9550	9675	9410.869	2024500
2022-01-29	9750	9825	9550	9675	9410.869	2024500
2022-01-30	9750	9825	9550	9675	9410.869	2024500
2022-01-31	9750	10200	9700	9900	9629.727	4886600

After the missing values have been resolved, then we create time series graphs is xts from the xts package. In the stock data of Astra Agro Lestari Tbk. the date is in the first column so we selected it as the horizontal axis. Consequently, the variable is still present in the data but has no name. Sometimes the numbers that appear on the graph are scientific. So, we recommend the options function where scipen is 999 to display the full number. We use the plot function to make the stock price when it opens (Open) as the main chart which has the title Stock Price of Astra Agro Letasi Tbk. Next, the highest stock price (High) represented by a red line, the lowest stock price (Low) represented by a yellow line, the stock price when closed (Close) represented by a green line, and the adjective the stock price when closed (Adj.Close). While the graph for the volume of stock transactions Astra Agro Letasi Tbk. We make different from stock prices because of differences in scale on the vertical axis. We give the graph the name Transaction Volume of Astra Agro Lestari Tbk. The graphs have been shown in Figures 1 and 2.

Table 4. Data and result of imputed stock of Astra Agro Lestari Tbk. in February 2022

Date	Open	High	Low	Close	Adj.Close	Volume
2022-02-01	9750	10200	9700	9900	9629.727	4886600
2022-02-02	9900	10075	9775	9850	9581.092	1275800
2022-02-03	9875	9875	9650	9775	9508.139	1269600
2022-02-04	9775	9800	9725	9725	9459.504	779600
2022-02-05	9775	9800	9725	9725	9459.504	779600
2022-02-06	9775	9800	9725	9725	9459.504	779600
2022-02-07	9725	10000	9725	9850	9581.092	1635800
2022-02-08	9875	10025	9875	9950	9678.361	1482600
2022-02-09	9950	10000	9800	9875	9605.409	1129300
2022-02-10	9975	10075	9925	9975	9702.679	1760200
2022-02-11	9975	10125	9850	10075	9799.949	1502600
2022-02-12	9975	10125	9850	10075	9799.949	1502600
2022-02-13	9975	10125	9850	10075	9799.949	1502600
2022-02-14	10100	10375	10075	10300	10018.81	3818700
2022-02-15	10325	11000	10300	10900	10602.43	11894300
2022-02-16	10850	11175	10800	11000	10699.7	5616900
2022-02-17	11000	11025	10900	11000	10699.7	10109000
2022-02-18	11000	11450	11000	11400	11088.78	8695200
2022-02-19	11000	11450	11000	11400	11088.78	8695200
2022-02-20	11000	11450	11000	11400	11088.78	8695200
2022-02-21	11100	11500	11100	11250	10942.87	3181800
2022-02-22	11225	11300	11000	11100	10796.97	1886900
2022-02-23	11100	11500	11100	11475	11161.73	6065600
2022-02-24	11400	11675	11000	11600	11283.32	8326800
2022-02-25	11600	11700	11300	11350	11040.14	3822700
2022-02-26	11600	11700	11300	11350	11040.14	3822700
2022-02-27	11600	11700	11300	11350	11040.14	3822700
2022-02-28	11600	11700	11300	11350	11040.14	3822700

Table 5. Data and result of imputed stock of Astra Agro Lestari Tbk. in March 2022

