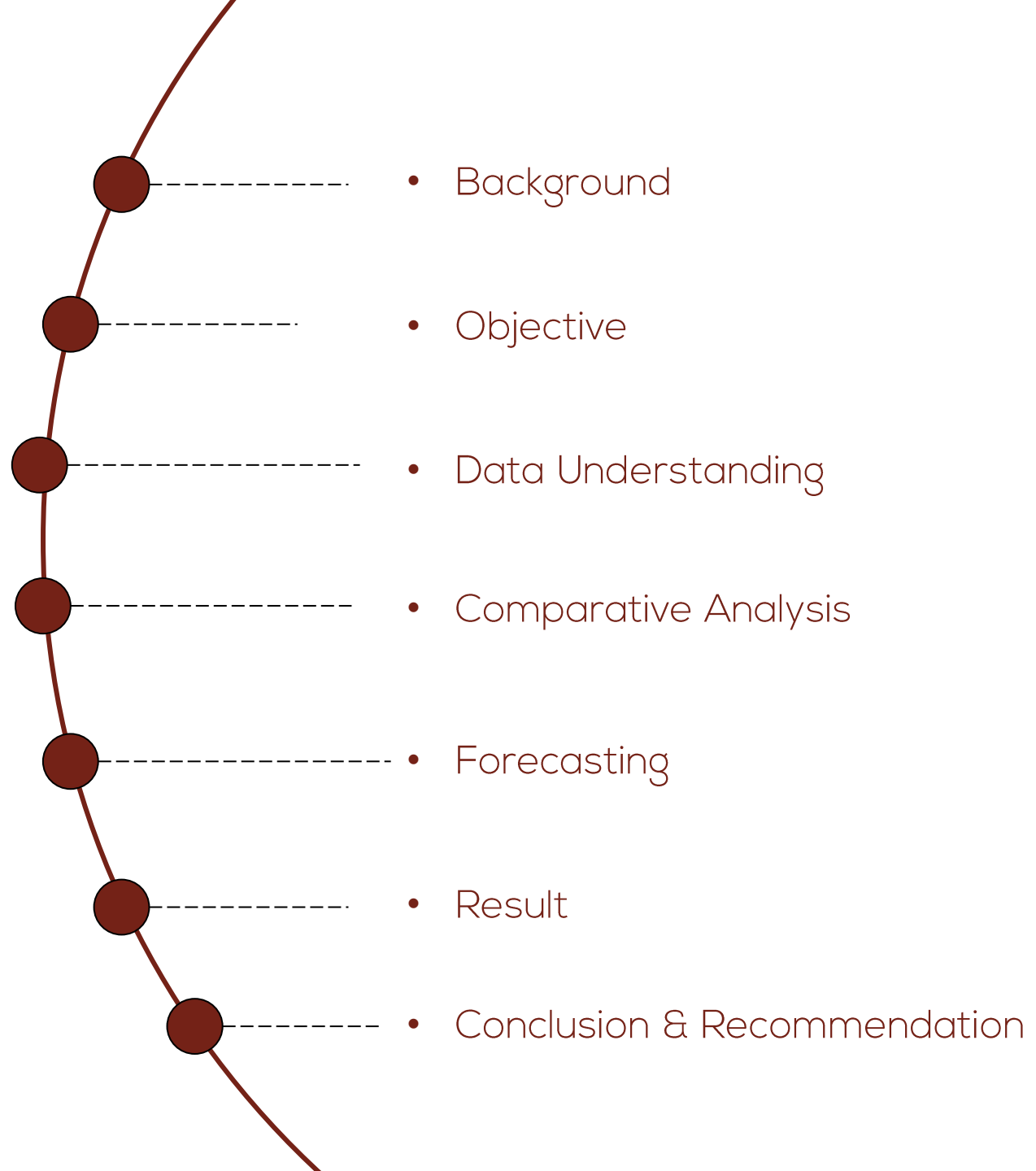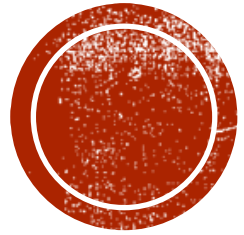# STOCK PRICE COMPARATIVE ANALYSIS AND FORECASTING WITH LSTM

Final Project by **Achmad Luckyta Fasyni**

PROJECT BACKGROUND

A stock is the small chunk of ownership in the company

Stock price reflects the net evaluation of the company and an insight into its performance.

These stocks are traded on exchanges and their prices are constantly changing due to their demand and supply in the market.

- If a stock is in high demand and low in supply i.e. more people want to buy it and fewer people are willing to sell it then the price for the stock will go up.

- If the stock is in low demand and high on supply which means more people are ready to sell it but fewer people are willing to buy it then its prices go down.

The stock prices going up and down is an iterative process and repeated.

This volatility of stock makes investors nervous while investing in a company. So to understand the risk associated with it there must be a proper analysis of stock before buying it.

In trading stocks, investor is interested in **making profitable stock trades with minimal risk**. So when an investor buy a stock, he want to be fairly certain that the price will increase. He will buy stock when the market opens, and sell it when the market closes.
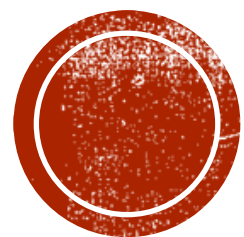
OBJECTIVES

to compare the stock options in a certain stock market sector in order to decide the best stock to buy

to forecast the stock price behavior in order to decide the best investment period and predict the return on investment

DATA UNDERSTANDING

BLUE CHIP STOCK!!!

The dataset will be used in this project is the stock price of three companies in basic industry sector which has been categorised as blue chip:

1. TPIA (PT Chandra Asri Petrochemical Tbk)

2. ANTM (PT Aneka Tambang Tbk)

3. INTP (PT Indocement Tunggal Prakarsa Tbk)

Downloaded from https://www.kaggle.com/datasets/muamkh/ihsgstockdata

WHY BLUE CHIP STOCK?

A blue chip stock is a huge company with an excellent reputation.

- typically large, well-established, and financially sound companies.

- has operated for many years.

- has dependable earnings, often paying dividends to investors.

- has a market capitalization in the billions (>10 billions).

- generally the market leader or among the top three companies in its sector and a household name.

For all of these reasons, blue chip stocks are among the most popular to buy among investors.

4 DIFFERENT PRICES PER DAY

The dataset consists of 6 columns:

- **timestamp** : The date
- **open** : The price of the stock when the market opens in the morning
- **close** : The price of the stock when the market closed in the evening
- **high** : Highest price the stock reached during that day
- **low** : Lowest price the stock is traded on that day
- **volume** : The total amount of stocks traded on that day

STOCK OPTION 1

PT. Chandra Asri Petrochemical Tbk (TPIA)
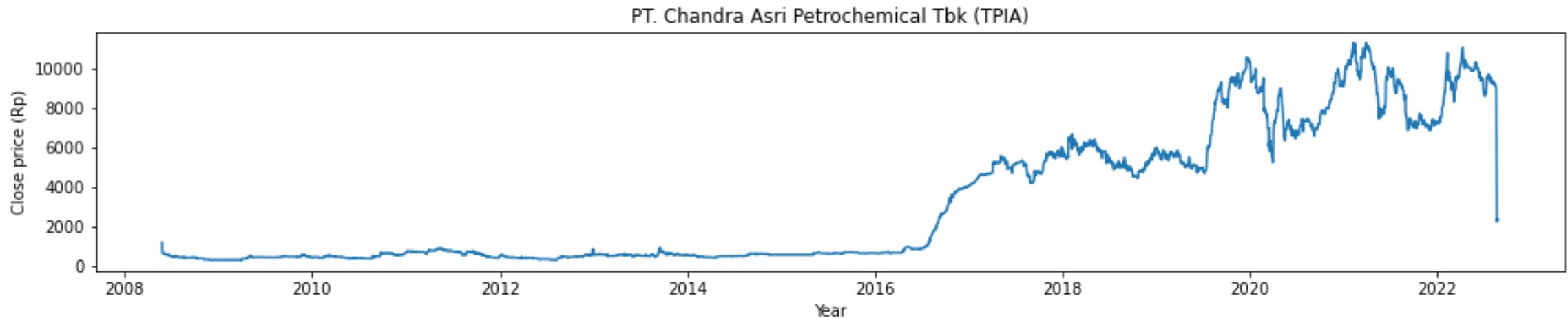
PT. Chandra Asri Petrochemical Tbk (TPIA)

▪ The suppliers of petrochemical product to various Indonesian manufacturing industries. The company produce products and resins including Monomers, Polyethylene, and Polypropylene. The Company belongs to a group of companies owned by Barito Pacific.

