

Comparative Analysis of Sentiment Analysis Using the Support Vector Machine and Naive Bayes Algorithm on Cryptocurrencies

Nicholas^a, Rudi Sutomo^b

^{a, b} Information Systems Study Program, Faculty of Engineering and Informatics, Multimedia Nusantara University, Jalan Scientia Boulevard, Gading Serpong, Tangerang, Banten 15811, Indonesia

ABSTRACT

Objective – Cryptocurrency is growing over time, even being adopted as legal money in a country out there. Besides can be used as money, cryptocurrency also can be used as digital goods to be trade and investment assets. To do some investing in cryptocurrency, there's a need to evaluate the fundamentals and sentiment of that cryptocurrency. This study aims to evaluate cryptocurrency based on the responses of the Twitter user.

Methodology – The Algorithms used in this sentiment analysis study are Support Vector Machine and Naïve Bayes because it's already proven that these two algorithms can give good accuracy and performance and use the CRISP-DM framework for the study flow.

Findings – This research predicts the sentiment for Bitcoin, Ethereum, Binance Coin, Dogecoin, and Ripple using the CRISP-DM method and using Support Vector Machine and Naïve Bayes algorithm.

Novelty – This study uses Bitcoin, Ethereum, Binance Coin, Dogecoin, and Ripple to calculate the sentiment on cryptocurrency using Rapidminer tools.

Limitations - This study uses Bitcoin, Ethereum, Binance Coin, Dogecoin, and Ripple using tools such as rapidminer from social media Twitter.

Keywords — *Cryptocurrency, Naïve Bayes, Sentiment Analysis, Support Vector Machine*

I. INTRODUCTION

Investment is an activity to invest capital directly and indirectly with the hope of getting a profit within a certain period. Investment can be made by an individual or a business entity such as a company. There are two types of investments, namely long-term and short-term investments. Short-term investments are investments made in less than three years to obtain the expected profit, while long-term investments are made in more than three years (Paranita 2015). The benefits of investing are achieving financial freedom, increasing wealth, and observing assets from inflation. Examples of investments are stocks, gold, jewelry, property, deposits, insurance, to cryptocurrencies.

Cryptocurrencies are digital assets used as a medium of exchange. Records of individual coin ownership are stored in a general ledger and balance sheet in a database consisting of a series of cryptographic mechanisms (Smith and Kumar 2019). Besides being used as a medium of exchange, cryptocurrency can also invest. Still, it is precarious because the price is very volatile (DeVries 2016).

#	Name	Price	24h %	7d %	Market Cap	Volume(24h)	Circulating Supply	Last 7 Days
1	Bitcoin BTC	\$54,658.29	-9.49%	-31.12%	\$1,032,726,499,894	\$50,500,878,912	18,836,525 BTC	
2	Ethereum ETH	\$3,581.52	-4.42%	-25.01%	\$423,794,209,089	\$22,344,168,698	117,818,231 ETH	
3	Binance Coin BNB	\$435.99	-0.08%	-18.41%	\$73,631,277,085	\$1,934,130,660	168,137,036 BNB	
4	Cardano ADA	\$2.22	-1.39%	-7.78%	\$71,394,341,435	\$2,847,815,499	32,025,787,327 ADA	
5	Tether USDT	\$0.9997	+0.11%	+0.01%	\$68,000,187,154	\$95,406,574,523	68,024,069,675 USDT	
6	XRP XRP	\$1.09	-1.95%	-15.74%	\$51,071,724,036	\$3,863,893,722	46,750,439,282 XRP	
7	Solana SOL	\$158.03	-2.80%	-16.65%	\$47,573,214,296	\$3,308,391,519	297,988,650 SOL	
8	Dogecoin DOGE	\$0.2542	-1.80%	-26.97%	\$33,731,921,862	\$5,011,806,579	131,583,358,259 DOGE	
9	USD Coin USDC	\$0.9995	-0.08%	+0.03%	\$32,409,439,766	\$3,419,023,691	32,424,548,744 USDC	
10	Polkadot DOT	\$32.37	-4.81%	-17.41%	\$32,273,130,926	\$1,766,009,537	987,579,315 DOT	

Figure 1. Top 10 Cryptocurrency with the Biggest Market Caps

Figure 1 is the picture of the ten cryptocurrencies with the largest market cap in the world, consisting of Bitcoin, Ethereum, Binance Coin, Cardano, Tether, Ripple, Solana, Dogecoin, USD Coin, and Polkadot. All of the cryptocurrencies mentioned above are suitable for investment due to their large market and relatively stable prices. However, before someone invests in cryptocurrencies, a review evaluation is needed, and research because the price of cryptocurrencies is strongly influenced by public sentiment and opinion (Brezo and Bringas 2012).