Date	Open	High	Low	Close	Adj.Close	Volume
2022-03-01	11525	11800	11400	11775	11453.54	5019600
2022-03-02	11825	12375	11800	12300	11964.21	6080700
2022-03-03	11825	12375	11800	12300	11964.21	6080700
2022-03-04	12550	12675	12100	12625	12280.33	5671100
2022-03-05	12550	12675	12100	12625	12280.33	5671100
2022-03-06	12550	12675	12100	12625	12280.33	5671100
2022-03-07	12625	12925	12350	12350	12012.84	3945600
2022-03-08	12350	12450	11575	11650	11331.95	7177800
2022-03-09	11650	12000	11575	12000	11672.4	4540500
2022-03-10	12000	12200	11250	11675	11356.27	5720200
2022-03-11	11650	12100	11525	11750	11429.22	4073900
2022-03-12	11650	12100	11525	11750	11429.22	4073900
2022-03-13	11650	12100	11525	11750	11429.22	4073900
2022-03-14	11750	12150	11650	11900	11575.13	5948700
2022-03-15	11900	11950	11550	11650	11331.95	2028100
2022-03-16	11675	12350	11675	12150	11818.3	5058600
2022-03-17	12275	12425	12050	12150	11818.3	2888300
2022-03-18	12150	12275	11850	12000	11672.4	4992900
2022-03-19	12150	12275	11850	12000	11672.4	4992900
2022-03-20	12150	12275	11850	12000	11672.4	4992900
2022-03-21	12000	12000	11825	11900	11575.13	2923200
2022-03-22	11850	12400	11850	12350	12012.84	6767700
2022-03-23	12350	12600	12275	12550	12207.38	3855400
2022-03-24	12550	12700	12400	12475	12134.43	1638800
2022-03-25	12475	12800	12475	12700	12353.29	4512100
2022-03-26	12475	12800	12475	12700	12353.29	4512100
2022-03-27	12475	12800	12475	12700	12353.29	4512100
2022-03-28	12800	13000	12700	12950	12596.46	2621700
2022-03-29	13000	13000	12300	12350	12012.84	4297300
2022-03-30	12350	12475	12150	12375	12037.16	1773400
2022-03-31	12400	12550	12300	12550	12207.38	1505900

Table 6. Data and result of imputed stock of Astra Agro Lestari Tbk. in April 2022

Date	Open	High	Low	Close	Adj.Close	Volume
2022-04-01	12500	12525	12250	12300	11964.21	1592700
2022-04-02	12500	12525	12250	12300	11964.21	1592700
2022-04-03	12500	12525	12250	12300	11964.21	1592700
2022-04-04	12400	12575	12150	12525	12183.06	1864200
2022-04-05	12275	12650	12275	12650	12304.65	2120600
2022-04-06	12650	12650	12300	12425	12085.79	1587000
2022-04-07	12500	12500	12200	12375	12037.16	1032200
2022-04-08	12375	12775	12325	12750	12401.92	2936300
2022-04-09	12375	12775	12325	12750	12401.92	2936300
2022-04-10	12375	12775	12325	12750	12401.92	2936300
2022-04-11	12800	12800	12550	12675	12328.97	1658100
2022-04-12	12675	13000	12600	13000	12645.1	3471700
2022-04-13	13000	13175	12675	12825	12474.87	3419300
2022-04-14	12825	13000	12800	12875	12523.51	1459500
2022-04-15	12825	13000	12800	12875	12523.51	1459500
2022-04-16	12825	13000	12800	12875	12523.51	1459500
2022-04-17	12825	13000	12800	12875	12523.51	1459500
2022-04-18	12875	13400	12875	13050	12693.73	3395600
2022-04-19	13200	13200	12550	12625	12280.33	2504800
2022-04-20	12800	12800	12325	12425	12085.79	2475100
2022-04-21	12450	13075	12450	12975	12620.78	3591600
2022-04-22	12975	13250	12975	13150	12791	4327600
2022-04-23	12975	13250	12975	13150	12791	4327600
2022-04-24	12975	13250	12975	13150	12791	4327600
2022-04-25	12775	12775	12250	12250	12250	4196800
2022-04-26	12225	12700	12025	12625	12625	4777600
2022-04-27	12800	12950	12625	12875	12875	3096900
2022-04-28	12425	12700	12025	12500	12500	4553600
2022-04-29	12425	12700	12025	12500	12500	4553600
2022-04-30	12425	12700	12025	12500	12500	4553600