▪ **Recording Date**: 1905-06-10 / **2008-05-26**

`chandra.tail()`

	timestamp	open	low	high	close	volume
3715	2022-08-22	2262	2243	2268	2256	13235200
3716	2022-08-23	2260	2260	2410	2410	13266200
3717	2022-08-24	2420	2360	2420	2380	11287200
3718	2022-08-25	2380	2330	2400	2330	11812700
3719	2022-08-26	2340	2310	2350	2350	9886400

PT. Aneka Tambang Tbk (ANTM)


PT. Aneka Tambang Tbk (ANTM)

- Engaged in the mining of natural deposits also manufacturing, trading, transportation and other related services. The Company commenced its commercial operations on July 5, 1968.

- **Recording Date**: 1968-07-05 / **1997-11-27**

`antam.tail()`

|	timestamp	open	low	high	close	volume
5570	2022-08-22	2060	1980	2070	1985	140299600
5571	2022-08-23	1985	1965	2050	2030	87682800
5572	2022-08-24	2020	2000	2040	2010	54617900
5573	2022-08-25	2010	1985	2040	1995	90209100
5574	2022-08-26	1995	1955	2000	1955	135647800

PT. Indocement Tunggal Prakarsa Tbk (INTP)
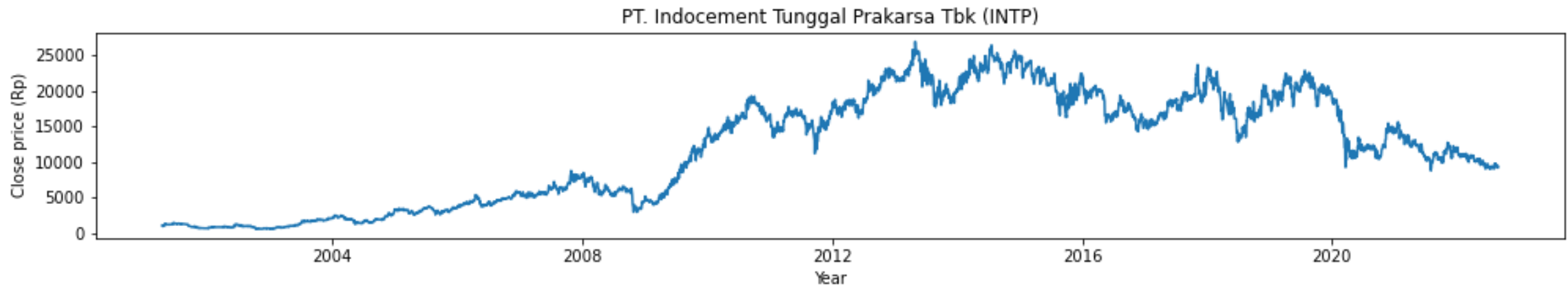
PT. Indocement Tunggal Prakarsa Tbk (INTP)

▪ Producers of cement with cement products marketed under the brand name "Tiga Roda". The Company started its commercial operations in 1985. Currently, the Company and Subsidiaries is involved in several businesses consisting of the manufacture and sale of cement (as core business) and ready-mix concrete, and aggregates and trass quarrying.

▪ **Recording Date**: 1985-01-16 / **1989-12-05**

`indocement.tail()`

	timestamp	open	low	high	close	volume
5570	2022-08-22	9200	9150	9300	9225	4176200
5571	2022-08-23	9275	9225	9450	9275	4323200
5572	2022-08-24	9275	9275	9525	9500	5760100
5573	2022-08-25	9500	9300	9525	9350	3582900
5574	2022-08-26	9350	9300	9375	9300	2149200
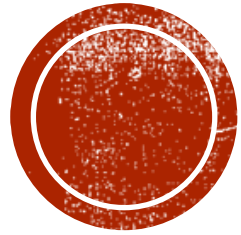
COMPARATIVE ANALYSIS

USING THE LATEST 5 YEARS DATA

THE STOCK PRICES MOVEMENT

Stock Prices of TPIA, ANTM and INTP
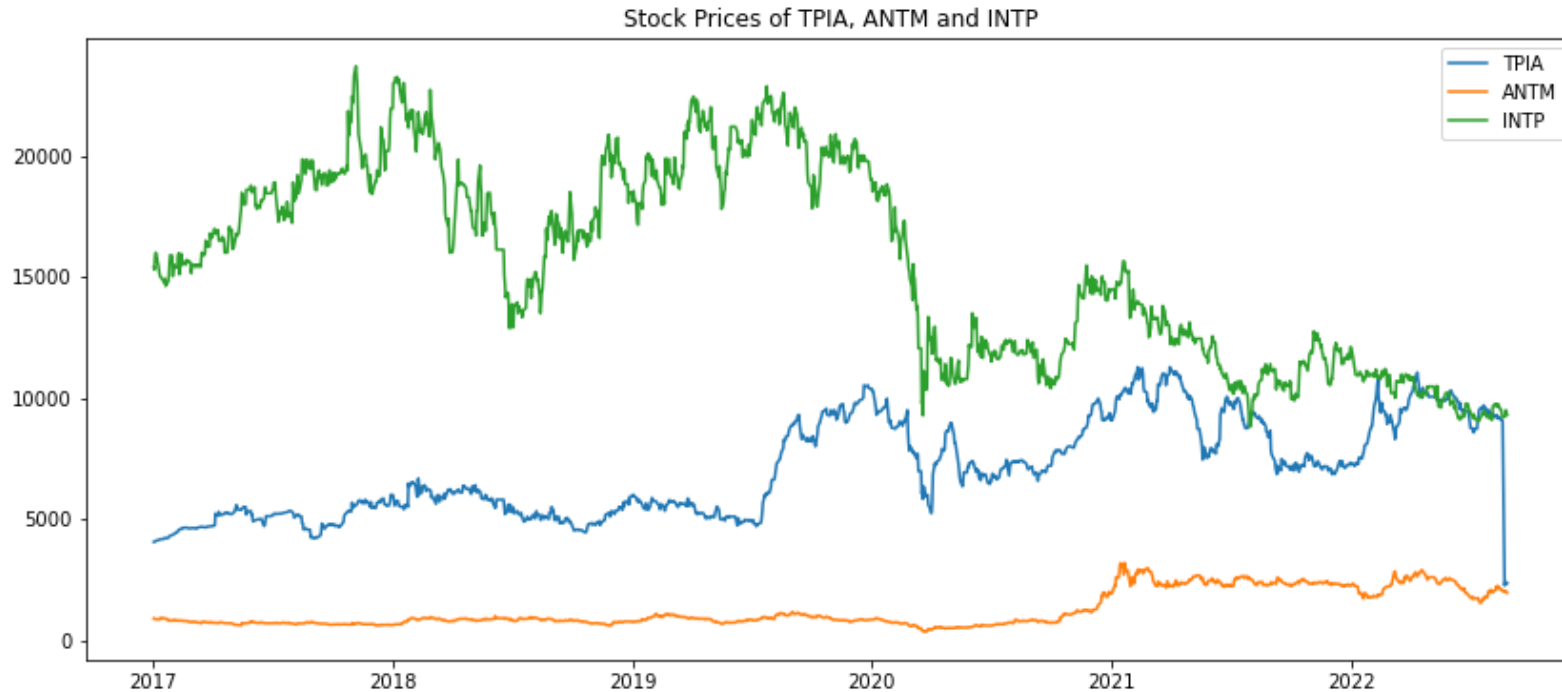
- The prices of Indocement (INTP) is generally much higher than others
- Only INTP that shows a slight declination
- TPIA and ANTM show gradual increase over the years.

The current stock price

- INTP: 9300 per share
- TPIA: 2350 per share
- ANTM: 1950 per share

(per 25-08-2022)

We clearly see that ANTM has lower price.