Public opinion is uncontrolled and unrestricted (Asih and Rosit 2018). In other words, public opinion can produce several kinds of traits, such as positive, negative, and neutral. In investing in cryptocurrencies, public opinion and sentiment on a large scale can affect the value of cryptocurrencies (Curse 2016). Public opinion about cryptocurrencies is widely spread on social media, one of which is Twitter.

Twitter is a social media application officially launched on July 13, 2006. The primary function of Twitter is to make a post, news, or short tweet about a news story, an expression of feelings, and an opinion through a website or application on a mobile or smartphone (Arief and Imanuel 2019).

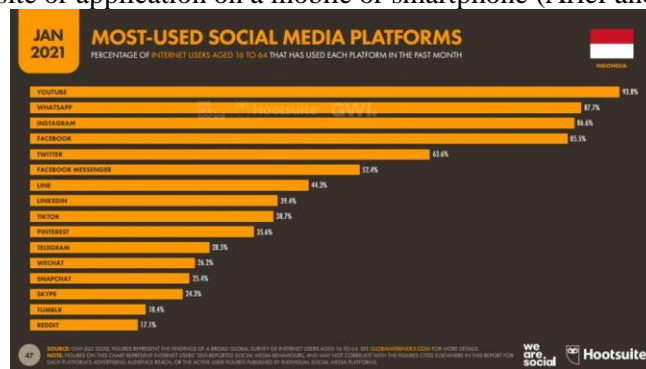


Figure 2. Most Used Social Media Platform

Figure 2 is the picture of the most use of social media in Indonesia. Twitter provides a source of information and discussion space about cryptocurrencies consisting of positive, negative, and neutral sentiments and opinions. For these sentiments and opinions to be used as helpful information, the data must be processed to conclude all Twitter users' thoughts, namely a sentiment analysis.

Sentiment analysis is a process used to detect and classify opinions and opinions by someone in the form of sentences and words on something that is currently happening and has happened. Sentiment

analysis is divided into two classifications, namely negative and positive sentiment (Arief and Imanuel 2019). In this study, sentiment analysis will be carried out using tweets data in the form of Text obtained from Twitter using the Support Vector Machine and Naïve Bayes algorithms. The two algorithms are used to make comparisons or comparisons because they have been proven and can produce reasonable classifications and accuracy values (Prasetya et al., 2021). Due to the many types of cryptocurrencies and their fluctuating prices, this sentiment analysis research was conducted to provide recommendations for cryptocurrencies with the most oversized market caps, especially Bitcoin, Ethereum, Binance Coin, DOGE, and Ripple, based on sentiment analysis that will be carried out.

II. LITERATURE REVIEW

A. Cryptocurrency

Cryptocurrency is a digital asset that has a function to be used as a medium of exchange where records of individual coin ownership are stored in ledgers and balance sheets in a database consisting of a series of cryptographic mechanisms (Smith and Kumar 2019). Cryptocurrency is a peer-to-peer (P2P) electronic financial system that allows users to make online payments sent directly from one party to another without going through financial institutions such as banks. Besides being used as a means of payment, cryptocurrency can also be used as an investment tool and a tool for trading digital assets (Abramova and Böhme 2016). Until now, there are more than 10 thousand cryptocurrencies scattered in the world (Cryptocurrency Prices, Charts And Market Capitalizations | CoinMarketCap n.d.).

B. Bitcoin

After the economic crisis that occurred in 2008, a figure called Satoshi Nakamoto created a P2P electronic system called Bitcoin (Monti and Rasmussen 2017). Bitcoin is a decentralized digital asset introduced in 2008 and launched in early 2009. According to experts, the creation of Bitcoin is the need for a financial system where one can make a transaction that is safe and fast without the presence of a third party such as a bank an institution. Institutions that monopolize people's money (Curse 2016). Since the launch of Bitcoin, there have been more than 11,000 cryptocurrencies worldwide. Cryptocurrencies can now be used to buy goods and services; for example, the country of El Salvador has adopted bitcoin as a legal medium of exchange to buy goods and services (Rejeb, Rejeb, and G. Keogh 2021). Bitcoin is believed to be an alternative to the world financial system, whose value is decreasing due to inflation; Bitcoin can also be used as a tool for investment that will be useful in the future (Bouri et al., 2017).