Table 7. Data and result of imputed stock of Astra Agro Lestari Tbk. in May 2022

Date	Open	High	Low	Close	Adj.Close	Volume
2022-05-01	12425	12700	12025	12500	12500	4553600
2022-05-02	12425	12700	12025	12500	12500	4553600
2022-05-03	12425	12700	12025	12500	12500	4553600
2022-05-04	12425	12700	12025	12500	12500	4553600
2022-05-05	12425	12700	12025	12500	12500	4553600
2022-05-06	12425	12700	12025	12500	12500	4553600
2022-05-07	12425	12700	12025	12500	12500	4553600
2022-05-08	12425	12700	12025	12500	12500	4553600
2022-05-09	12400	12525	11800	12000	12000	3370500
2022-05-10	12000	12000	11450	11800	11800	3164900
2022-05-11	11800	12500	11800	12250	12250	2761900
2022-05-12	12350	12350	11875	12100	12100	1734000
2022-05-13	12000	12350	11925	12175	12175	2252600
2022-05-14	12000	12350	11925	12175	12175	2252600
2022-05-15	12000	12350	11925	12175	12175	2252600
2022-05-16	12000	12350	11925	12175	12175	2252600
2022-05-17	12175	12175	11950	12025	12025	1274500
2022-05-18	12100	12175	11925	11950	11950	1246900
2022-05-19	11950	12300	11750	12200	12200	2233000
2022-05-20	12400	12975	12300	12925	12925	4929000
2022-05-21	12400	12975	12300	12925	12925	4929000
2022-05-22	12400	12975	12300	12925	12925	4929000
2022-05-23	13150	13150	12300	12325	12325	3199800
2022-05-24	12325	12550	12125	12250	12250	1991700
2022-05-25	12250	12500	12000	12000	12000	1370700
2022-05-26	12250	12500	12000	12000	12000	1370700
2022-05-27	12050	12350	12050	12225	12225	1029600
2022-05-28	12050	12350	12050	12225	12225	1029600
2022-05-29	12050	12350	12050	12225	12225	1029600
2022-05-30	12275	12350	12200	12350	12350	917200
2022-05-31	12400	12425	12000	12000	12000	4194800

```
R> library(xts)
R> AALI<-xts(AALI[,-1],AALI[,1])
R> options(scipen = 999)
R> plot(AALI$Open,main="Stock Price of Astra Agro Lestari Tbk.")
R> lines(AALI$High,col="red")
R> lines(AALI$Low,col="yellow")
R> lines(AALI$Close,col="green")
R> lines(AALI$Adj.Close,col="blue")
R> plot(AALI$Volume,main="Transaction Volume of Astra Agro Lestari Tbk.")
```

Based on Figure 1, from January 3, 2022 to February 14, 2022, the stock price of Astra Agro Lestari Tbk. relatively constant. Then between February 14, 2022 and March 7, 2022, the stock price rose sharply. Until May 31, 2022, stock prices are relatively constant. This pattern is different from the transaction volume of stocks of Astra Agro Lestari Tbk (Figure 2). Between 3 January 2022 and 13 February 2022, the volume of stock transactions of Astra Agro Lestari Tbk. relatively constant. Between February 13, 2022 and February 15, 2022, transaction volume rose sharply. Then the transaction volume decreased relatively between 15 February 2022 to 30 March 2022. After that, between 30 March 2022 and 8 May 2022, the transaction volume relatively increased. A few days after that the volume of stock transactions rose and fell until May 31, 2022.

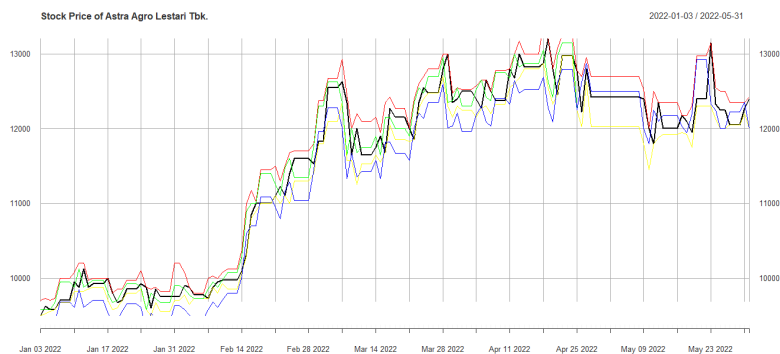


Figure 1. Stock price of Astra Agro Lestari Tbk.