But again, to gain benefit of stock trading we do not need the absolute prices but its fluctuations with time.
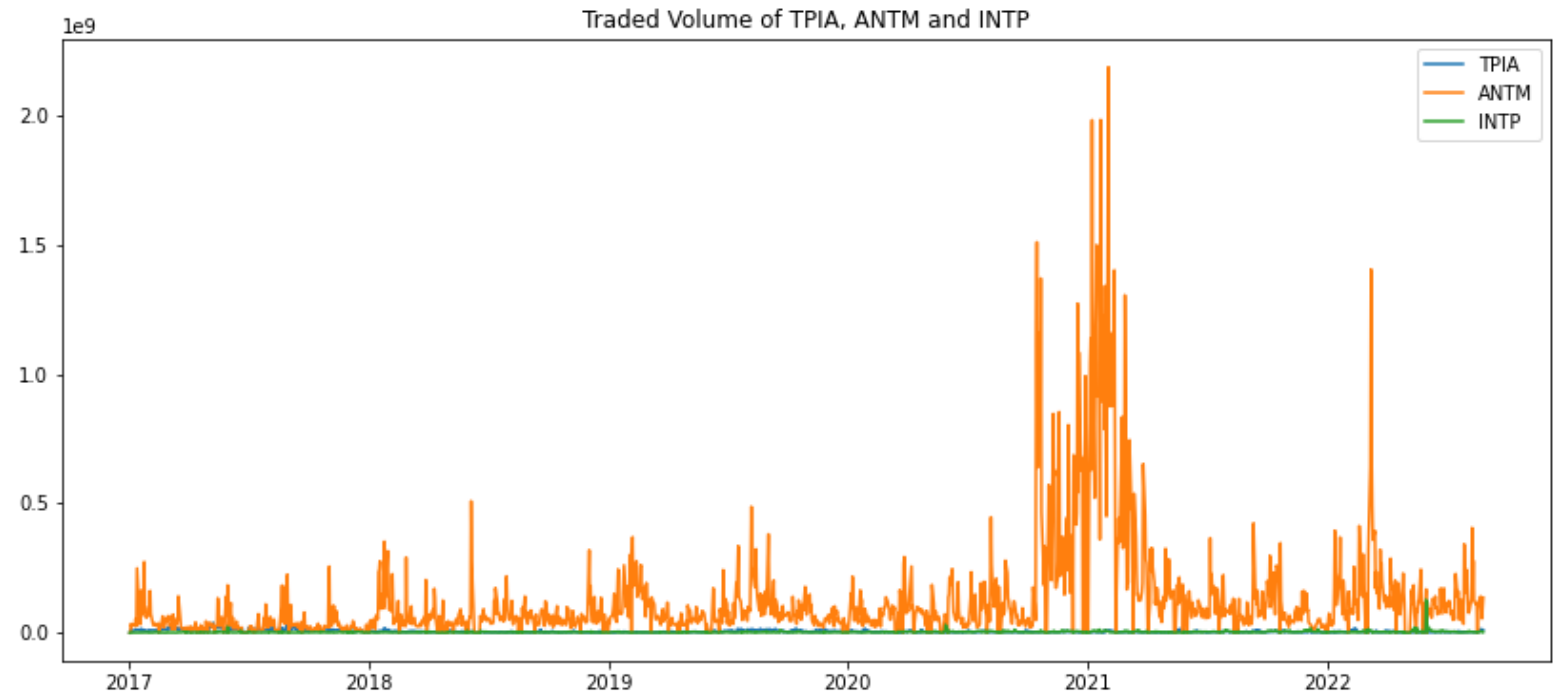
THE TRADED VOLUME

The amount of volume traded should also show the liquidity of a stock. For investor, the liquidity guarantees that the stock will always be available in a good amount for trading. There will be a good amount of people who are willing to buy and sell the stocks.
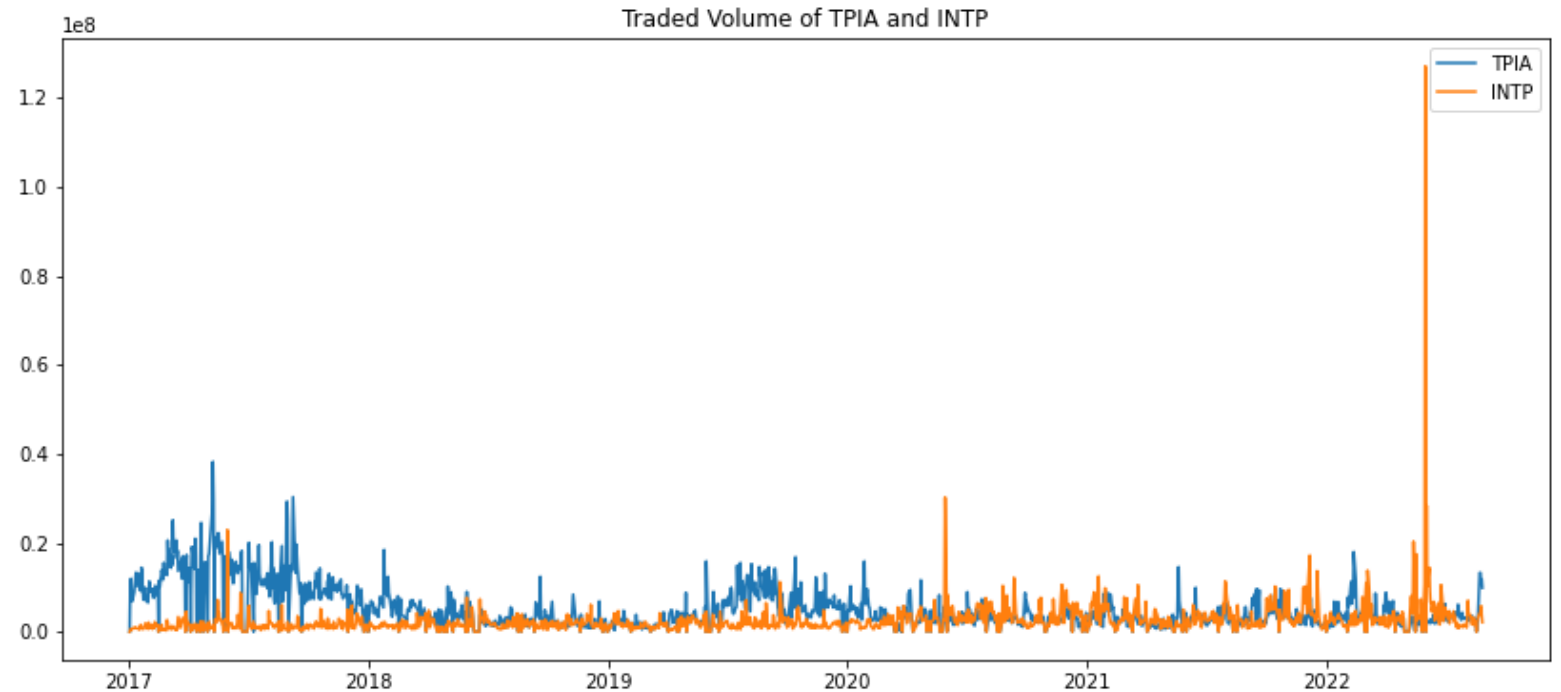
- ANTM is superior in almost every single day than INTP and TPIA. Which means ANTM is much more liquid than others.

- **In 2021, 2 billion ANTM shares traded per day!**

- Liquidity wise, **ANTM is much preferable than others.**

Traded Volume of TPIA, ANTM and INTP

HOW ARE TPIA AND INTP?

Traded Volume of TPIA and INTP

- Their traded volume are **below 20 million shares per day**.

- Around 2017 - 2020, TPIA is more liquid. In the last 2020 until now, INTP had slight favour in terms of liquidity. There is a high jump in volume traded in 2022.

- Among **TPIA and INTP have fair share of volume traded** since there is no significant difference between them overall.

MARKET CAPITALIZATION

WHAT IS THAT?

According to **Investopedia**, **market capitalization refers to how much a company is worth as determined by the stock market**. It is defined as the total market value of all outstanding shares.

To calculate a company's market cap, multiply the number of outstanding shares by the current market value of one share.

Market Cap = Traded Volume x Stock Price

Market cap is often used to determine a company's size, then evaluate the company's financial performance to other companies of various sizes.

In investing, **companies with larger market capitalization are often safer investments as they represent more established companies with generally longer history in business.**

MARKET CAPITALIZATION

Market Capitalization of TPIA, ANTM and INTP
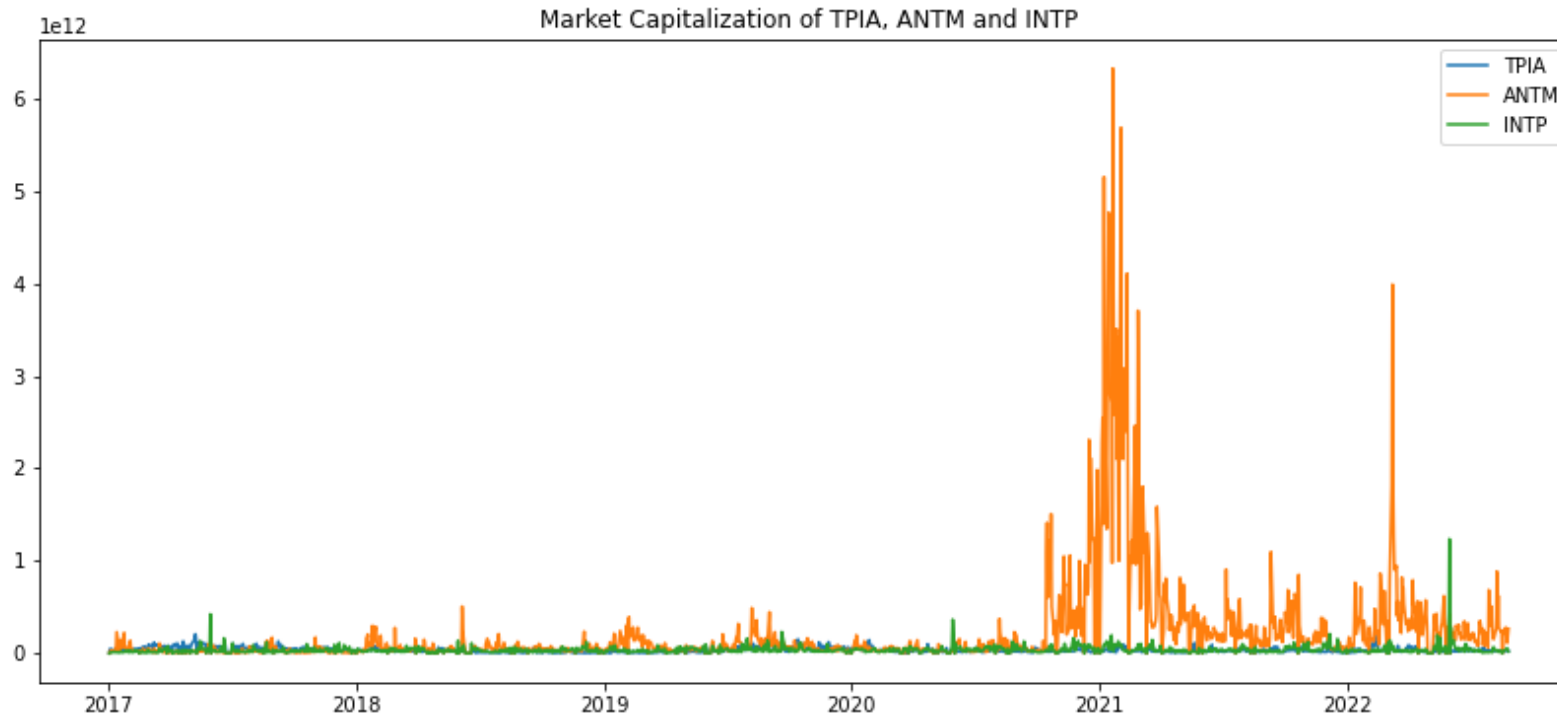
The recent superior amount of ANTM stocks traded ~ its superior market cap.