C. Ethereum

Ethereum is a blockchain that can be programmed with its original coin, Ether (What Is Ethereum and How Does It Work? - Coin Journal n.d.). Ethereum is a decentralized cryptocurrency with the symbol code ETH. Ether is not controlled by a government agency or an organization and can be used for investments and payments. Ethereum is the second-largest cryptocurrency after Bitcoin. Blockchain Ethereum is an open-source distributed computing platform that highlights the usefulness of Smart Contracts (scripting). One can quickly write decentralized applications at a significant rate and profit from the distribution gained from Blockchain technology (Susanto 2020).

D. Binance Coin

Binance Coin or BNB is a cryptocurrency created and owned by Binance, which is the largest cryptocurrency trading market in the world (Top Cryptocurrency Exchanges Ranked By Volume | CoinMarketCap n.d.). Binance Coin can be used for investment and as a means of payment and purchase of special cryptocurrencies on the Binance platform. Binance Coin was first launched to the public with 100 million coins, and every four months Coin Burn will be carried out, namely deleting, burning, and destroying 20% of the coins every four months (Binance Coin (BNB) - Crypto Valley Journal n.d.). This is done to maintain the price of Binance Coin and make Binance Coin step up so that the value of the cryptocurrency can increase.

E. Dogecoin

Dogecoin or DOGE is a cryptocurrency launched for a prank referred to as a meme (Chohan 2021). However, when Elon Musk, as CEO of Tesla, mentioned DOGE's name on his Twitter account, the DOGE price immediately increased by hundreds of percent. THANKS TO ELON MUSK, the DOGE cryptocurrency created as a joke, has become the 10th largest cryptocurrency market cap. DOGE coin is very suitable for investment because it has collaborated with Elon Musk is working on his Blockchain-based project.

F. Ripple

Ripple is a cryptocurrency that uses a decentralized peer-to-peer network that provides digital payment protocols to financial institutions (Widyastuti and Hermanto 2021). Ripple allows unlimited digital money transfers, whether it's sending conventional money in dollars or cryptocurrencies like Bitcoin. The network has its token, which XRP denotes. Based on market capital, XRP is currently the sixth-largest cryptocurrency (Cryptocurrency Prices, Charts And Market Capitalizations | CoinMarketCap n.d.)

G. Sentiment Analysis

Sentiment analysis is a process used to detect and classify opinions and opinions by someone in the form of sentences and words on something that is currently happening and has happened. Sentiment analysis is divided into two classifications, namely negative and positive sentiment. These two sentiments are used to predict sentiment polarity based on data that has been obtained from users or social media users. Textual sentiment analysis is widely used in the scientific area. Still, it is also often used in the business and marketing areas to find out opinions and opportunities that will arise from the public through social media (Arief and Imanuel 2019).

H. Naïve Bayes

Naïve Bayes is an algorithm commonly used to perform a statistical classification that can predict a probability of a certain class (Faid, Jasri, and Rahmawati 2019)

$$P(C_i|X) = \frac{p(X|C_i)p(C_i)}{P(X)}$$

X = Data with unknown class

C_i = Hypothesis data X Is a specific class

p(C_i|X) = hypothesis probability based on condition (posterior probability)

p(C_i) = hypothesis probability (prior probability)

p(X|C_i) = probability based on condition on the hypothesis

p(X) = probability of C_i

I. Support Vector Machine

Support Vector Machine is a standard algorithm often used to perform classification and regression. The Support Vector Machine algorithm has a fundamental principle in linear classification; namely, classification cases can be separated linearly and nonlinearly by adding the kernel concept (Azis, Tangguh Admojo, and Susanti 2020). The hyperplane maximizes the margin and distance between different data classes. The data will then be made into two classifications, namely 1 for positive and -1 for negative.