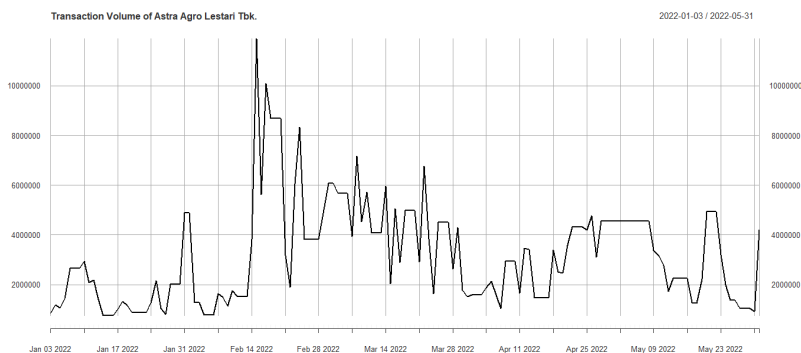


Figure 2. Transaction volume of Astra Agro Lestari Tbk.



### 3. Graph of Anadolu Group

The process for forming a time series chart for Anadolu Group stocks is actually almost the same as for Astra Agro Lestari Tbk stocks. especially in the syntax of the R program. In the process, only the data and function names are different. If previously in stocks using Astra Agro Lestari Tbk. Labeled with AALI, Anadolu Group stocks are named AGHOL. In addition, the total Anadolu Group stock series in that time span is 103. So, the data and results of imputation on Anadolu Group stocks are available in Table 8-Table 12. If the Astra Agro Lestari Tbk stock uses the Indonesian Rupiah (IDR) currency, the Anadolu Group stock uses the Turkish Lira (TRY) currency. We use the plot function to create the current stock price (Open) as the main chart which has the title Stock Price of Anadolu Group. Next, the highest stock price (High) is represented by a red line, the lowest stock price (Low) is represented by a yellow line, the stock price when closed (Close) is represented by a green line, and the adjective the stock price when closed (Adj.Close). While the graph for the volume of Anadolu Group stock transactions. we make different from stock prices because of differences in scale on the vertical axis. We give the graph the name Transaction Volume of Anadolu Group. The graphs have been shown in Figures 3 and Figure 4.

```
R> AGHOL<-read.csv("D:/JOURNAL/Journal 9 -/AGHOL.IS.csv",header=T)
R> AGHOL$Date<-as.Date(AGHOL$Date,"%Y-%m-%d")
R> Date<-seq(as.Date("2022/1/3"),as.Date("2022/5/31"),"days")
R> Date<-data.frame(Date)
R> AGHOL<-merge(x=Date,y=AGHOL,by="Date",all=TRUE)
R> library(zoo)
R> AGHOL<-na.locf(AGHOL)
R> write.csv(AGHOL,"D:/JOURNAL/Journal 9 -/AGHOL.LOCF.csv", row.names = FALSE)
R> AGHOL<-xts(AGHOL[,-1],AGHOL[,1])
R> options(scipen = 999)
R> plot(AGHOL$Open,main="Stock Price of Anadolu Group")
R> lines(AGHOL$High,col="red")
R> lines(AGHOL$Low,col="yellow")
R> lines(AGHOL$Close,col="green")
R> lines(AGHOL$Adj.Close,col="blue")
R> plot(AGHOL$Volume,main="Transaction Volume of Anadolu Group")
```



Based on Figure 3, between January 3, 2022 and January 24, 2022, Anadolu Group's stock price has been in a downward trend. Then between January 24, 2022 and January 33, 2022, the stock price rose. Then from that date until February 25, 2022, the stock price has decreased relatively. Between February 25, 2022 and March 14, 2022, the stock price is constant. Then until April 12, 2022, the stock price rose sharply. The stock price is constant between April 12, 2022 and May 10, 2022. Between May 10, 2022 and May 23, 2022, the stock price is relatively down. Then until May 31, 2022, the stock price rose again. This pattern is different from the transaction volume of Anadolu Group's stocks (Figure 4). Between January 3, 2022 and March 23, 2022, the volume of stock transactions remains relatively constant. Between March 23, 2022 and March 26, 2022, transaction volume rose sharply. Then the transaction volume decreased relatively between March 26, 2022 to May 29, 2022. After that the stock price rose until May 30, 2022 and fell slightly on May 31, 2022.