ANTM is better and safer choice than others. But not saying that others are risky choices.

ANTM Market Cap (per 25-08-2022) = 265.2 billion rupiahs!

VOLATILITY
WHAT IS THAT?

Volatility is a statistical measure of the dispersion of returns for a given security or market index.

**The higher the volatility, the riskier the security.**

Volatility is often measured from either the standard deviation or variance between returns from that same security or market index.

When the stock market rises and falls more than one percent over a sustained period of time, it is called a **"volatile" market**. An asset's volatility is a key factor when pricing options contracts.

Calculate the percentage increase in stock value. **A percentage increase in stock value is the change in stock comparing that to the previous day.** The bigger the value either positive or negative the volatile the stock is.

VOLATILITY

Volatility of TPIA, ANTM and INTP
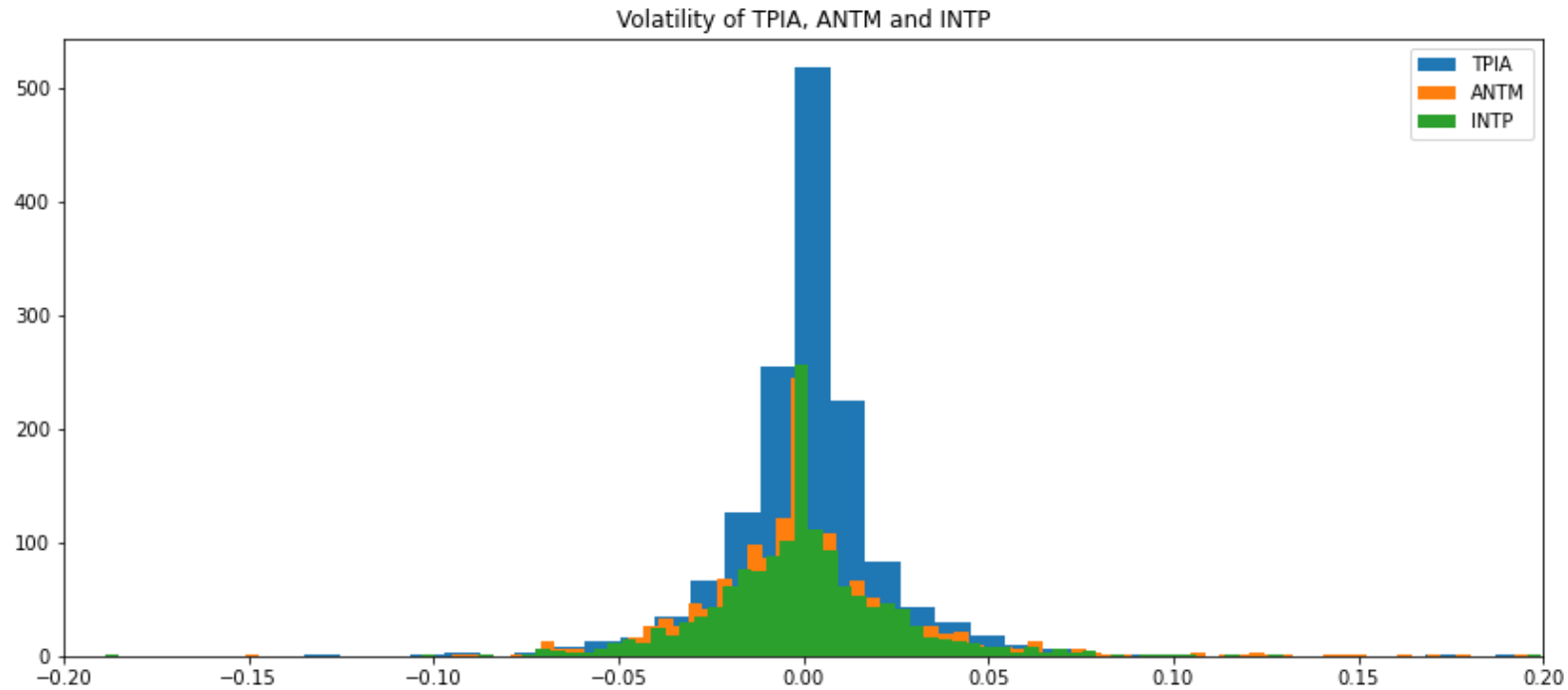
The wider, the more volatile the stock value is.

TPIA has the least volatile stock value than others. Although the differences are not quite significant.

Volatility-wise, **TPIA is a slight safer option to invest**

MOVING AVERAGE

WHAT IS THAT?

Moving Average (MA) is a stock indicator commonly used in technical analysis. To **help smooth out the price data by creating a constantly updated average price**.

The impacts of random, short-term fluctuations on the price of a stock over a specified time frame are mitigated.

Investors may choose different periods of varying lengths to calculate moving averages based on their trading objectives. **Shorter moving averages are typically used for short-term trading, while longer-term moving averages are more suited for long-term investors**.

While it is impossible to predict the future movement of a specific stock, using technical analysis and research can help make better predictions. **A rising moving average indicates that the security is in an uptrend, while a declining moving average indicates that it is in a downtrend.**

As a general guideline, **when the price is above a moving average, the trend is considered up. When the price is below, the trend is considered down.**

Trading Strategy: **Crossovers**

When **the shorter-term MA crosses above the longer term MA**, it is a **'buy signal'**, as it indicates that the trend is shifting up. Known as a **golden cross**. Meanwhile, when **the shorter-term MA crosses below the longer-term MA**, it is a **'sell signal'** , as it indicates that the trend is shifting down. Known as a **death cross**.