J. CRISP – DM

The cross-Industry Standard process or CRISP-DM is a standard that is commonly used in conducting a data mining process that is used to solve a general problem starting from a particular business to research on a problem. CRISP - DM has six stages of work, namely (Suhanda, Kurniati, and Norma 2020):

1. Business Understanding phase The first stage, or Business Understanding Phase, is a phase used to understand the core of activity through the point of view of doing a business. In this phase, what will be done is to determine the goals, strategies, and overall needs in achieving the goals to be addressed

- (Putra, Johan, and Kaburuan 2019).
2. Data Understanding phase The second stage or Data Understanding Phase is the phase to collect the various data needed to study the data to be understood, which will later be carried out in research (Putra, Johan, and Kaburuan 2019)
 3. The data preparation phase The third phase, or Data Preparation Phase, is the phase used to prepare data and select variables to be used in the research that will be used (Putra, Johan, and Kaburuan 2019).
 4. Modeling phase The fourth phase, or Modeling Phase, is used to select and determine the technique of the model based on predetermined objectives (Putra, Johan, and Kaburuan 2019).
 5. Evaluation phase The fifth phase or evaluation phase is the phase used to evaluate the model used in the study to ensure that the selected model will have the expected level of quality and efficiency (Putra, Johan, and Kaburuan 2019).
 6. The deployment phase The sixth phase, or Deployment Phase, is the phase used to provide an overview or visualization of the research report that will be made (Putra, Johan, and Kaburuan 2019).

III. RESEARCH METHODOLOGY

A. Business Understanding

This study aims to find the order of cryptocurrencies based on the classification of positive sentiments consisting of Bitcoin, Ethereum, Binance Coin, DOGE, and Ripple. This study will also compare classification algorithms to find the best performance of the classification algorithm, which consists of the Support Vector Machine and Naïve Bayes algorithms.

B. Data Understanding

At this stage, Text Mining will be carried out on Twitter social media using an application called Rapidminer. The data collected through Twitter social media is regarding the cryptocurrencies Bitcoin, Ethereum, Binance Coin, DOGE, and Ripple. This Text Mining process is carried out once a week, starting from August 1, 2021, to August 22, 2021, because the target data to be collected has been achieved. The data is targeted at 7500 because the previous research used as a reference using 3000 data; this study uses 7500 data so that the results obtained are more accurate.

C. Data Preparation

At this stage of research, the data that has been previously collected will be processed and cleaned so that the data is suitable for use. This stage consists of 3 processes, namely:

1) Data Union

The previously collected data will be combined for each coin in this process.

2) Data Cleansing

I. Remove URL

Removing all websites and links in the Text

II. Remove Non-Alphabet

Removing all non-alphabet letters in the Text

III. Remove RT

Removing all RT in the Text

IV. Remove Duplicate

Remove any duplicate data

3) Data Labelling

I. Extract Sentiment

Using the VADER algorithm to assign a score or value to a Tweets data that has previously passed the Data Union and Data Cleansing stages.

II. Labelling Data

Give a label to the data that has previously been given a score or value. A positive label is given to data with a positive score, a negative label to data with a negative score, and a neutral label to data with a score of 0.

III. Remove Netral Sentiment

Eliminating data with a neutral label because, in this study, there were only two types of classification, namely positive and negative.

D. Modeling

In sentiment analysis, a classification algorithm model will be chosen at this stage, namely the Support Vector Machine and Naïve Bayes algorithms. Confusion Matrix is used to calculate the accuracy and precision of the algorithm.

E. Evaluation

At this stage, the calculations using the Confusion Matrix will be obtained, consisting of accuracy, precision, and recall. The results of each Confusion Matrix from the Support Vector Machine and Naïve Bayes classification algorithms will be compared with cryptocurrencies such as Bitcoin, Ethereum, Binance Coin, DOGE, and Ripple.

F. Deployment

At this stage, visualization in the form of a Pie Chart and Bar Chart will be displayed of all the data obtained and the results of the classification and performance comparison of the Support Vector Machine and Naïve Bayes algorithms.

IV. RESULTS AND DISCUSSION

A. Business Understanding Phase

In the first phase of this research, five cryptocurrencies with the largest market cap have been determined, namely Bitcoin, Ethereum, Binance Coin, DOGE, and Ripple, to be used as good assets for investing. The five coins will be sorted from the best to the worst for investment based on the sentiment analysis carried out in this study.