Table 8. Data and result of imputed stock of Anadolu Group in January 2022

Date	Open	High	Low	Close	Adj.Close	Volume
2022-01-03	39.98	40.14	38.5	39.78	39.50221	759159
2022-01-04	40.02	40.28	38.9	39.2	38.92625	1672170
2022-01-05	39.3	39.5	38.02	38.56	38.29073	718751
2022-01-06	38.32	39.52	37.58	39.22	38.94612	1283126
2022-01-07	39.46	39.5	38.6	38.68	38.40989	673706
2022-01-08	39.46	39.5	38.6	38.68	38.40989	673706
2022-01-09	39.46	39.5	38.6	38.68	38.40989	673706
2022-01-10	38.8	39.04	38.12	38.18	37.91338	661331
2022-01-11	38.4	38.48	37.5	37.5	37.23813	564692
2022-01-12	37.8	37.86	36.8	36.92	36.66217	699933
2022-01-13	36.92	37.88	36.56	36.56	36.30469	817837
2022-01-14	36.58	37.44	36.48	37.22	36.96008	588990
2022-01-15	36.58	37.44	36.48	37.22	36.96008	588990
2022-01-16	36.58	37.44	36.48	37.22	36.96008	588990
2022-01-17	37.42	37.86	36.98	37.02	36.76148	736576
2022-01-18	37	37.22	35.16	35.16	34.91447	691905
2022-01-19	35	36.12	34.52	36	35.7486	961717
2022-01-20	36.14	36.9	35	35.2	34.95419	890721
2022-01-21	35	35.02	34.5	34.92	34.67614	537984
2022-01-22	35	35.02	34.5	34.92	34.67614	537984
2022-01-23	35	35.02	34.5	34.92	34.67614	537984
2022-01-24	34.6	34.88	32.66	32.66	32.43193	896857
2022-01-25	32.92	33.34	31.86	32.9	32.67025	644074
2022-01-26	33.02	34.5	32.92	34.34	34.10019	554880
2022-01-27	33.98	37.18	33.68	37.18	36.92036	1227962
2022-01-28	37.16	38.36	36.1	36.24	35.98693	1259570
2022-01-29	37.16	38.36	36.1	36.24	35.98693	1259570
2022-01-30	37.16	38.36	36.1	36.24	35.98693	1259570
2022-01-31	36.78	38	36.62	37.86	37.59562	1009886