MOVING AVERAGE OF TPIA

Moving Average of TPIA

Legend:
- Actual Stock Price
- Moving Avg 50 Days
- Moving Avg 100 Days
- Moving Avg 200 Days
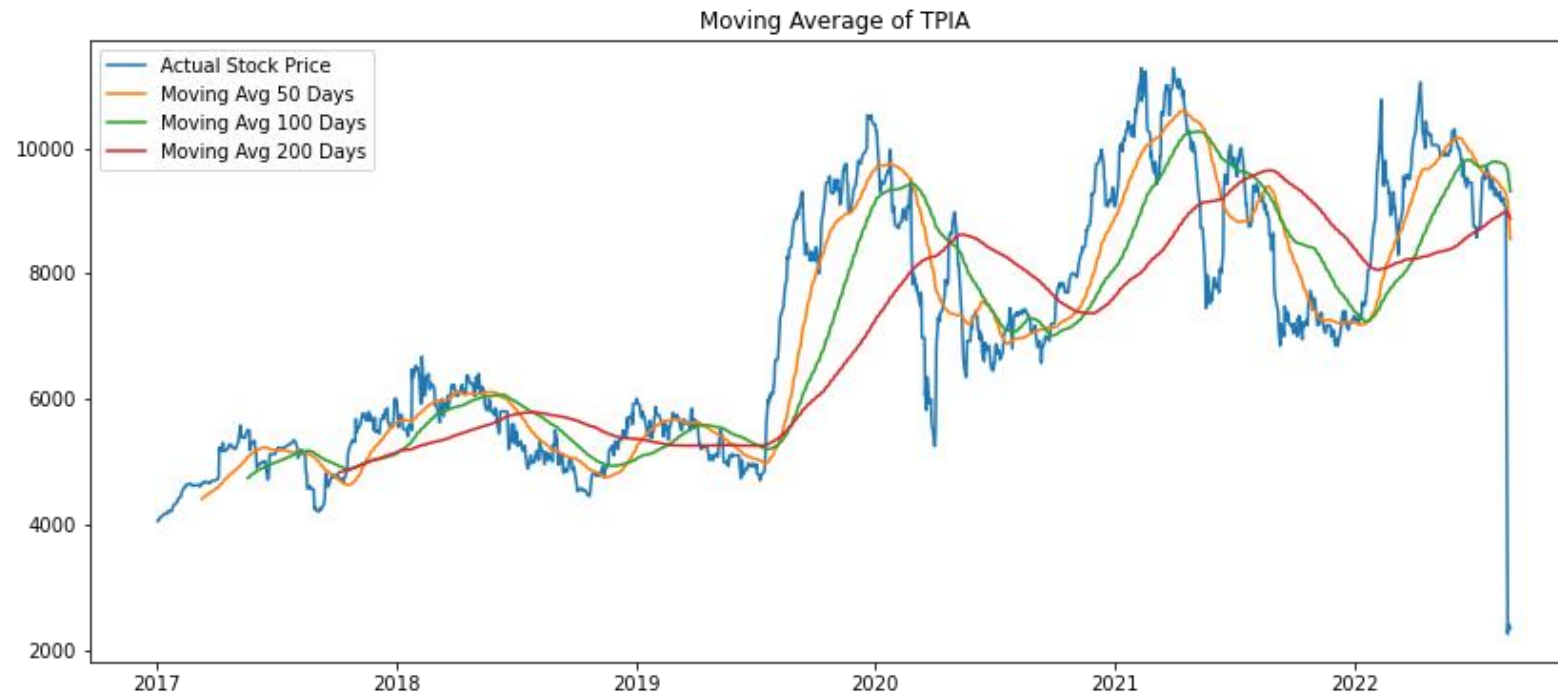
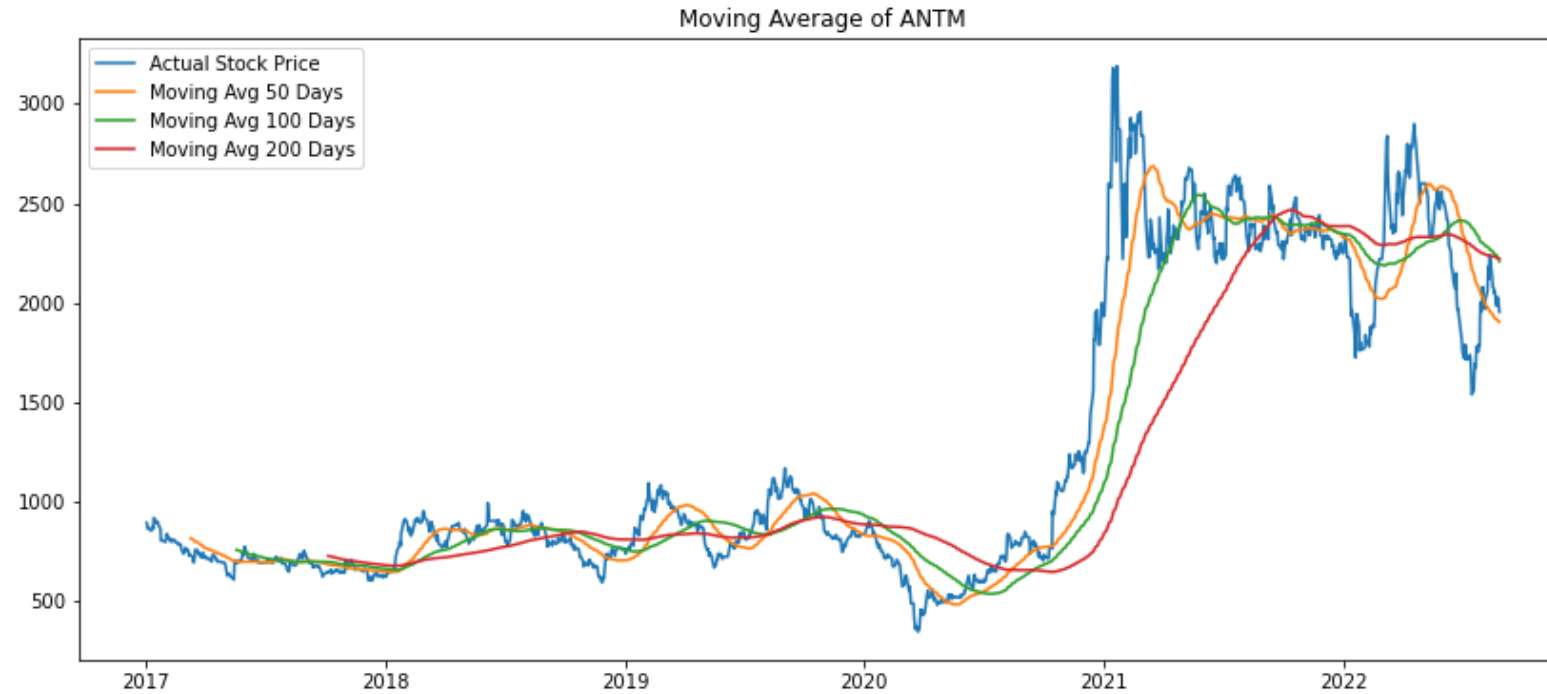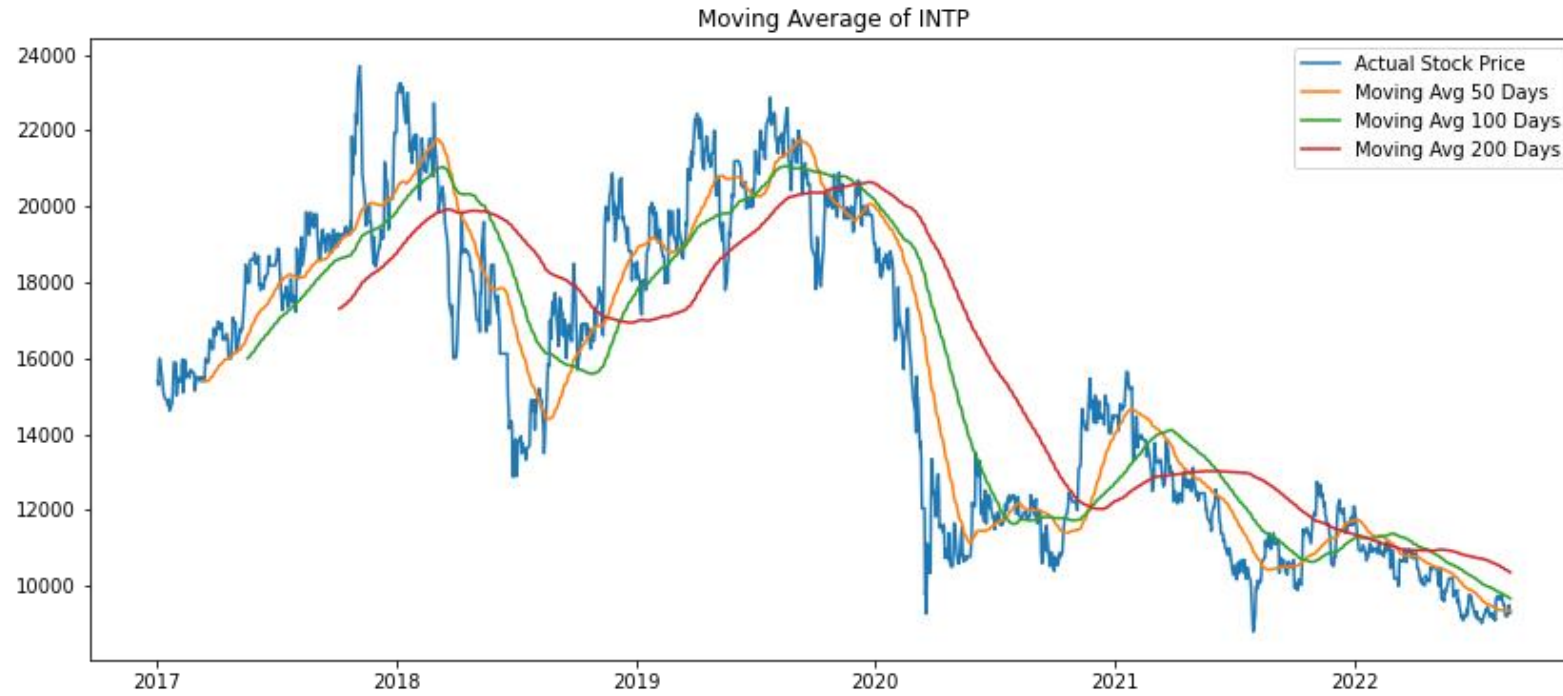**Overall, TPIA has a gradual increase/leap!**

MOVING AVERAGE OF ANTM

After going on plateau through 2017-2019, ANTM has a significant breakthrough in 2020 then successfully maintain its latest price. Giving an overall uptrend.