B. Data Understanding Phase

Text Mining will be carried out on the Rapidminer application in the second phase of this research. The following is collecting twitter data which consists of 5 cryptocurrencies, namely Bitcoin, Ethereum, Binance Coin, DOGE, and Ripple. The following are the processes and results at the Data Understanding stage:

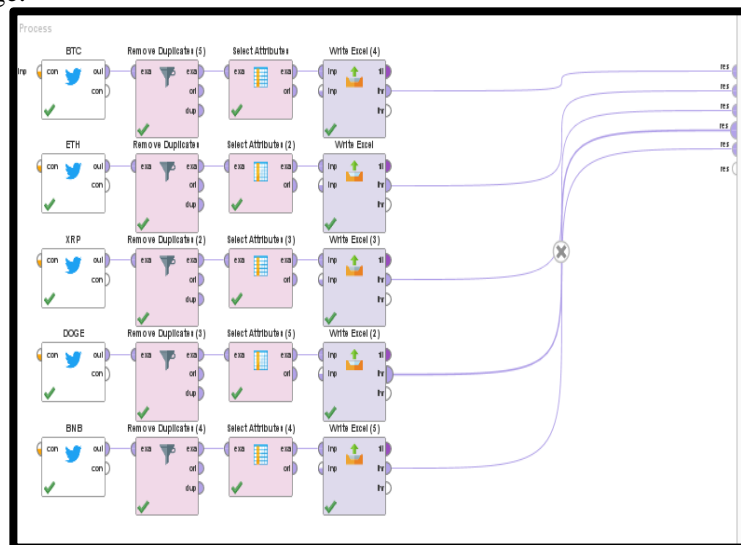


Figure 3. Data Understanding Phase

Figure 3 shows the data understanding phase for mining data such as Bitcoin, Ethereum, Binance Coin, DOGE, and Ripple.

Row No.	ID	Created	Text
23	1431179319	Aug 27, 2021	RT @C_M_101: Let's ask Brad at Ripple why they keep suppressing the value of XRP all these years, because I'd like to know as well!
24	1431179317	Aug 27, 2021	RT @FianiLaw: #RIPCCommunity #SECgov v. #Ripple #XRP. The Court has granted the motion for extension of time. The extension for filing pre...
22	1431179689	Aug 27, 2021	Precio actual del Bitcoin, #Ethereum y #Ripple
21	1431179683	Aug 27, 2021	増設100ビットコインでもらうプロジェクト
20	1431180320	Aug 27, 2021	Ripple Price Falls 1.4% to \$1.24 - Where to Buy XRP https://t.co/JJ4H4Gna https://t.co/WMLZYboft
19	1431180452	Aug 27, 2021	RT @Leerica1: A small fraction of the unanswered questions raised by the bizarre behaviour of the Securities and Exchange Commission in the...
18	1431180558	Aug 27, 2021	#ripotpara laria figli sonatamzo bana canli yayimlarda sohbet bolumunden sorabirsiniz
17	1431180687	Aug 27, 2021	RT @BankXRP: Ripple SEC ex-chief Hinman's views on XRP are 'dubious' 金融
16	1431180905	Aug 27, 2021	RT @JMIC359: Can someone please explain how a partnership between #Ripple & #SWIFT is announced for the use of #XRP in 11,500 banks world...
15	1431181081	Aug 27, 2021	RT @18818Erdem: #ripotpara laria figli sonatamzo bana canli yayimlarda sohbet bolumunden sorabirsiniz
14	1431181470	Aug 27, 2021	RT @MinusWells: We all knew years ago that #XRP would be used by SWIFT
13	1431181766	Aug 27, 2021	RT @XRPNews_: Hello Ripple test
12	1431181915	Aug 27, 2021	@CryptoLawUS @SECgov @Ripple @Send_The_Bits WTF? Get your head out of your ass @SECgov @GaryGensler. XRP has the most utility and mo...
11	1431181971	Aug 27, 2021	RT @Foreverdrawing1: I completed a fan based XRP digital artwork and hope it can be shared on the xrp community, it would be an honor if an...
10	1431181885	Aug 27, 2021	RT @CryptoLawUS: (1/2) The @SECgov claims #XRP has no utility except as an investment contract in @Ripple.
9	1431182000	Aug 27, 2021	@Foreverdrawing1 @Ripple @XRP_OWL @JoelKat @BakhusBradley @digitalassstboy @WottingMoneyCH @unleincorp https://t.co/4CH5FQgik
8	1431182197	Aug 27, 2021	RT @UniverseTwenty: Once SWIFT Starts Using #Ripple #XRP Price Will Shoot Up More Than 1,500%+ Just Imagine The Price Once FED - ECB - BOE...
7	1431182257	Aug 27, 2021	@JimBob200 @sentosmosaba @samsmek @XrpGreyhound @FlareNetworks @MCS1236843 @Ripple I'm going to take the time to help you under...
6	1431182416	Aug 27, 2021	ripple[Ripple]の文書提出期限が来るとどうなるのか? その時点で何かと発表があるのか? 5?
5	1431182448	Aug 27, 2021	@sentosmosaba @sbigroup @Bitbot_Crypto You are also wrong EH. The distance between Japan and India is 5,956 km @
4	1431182631	Aug 27, 2021	RT @WottingMoneyCH: Remember when a wise man (@bearbleguy123) once alluded to the fact that, "if you can't beat 'em, you might as well joi...