Table 9. Data and result of imputed stock of Anadolu Group in February 2022

Date	Open	High	Low	Close	Adj.Close	Volume
2022-02-01	38.1	39.48	37.88	39.48	39.2043	1265208
2022-02-02	39.76	40.16	38.2	39.38	39.105	1246992
2022-02-03	38.8	40	37.34	37.38	37.11897	1007691
2022-02-04	37.62	37.98	36.38	36.88	36.62246	682633
2022-02-05	37.62	37.98	36.38	36.88	36.62246	682633
2022-02-06	37.62	37.98	36.38	36.88	36.62246	682633
2022-02-07	36.28	36.76	35.5	36.24	35.98693	986659
2022-02-08	36.3	36.9	35.68	35.86	35.60958	929172
2022-02-09	36	37.6	35.84	36.72	36.46357	1544727
2022-02-10	36.9	37.56	36.54	36.56	36.30469	852650
2022-02-11	36.4	36.92	35.9	36.6	36.34441	603538
2022-02-12	36.4	36.92	35.9	36.6	36.34441	603538
2022-02-13	36.4	36.92	35.9	36.6	36.34441	603538
2022-02-14	36.3	36.3	35.18	35.4	35.15279	534201
2022-02-15	35.38	36.38	35.28	35.62	35.37125	586831
2022-02-16	35.8	37.26	35.8	36.52	36.26497	795140
2022-02-17	36.54	36.88	35.72	35.78	35.53014	715749
2022-02-18	35.98	36.44	35.62	36	35.7486	498340
2022-02-19	35.98	36.44	35.62	36	35.7486	498340
2022-02-20	35.98	36.44	35.62	36	35.7486	498340
2022-02-21	36	36.7	35.3	35.58	35.33154	564318
2022-02-22	35.2	35.2	34.12	34.88	34.63643	487544
2022-02-23	34.9	35.56	34.82	35.02	34.77545	324362
2022-02-24	32	33.02	31.52	32	31.77654	910912
2022-02-25	32.5	33.3	31.16	32.82	32.59081	944647
2022-02-26	32.5	33.3	31.16	32.82	32.59081	944647
2022-02-27	32.5	33.3	31.16	32.82	32.59081	944647
2022-02-28	31.62	32.58	31.04	32.32	32.0943	1009910

Table 10. Data and result of imputed stock of Anadolu Group in March 2022

Date	Open	High	Low	Close	Adj.Close	Volume
2022-03-01	32.4	32.98	31.62	32.02	31.7964	771477
2022-03-02	32	33.14	31.58	32.96	32.72983	760428
2022-03-03	33.04	33.42	32.32	32.5	32.27305	920924
2022-03-04	32	32.54	31.58	31.9	31.67723	695074
2022-03-05	32	32.54	31.58	31.9	31.67723	695074
2022-03-06	32	32.54	31.58	31.9	31.67723	695074
2022-03-07	31.86	32.26	30.68	31.7	31.47863	733080
2022-03-08	31.56	32.58	31.42	31.78	31.55807	606825
2022-03-09	31.8	32.48	31.8	32.14	31.91556	609869
2022-03-10	32.36	32.88	31.72	31.78	31.55807	722184
2022-03-11	31.82	32.62	31.64	32.6	32.37235	659444
2022-03-12	31.82	32.62	31.64	32.6	32.37235	659444
2022-03-13	31.82	32.62	31.64	32.6	32.37235	659444
2022-03-14	32.7	34.58	32.68	34.22	33.98103	973249
2022-03-15	34.22	34.38	33.5	33.54	33.30578	569081
2022-03-16	33.72	35.08	33.72	34.3	34.06047	933876
2022-03-17	34.46	35.56	34.46	34.94	34.696	1045478
2022-03-18	34.94	35.38	34.64	34.64	34.3981	886758
2022-03-19	34.94	35.38	34.64	34.64	34.3981	886758
2022-03-20	34.94	35.38	34.64	34.64	34.3981	886758
2022-03-21	34.82	35	34.2	34.5	34.25908	954625
2022-03-22	34.5	34.76	34.34	34.44	34.19949	851916
2022-03-23	34.54	34.56	33.7	33.8	33.56397	764274
2022-03-24	33.9	34.16	33.68	33.68	33.44481	6138629
2022-03-25	33.86	36.8	33.82	36.2	35.94721	3012158
2022-03-26	33.86	36.8	33.82	36.2	35.94721	3012158
2022-03-27	33.86	36.8	33.82	36.2	35.94721	3012158
2022-03-28	36.98	37.94	36.9	37.24	36.97995	1949301
2022-03-29	37.48	38.42	37.34	37.34	37.07924	2614632
2022-03-30	37.4	37.88	36.9	37.08	36.82106	1165920
2022-03-31	37.26	37.56	36.4	36.64	36.38413	1084283