MOVING AVERAGE OF INTP

Moving Average of INTP

Legend:
- Actual Stock Price
- Moving Avg 50 Days
- Moving Avg 100 Days
- Moving Avg 200 Days

INTP is the only stock option shows a downtrend, which is unlikely to invest our capital here.

Considering several factors that we have dived deep in comparative analysis, such as traded volume, market capitalization, volatility, and current trend as shown by moving average, we may infer that
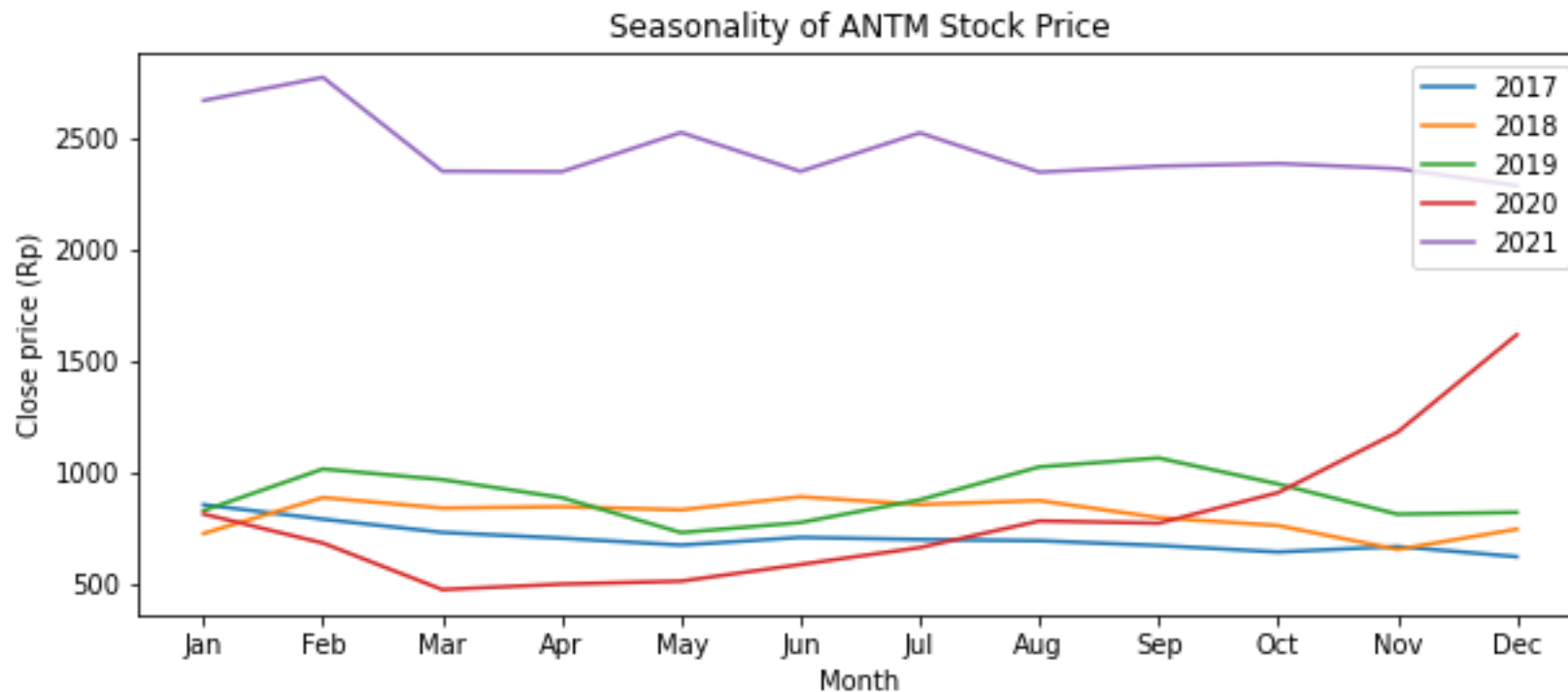
ANTM has the best overall performance

Hence, we will continue to analyze and forecast this particular stock option for our investment.
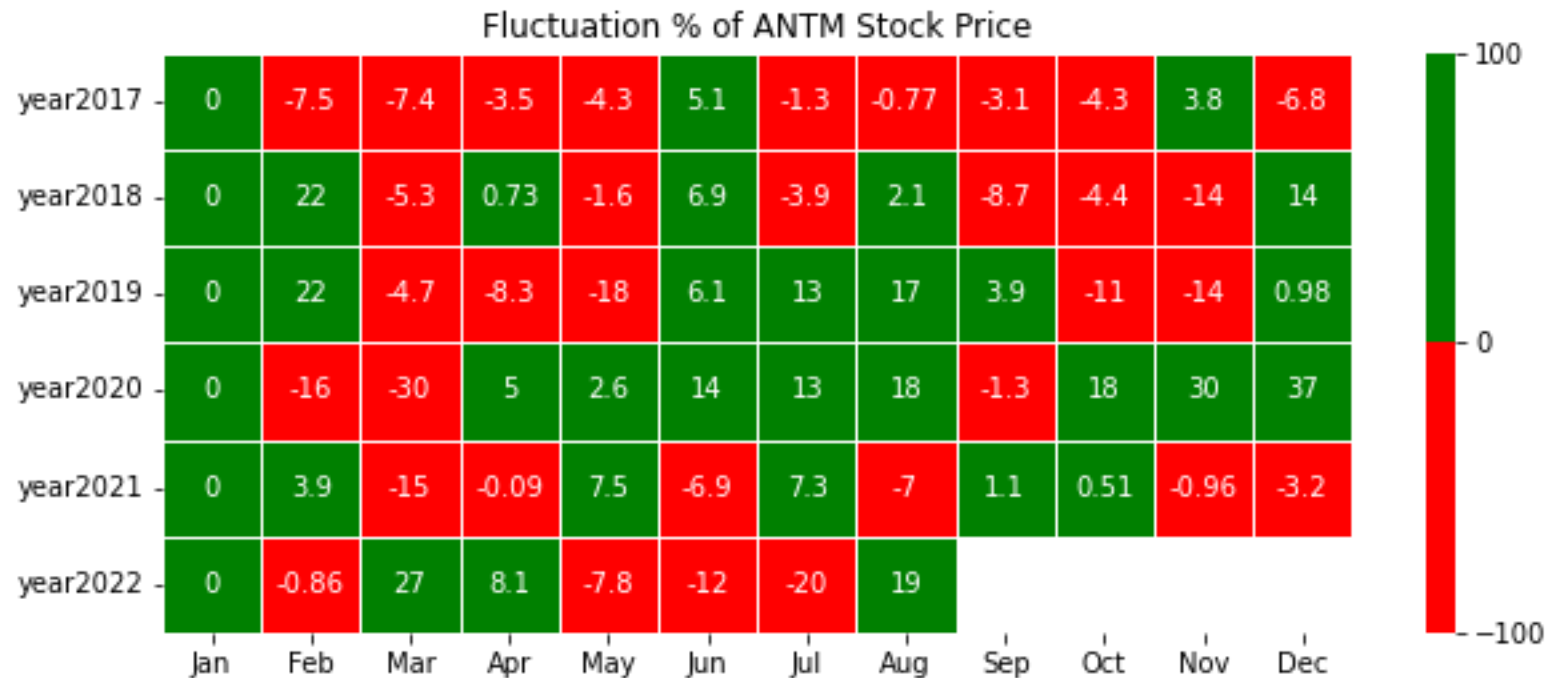
SEASONALITY (ANTM)

Seasonality refers to **predictable changes that occur over a one-year period** in a business or economy based on the seasons including calendar or commercial seasons. Seasonality can be used to help analyze stocks and economic trends.

Seasonality of ANTM Stock Price

There is no particular characteristics in each month.

SEASONALITY (ANTM)

Fluctuation % of ANTM Stock Price

|	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
year2017	0	-7.5	-7.4	-3.5	4.3	5.1	-1.3	-0.77	-3.1	-4.3	3.8	-6.8
year2018	0	22	-5.3	0.73	-1.6	6.9	-3.9	2.1	-8.7	-4.4	-14	14
year2019	0	22	-4.7	-8.3	-18	6.1	13	17	3.9	-11	-14	0.98
year2020	0	-16	-30	5	2.6	14	13	18	-1.3	18	30	37
year2021	0	3.9	-15	-0.09	7.5	-6.9	7.3	-7	1.1	0.51	-0.96	-3.2
year2022	0	-0.86	27	8.1	-7.8	-12	-20	19				

The ANTM stock almost always suffers a downtrend in March. The latest 3 years showed high risk high return situation, move within a huge drop (2020-2021) or a huge leap (2022).