Figure 4. Text Mining Results

Figure 4 is the result of text mining Twitter social media using the Rapid miner application. The data above consists of 3 columns, namely Created at is the date the Twitter comment was made, ID is the ID of the Twitter data type, and Text is the content of the message or sentiment which will be used as the core data in doing sentiment analysis.

C. Data Preparation Phase

The third phase is data preparation which is used to prepare and process data to be ready and suitable for use in research. All the data needed for research will be prepared and processed with the RapidMiner application in the research carried out. The following are the stages of the Data Preparation Phase:

1) Data Union

The first stage in the Data Preparation Phase is Data Union, which aims to unite all data that has previously been in Text Mining periodically into one complete file. This data merge is carried out for each cryptocurrency, for example merging all BTC data previously in Text Mining. The following are the stages of the data merging process.

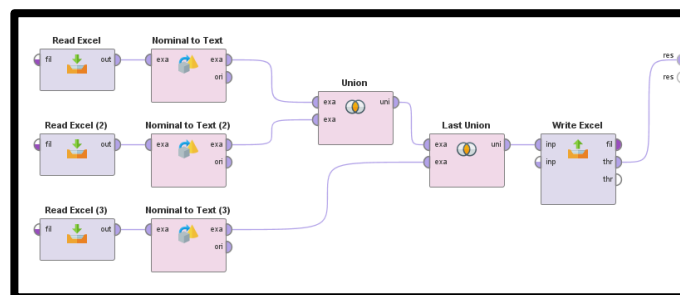


Figure 5. Data Union

Figure 5 is the process of the first stage, namely Data Union, which consists of several processes, namely:

- I. Nominal to Text
To read the data and prevent any errors
- II. Union
The previously collected data will be combined for each coin in this process.

2) Data Cleansing

The second stage in the Data Preparation Phase is Data Cleansing which is used to clean up data or delete the contents of Twitter tweets that are not used in the sentiment analysis process. Here is the process of the Data Clearing stage.

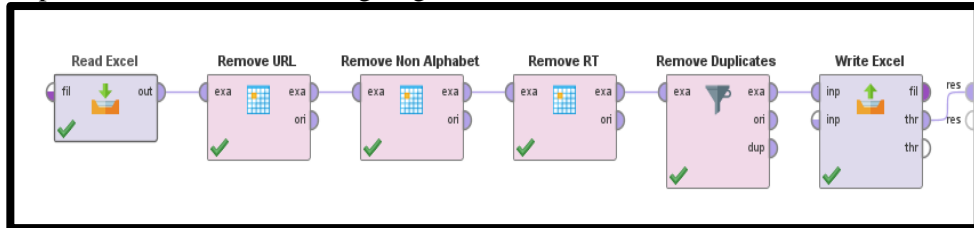


Figure 6. Data Cleansing

Figure 6 is the process of data cleansing that has a few steps:

I. Remove URL

The first stage in the Data Preparation Phase is the Remove URL used to remove tweets containing a link or URL that a Twitter user usually uses to promote something in the tweet. This is done because a link or URL in the user's tweet cannot perform sentiment analysis.

II. Remove Non-Alphabet

The second stage in the Data Preparation Phase is the Remove Non-Alphabet which removes the signs or symbols contained in a tweet from a Twitter user. This is done because the symbol or punctuation on Twitter is useless or cannot conduct sentiment analysis.

III. Remove RT

The third stage in the Data Preparation phase is Remove RT, which removes the letter RT from a Twitter user's tweet. The letter RT is omitted because it cannot be used in sentiment analysis and will interfere with the accuracy of sentiment analysis.