Table 11. Data and result of imputed stock of Anadolu Group in April 2022

Date	Open	High	Low	Close	Adj.Close	Volume
2022-04-01	36.66	38.72	36.34	38.3	38.03254	2314398
2022-04-02	36.66	38.72	36.34	38.3	38.03254	2314398
2022-04-03	36.66	38.72	36.34	38.3	38.03254	2314398
2022-04-04	38.64	39.4	38.16	38.48	38.21129	1762316
2022-04-05	39.7	40.16	39.28	39.98	39.70081	2507162
2022-04-06	39.96	40.7	39.42	39.52	39.24402	1848915
2022-04-07	39.54	39.8	39.2	39.3	39.02556	847297
2022-04-08	39.38	40.42	38.72	39.06	38.78724	2260350
2022-04-09	39.38	40.42	38.72	39.06	38.78724	2260350
2022-04-10	39.38	40.42	38.72	39.06	38.78724	2260350
2022-04-11	39.18	39.88	39.08	39.6	39.32346	1555987
2022-04-12	39.92	42.66	39.38	42.56	42.26279	3918211
2022-04-13	42.6	42.9	40.62	41.04	40.75341	2176882
2022-04-14	41.22	41.98	41.08	41.22	40.93215	908450
2022-04-15	41.24	41.76	40.5	41.16	40.87257	973017
2022-04-16	41.24	41.76	40.5	41.16	40.87257	973017
2022-04-17	41.24	41.76	40.5	41.16	40.87257	973017
2022-04-18	41.46	41.7	40.76	41.06	40.77327	1140655
2022-04-19	41.26	42.4	40.46	41.26	40.97187	1881393
2022-04-20	41.3	42.16	40.94	41.7	41.4088	1237048
2022-04-21	42.04	42.18	41.4	41.4	41.11089	1073274
2022-04-22	41.38	42	39.42	39.6	39.32346	1199609
2022-04-23	41.38	42	39.42	39.6	39.32346	1199609
2022-04-24	41.38	42	39.42	39.6	39.32346	1199609
2022-04-25	39.6	40.08	38.56	40.04	39.76039	996733
2022-04-26	40.4	40.64	38.72	39.02	38.74751	1061956
2022-04-27	39.48	39.72	38.9	39.3	39.02556	743507
2022-04-28	39.6	39.9	38.96	39.4	39.12486	655767
2022-04-29	39.68	41	39.26	41	40.71368	833799
2022-04-30	39.68	41	39.26	41	40.71368	833799

Table 12. Data and result of imputed stock of Anadolu Group in May 2022

Date	Open	High	Low	Close	Adj.Close	Volume
2022-05-01	39.68	41	39.26	41	40.71368	833799
2022-05-02	39.68	41	39.26	41	40.71368	833799
2022-05-03	39.68	41	39.26	41	40.71368	833799
2022-05-04	39.68	41	39.26	41	40.71368	833799
2022-05-05	41.48	41.68	40.96	41.22	40.93215	1130816
2022-05-06	40.9	41.94	40.78	41.46	41.17047	920432
2022-05-07	40.9	41.94	40.78	41.46	41.17047	920432
2022-05-08	40.9	41.94	40.78	41.46	41.17047	920432
2022-05-09	41.64	42.18	40.8	40.98	40.69383	644233
2022-05-10	41.2	41.28	40.92	41.1	40.81298	103737
2022-05-11	39.6	39.7	37.94	38.3	38.03254	1309541
2022-05-12	38.58	38.64	37	37.3	37.03952	858874
2022-05-13	37.7	38.08	37.5	37.52	37.25799	500498
2022-05-14	37.7	38.08	37.5	37.52	37.25799	500498
2022-05-15	37.7	38.08	37.5	37.52	37.25799	500498
2022-05-16	37.58	37.66	36.78	36.78	36.52316	645155
2022-05-17	37	37.22	35.94	35.96	35.70888	664456
2022-05-18	36.08	36.3	35.5	35.54	35.29182	546709
2022-05-19	36.08	36.3	35.5	35.54	35.29182	546709
2022-05-20	35.52	35.84	34.62	34.62	34.37824	413857
2022-05-21	35.52	35.84	34.62	34.62	34.37824	413857
2022-05-22	35.52	35.84	34.62	34.62	34.37824	413857
2022-05-23	34.98	35.92	34.7	35.28	35.03363	508357
2022-05-24	35.46	35.94	35.2	35.28	35.03363	426902
2022-05-25	35.68	35.7	35.02	35.34	35.34	264622
2022-05-26	35.38	36.44	35.38	36	36	505278
2022-05-27	36.1	36.8	35.4	35.46	35.46	531831
2022-05-28	36.1	36.8	35.4	35.46	35.46	531831
2022-05-29	36.1	36.8	35.4	35.46	35.46	531831
2022-05-30	37.64	39	37.64	39	39	2255590
2022-05-31	39.4	39.96	38.22	39.96	39.96	1698178