In June, the stock usually has an uptrend, but 2021-2022.

SEASONALITY (ANTM)

In February, the stock casually has an uptrend, but then drop in March. The stock moves upward gradually until August. Then suffers a significant drop, before recovers towards the end of the year.

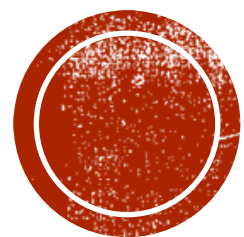Month-wise Fluctuation % of ANTM Stock Price Box Plot
(Seasonality)
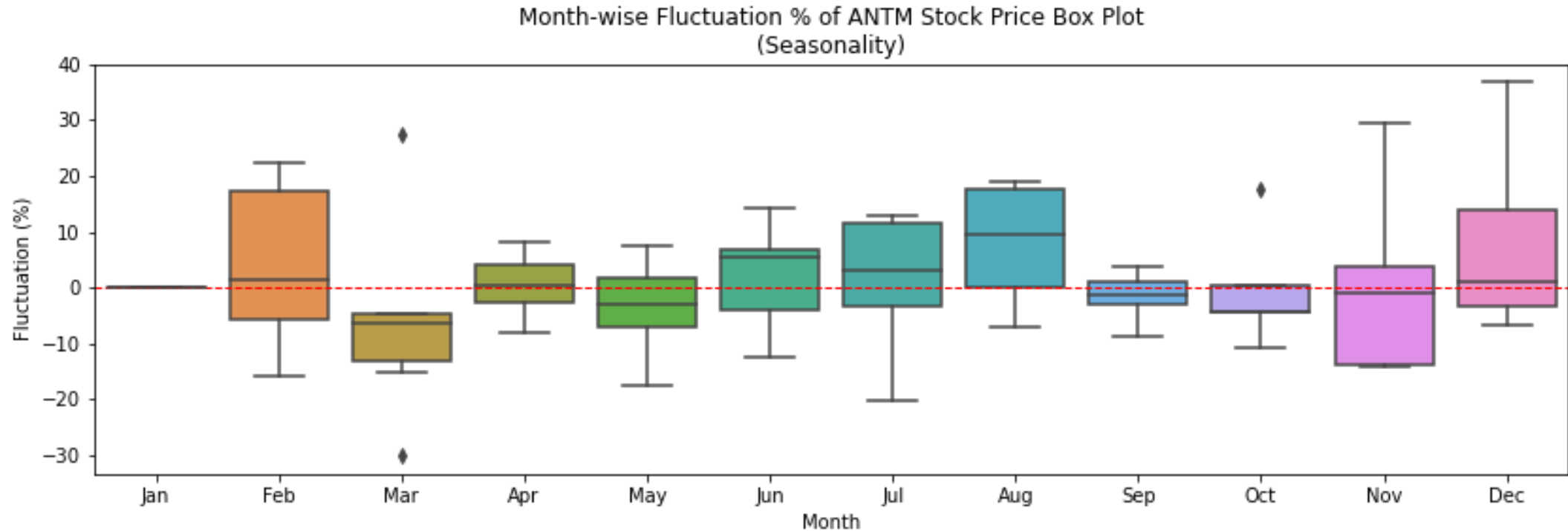
SEASONALITY (ANTM)

From the seasonality, we may infer that:

- **Good time to buy is in December** when the price starts to rise significantly after suffering slight drop in the previous months.

- **In February**, it has been seen that the price rather volatile so **we have to be aware of the market**. It may be time to **sell the share before March.**

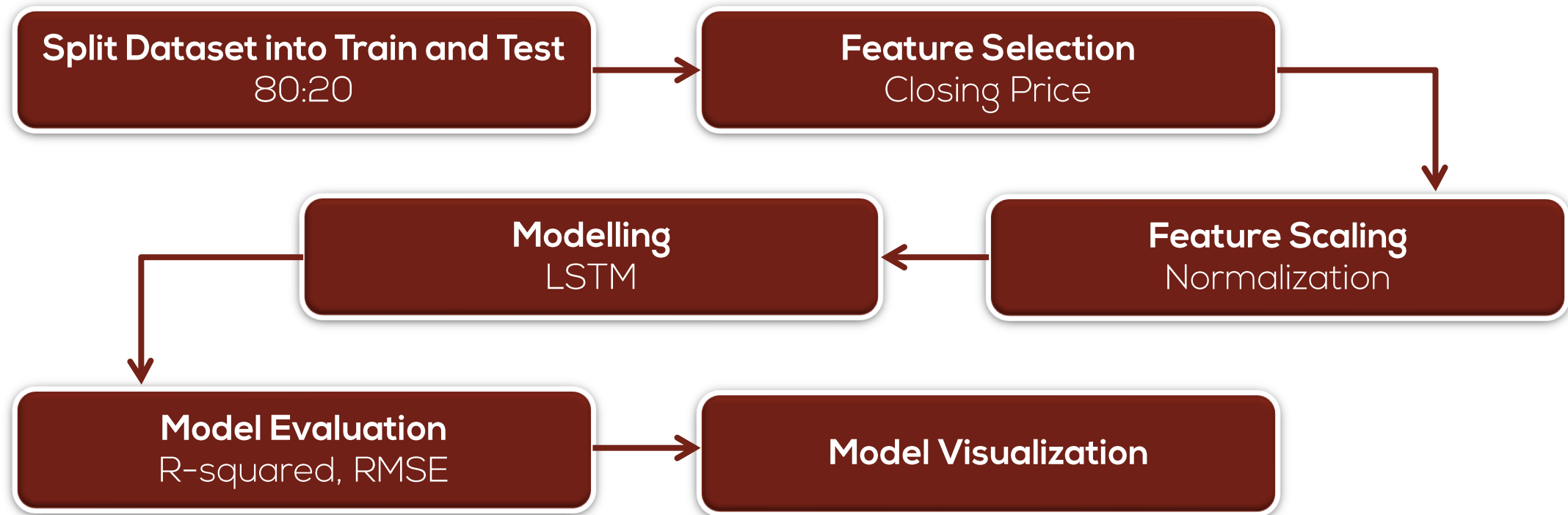- We may **buy shares in May**, in the start of an uptrend in middle of the year. Then **release it in August**.

FORECASTING

WORKFLOW

Split Dataset into Train and Test 80:20	→	**Feature Selection** Closing Price

Modelling LSTM ← **Feature Scaling** Normalization

Model Evaluation R-squared, RMSE → **Model Visualization**

MODEL FITTING
LONG SHORT TERM MEMORY

```python
from keras.models import Sequential
from keras.layers import Dense, LSTM

#building model
model = Sequential()
model.add(LSTM(units=50, return_sequences=True, input_shape=(feature_df_train2.shape[1], 1)))
model.add(LSTM(units=50, return_sequences=False))
model.add(Dense(units=25))
model.add(Dense(units=1))

#modelling
model.compile(optimizer='adam', loss='mean_squared_error')
model.fit(feature_df_train2, target_df_train1, batch_size=1, epochs=1)
```

MODEL EVALUATION
RMSE SCORED IS 113.49 RUPIAHS

Training Dataset

```
35/35 [==============================] - 3s 27ms/step
R-squared for training data is 0.981988574442001
RMSE for training data is 0.027772294481879324
Normalized RMSE for traning data is 0.027772294481879328
```

Testing Dataset

```
10/10 [==============================] - 0s 25ms/step
R-squared for testing data is 0.8386937000424876
RMSE for testing data is 113.49161714321366
Normalized RMSE for testing data is [0.08344972]
```

▪ The model has successfully predicted 98.19% rows of stock price training dataset and 83.86% rows of testing dataset.

▪ As RMSE scores for training and testing dataset are in a different scale, we use normalized RMSE. The measured RMSE for training dataset is 0.03, while **the measured RMSE for testing dataset is 0.08**. This error is considerably small and acceptable.

• The model **scored 113.49 rupiahs in RMSE**. Considering the range of closing price is around 1132.13 rupiahs, **this figure is considerably small and acceptable**.

Conclusion : Just Fit!