IV. Remove Duplicate

The fourth stage in the Data Preparation phase is Remove Duplicate, which removes any duplicate or similar data.

Row No.	Text	Created-At
1	Doge Cakes is a double dividend yield paying token that just fair launched on the BSC Experienced dev team DOGE and CAKE rewards for all holders Coinhunt and Poooin Ads already up Huge m...	Aug 16, 2021 ...
2	The point about DOGE that people miss is that DOGEs imperfections and simplicity are its greatest strengths You can only use it to do things Spend It or HODL It Both are easy to understand And its ...	Aug 15, 2021 ...
3	Joel that applies to everything Supply and demand is undefeated But with DOGE you can spend to own DOGE and have fun as part of a fun community The BTC maxis experience and do the same...	Aug 16, 2021 ...
4	RT RYOSHIMILLION RYOSHIVISION IS COMING ALIVE AS IT WAS MEANT TO DO GET IN NOW BEFORE K HOLDERS AND AX FROM CURRENT PRICE	Aug 17, 2021 ...
5	PancakeSwap BinanceChain GGG Easy xGigabyte Games is the unified casino platform on BSC to enjoy Hold your share and earn your sharehttpscoBbbdpv/YBNBinance BTC TRONSHIB doge...	Aug 17, 2021 ...
6	RT flurnt to one person in hoursRetweet follow cocainutoken likert their pinned join telegram httpstcoOUwSkeoBo	Aug 17, 2021 ...
7	Eyes on SPO OpenSea Competitor ADA season Project x from lowest entriesSub M MC - to M MC Rocket AXE CHZ ENJ FLOW MANA UOS SAND BAKE OGN WAXP SUPER SLP GALA AUDIO RNDR ...	Aug 17, 2021 ...
8	RT pinetworkcoin AiDrop katlmak iin httpscoIHCVzAA BSC BitcoinBTCUSDt btcXRP Coinbase Ripple TRX	Aug 17, 2021 ...
9	RT RYOSHIMILLION DONT LET RYOSHI CATCH YOU OFF GUARD LIKE SHIBA DID holders are growing every minute BUY AND HODL IN TWO WEEKS YOU CO	Aug 17, 2021 ...
10	ethereum ADA ShibaSwap dogecoin kishu BabyDoge SHIB BSCGems BSCGem cryptocurrency Crypto cryptotwitter XGems xCoin dut shib ada tel btc eth doge NFTCommunity protectherugged http...	Aug 17, 2021 ...
11	RT astoned BTC ETH	Aug 17, 2021 ...
12	Filecoin sxsxw btc eth dot bnb doge pump so much why filecoin dumpling everyday	Aug 17, 2021 ...
13	DOGE	Aug 17, 2021 ...
14	RT RYOSHIMILLION In weeks you could be a millionaire if you buy RYOSHI AND HODL doge bitcoin xrp altcoin AltCoinSeason xrp SAF	Aug 17, 2021 ...
15	RT ShibaInuCoin Does SHIB Needs Support From Elon Musk RT and Like let elonmusk hear shibainu woof woof Elon give some time	Aug 17, 2021 ...
16	RT tsALLrisky Pay me in DOGE	Aug 17, 2021 ...
17	RT ElenaCryptoBaby BNB Giveaway k will be overRT Follow ElenaCryptoBaby BSCGems doge BabyDoge Bitcoin KISHUARMY e	Aug 17, 2021 ...
18	RT inamzax UNITY PROTOCOL FUTURE PROJECT LISTING ON COINGECKOLISTING ON CMCNFT MARKETPLACEIDO PLATEFORMUNITY	Aug 17, 2021 ...
19	RT DogeEducation Whos still HODLing DOGE and watching it take off	Aug 17, 2021 ...
20	azziaador GGG Easy xGigabyte Games is the unified casino platform on BSC to enjoy Hold your share and earn your sharehttpscoBbbdpv/YBNBinance BTC TRONSHIB doge Ethereum WSG AR...	Aug 17, 2021 ...

Figure 7. Data Cleansing Results

Figure 7 is the result from Data Cleansing Phase through 4 processes: Remove URL, non-alphabet, RT, and Duplicate.