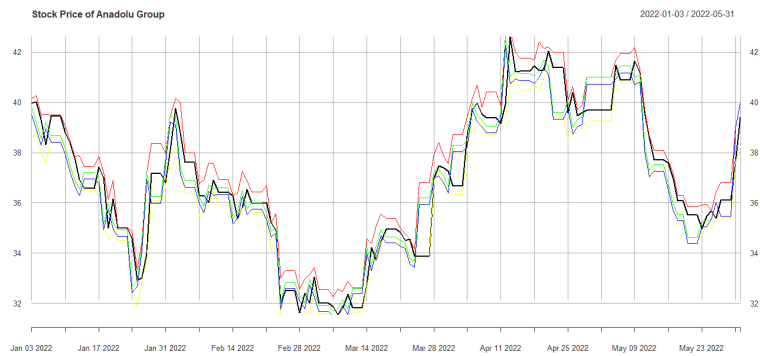


Figure 3. Stock price of Anadolu Group

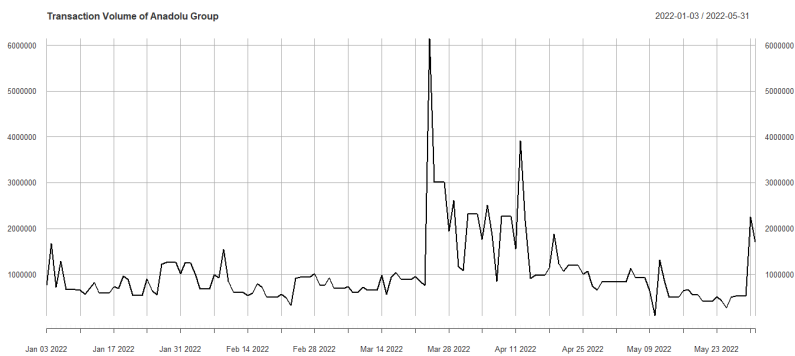


Figure 4. Transaction volume of Anadolu Group

#### 4. Conclusion

Stock data comes from Yahoo Finance, especially on stocks of Astra Agro Lestari Tbk. and Anadolu Group have missing values on several dates. Total missing value in stocks of Astra Agro Lestari Tbk. more than Anadolu Group because there are more vacation schedules in Indonesia than Turkey. This becomes a problem if you directly form a time series graph because the time must be sequential. This missing value problem has been solved by imputing LOCF where if on a certain date there is a missing value, it is imputed with the previous lag data. We modified the stock data of Astra Agro Lestari Tbk. and Anadolu Group so that the horizontal axis on the time series graph is not only based on the order of the data but the date of the data. Based on the chart of stock prices and transaction volume of stocks of the company Astra Agro Lestari Tbk. and Anadolu Group experienced increases, decreases, and is constant on several dates. These factors need to be researched in the future.

In addition, stocks in other countries related to agriculture also need to be examined to see whether stock price movements and stock transaction volumes have global or local influences. Then this research still uses their respective currencies where Astra Agro Lestari Tbk. using Indonesian Rupiah (IDR) and Anadolu Group using Turkish Lira

(TRY). So, we recommend converting the stock price of Astra Agro Lestari Tbk. and Anadolu Group into Dollars (USD), Euros (EUR), or other currencies and then forms a graph that compares the two based on the same category. For example, the stocks of Astra Agro Lestari Tbk. when open with Anadolu Group stocks when open (Open) and so on. Another alternative is to standardize the Z-score technique on the two stocks based on techniques in statistics.

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