MODEL VISUALIZATION
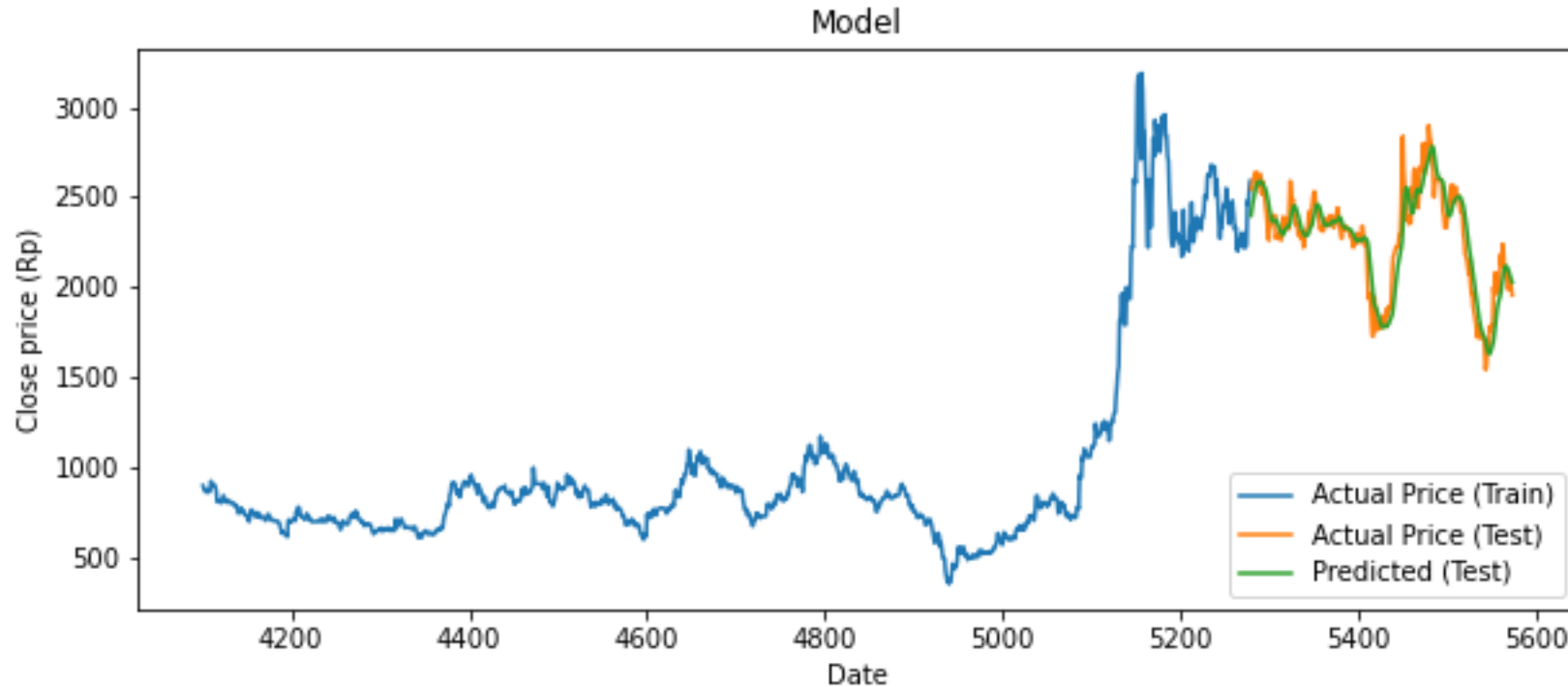
Our model can follow the trend of stock price movement very well. Either uptrend or downtrend has been successfully predicted.

TAKE A SNIP AT THE PREDICTED PRICE...

Though not perfect, **our LSTM model seems to be able to predict stock price behavior correctly most of the time**. This is okay, because again we are predicting the stock price movement, not the prices themselves.

Remember! **to gain benefit of stock trading we do not need the absolute prices but its fluctuations with time**.

HOW MUCH IS OUR PREDICTED RETURN?

Our strategy elected to **make investment on February 15th, 2022 and sell it on May 3rd, 2022**. This strategy makes two bold assumptions:

1. We were able to purchase a share at the exact price recorded as the actual historic closing price

2. We were able to sell that share just before closing at the exact price recorded as the actual historic closing price
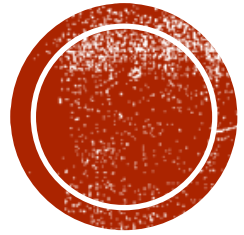

Modelled Stock Price
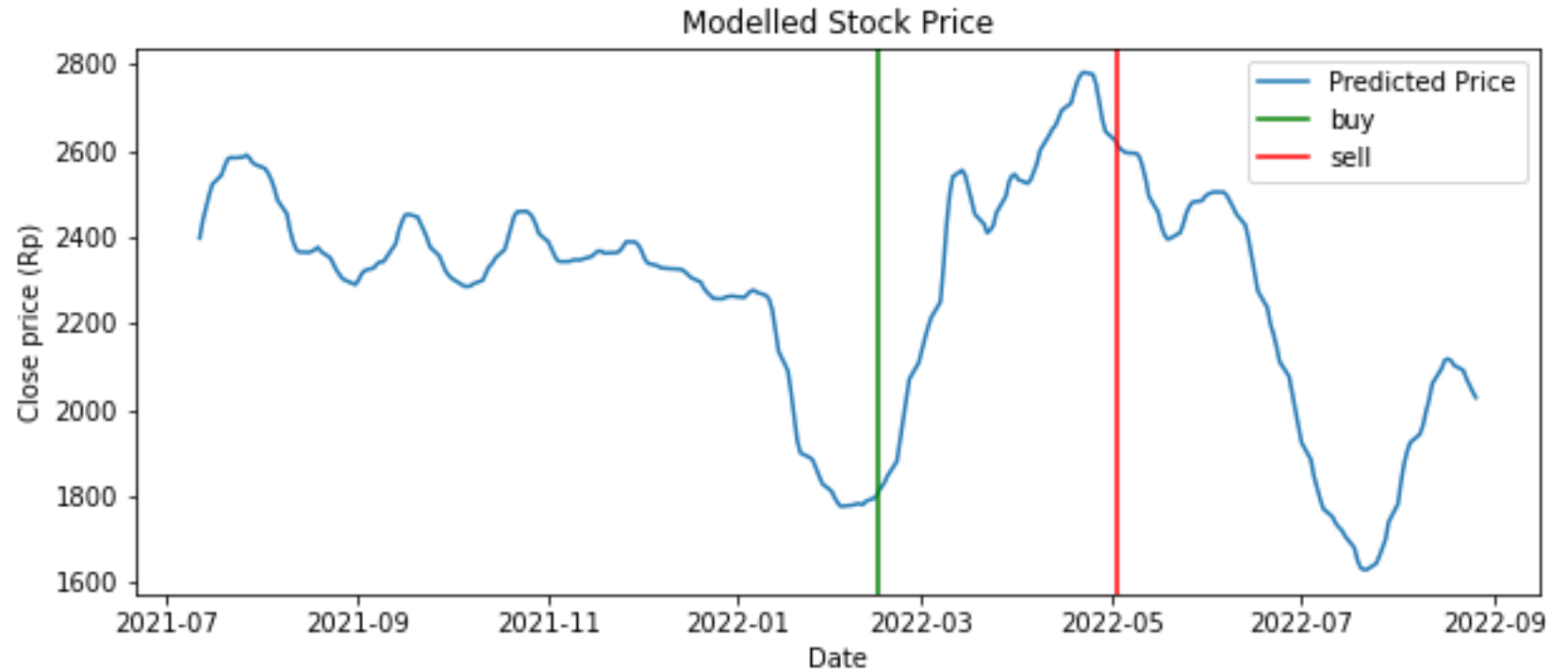
The Predicted Return on Investment : 41.662140141227596 %
The Actual Return on Investment : 38.297872340425535 %

Applying this strategy and these assumptions, **our model generated ~38.29% increase of total capital**. If our starting capital was Rp10,000,000.00, we would gain profit by Rp3,829,000.00 after the investment period.

CONCLUSION AND RECOMMENDATION

CONCLUSION (1)

The comparative analysis results in:

- Based on **the traded volume, ANTM** is the most superior. Which means ANTM is the most liquid.

- Based on **the market capitalization, ANTM** is also the best.

- Based on **the volatility** - means the swings around the stock price, **TPIA** is the least volatile though it is not in a significant manner.

- Based on the current trend, **INTP → downtrend**, **ANTM and INTP → uptrend**

ANTM has the best performance overall → Stock to invest!

CONCLUSION (2)

In our forecasting project, we use **LSTM algorithm** due to its superiority on time series modelling than other algorithm as shown in several references. The modelling results in:

- The model could **predict 83.86% of the actual ANTM stock price** available in the testing dataset.

- The model **scored 113.49 rupiahs in RMSE**. Considering the range of closing price is around 1132.13 rupiahs, **this figure is considerably small and acceptable**.

- **The model has followed the behavior of the stock price successfully**. This one is important since for gaining benefit of stock trading, we need its fluctuations with time rather than its absolute prices.

- The model could **generate ~38.29% increase of total investment capital**

RECOMMENDATION

- Learn more about the implementation of LSTM

- Conduct hyperparameters tuning for several parameters such as learning rate, neuron nodes, batch size, epoch, etc.

- Explore other algorithms, such as linear regression, random forest, ARIMA, etc. to compare each model's performance which one gives the best result.

REFERENCE

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- https://www.datacamp.com/tutorial/lstm-python-stock-market?utm_source=pocket_mylist

THANK YOU

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