3) Data Labelling

The third stage in the Data Preparation Phase is Data Labeling. Data that has previously been cleaned through the Data Cleansing stage will be labeled so that sentiment analysis can be carried out. The following is the process of the Data labeling stage:

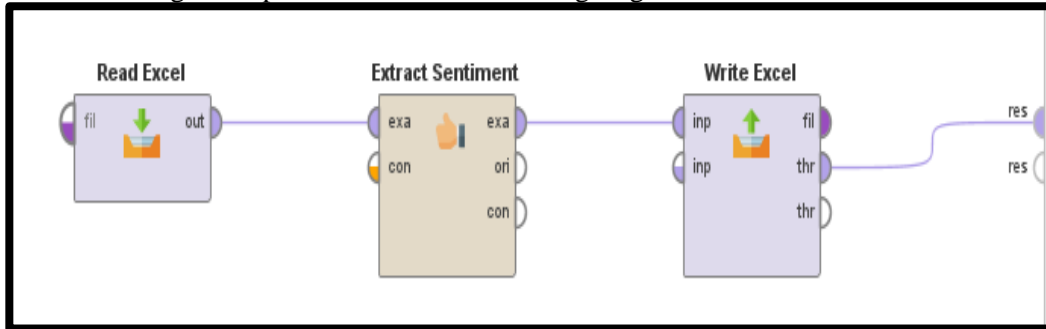


Figure 8. Data Labelling

Figure 8 is a Data Labelling process that has a few steps:

I. Extract Sentiment

The first process in data labeling is Extracting sentiment using the Vader algorithm. Using the Vader algorithm, all data that has previously been combined and cleaned will be labeled using the Vader algorithm with numbers or values. The following is an example of the results of Data Labeling using the Vader algorithm.

II. Labelling Data

The second process in the Data Labeling stage is Data Labeling, where the previous data that has been assessed and scored by the Vader algorithm will be labeled for neutral, positive, and negative data classification. The following is an example of the results of Labeling Data in the Microsoft Excel application.

	A	B	C	D	E
1	Text	Created At	Id	Score	Label
2	Doge Cakes is a double dividend yield paying token that just fair launched on the BSC Experience	2021-08-16 06:46:24	1427054094069570000,0	1,3	positif
3	The point about DOGE that people miss is that DOGGS imperfections and simplicity are its greatest	2021-08-15 20:56:05	14269055393420000,0	2,5	positif
4	Joel that applies to everything Supply and demand is undefeated But with DOGE you can spend	2021-08-16 01:05:20	1426968262527090000,0	2,6	positif
5	RYOSHIMILLION RYOSHIVISION IS COMING ALIVE AS IT WAS MEANT TO DO GET IN NOW BEFORE!	2021-08-17 14:59:09	1427540487897030000,0	,4	positif
6	PancakeSwap BinanceChain GGG Easy xGigabyte Games is the unified casino platform on BSC to e	2021-08-17 14:59:09	142754048712520000,0	1,8	positif
7	flunrft: to one person in hoursRetweet follow cocainutoken Ikeret their pinned join telegram	2021-08-17 14:59:08	1427540488055620000,0	,3	positif
8	Eyes on SPO OpenSea Competitor ADA season Project x from lowest entriesSub M MC - to M MC	2021-08-17 14:59:07	14275404790150000,0	,3	negatif
9	pinetworkcoin AirDrog kalimak in: BSC BitcoinCUSTODI bckRP Coinbase Ripple TRX	2021-08-17 14:59:07	1427540478831140000,0	,0	netral
10	RYOSHIMILLION DONT LET RYOSHIN CATCH YOU OFF GUARD LIKE SHIBA DID holders are growing ev	2021-08-17 14:59:06	142754047649520000,0	,6	positif
11	ethereum ADA ShibaSwap dogecoin kishu BabyDoge SHIB BSCGems BSCGem cryptocurrency Cryp	2021-08-17 14:59:05	142754047268080000,0	,0	netral
12	astoned BTC ETH	2021-08-17 14:59:04	142754046656480000,0	,0	netral
13	Filecoin xxxsv btc eth dot brib doge pump so much why filecoin dumpling everyday	2021-08-17 14:59:01	142754045496980000,0	,1	positif
14	DOGE	2021-08-17 14:59:01	142754045458560000,0	,0	netral
15	RYOSHIMILLION In weeks you could be a millionaire if you buy RYOSHI AND HDOL doge bitcoin xi	2021-08-17 14:58:57	1427540438861070000,0	,0	netral
16	ShibainuCoin Does SHIB Needs Support From Elon Musk and Like let elonmusk hear shibainu wo	2021-08-17 14:58:57	142754043701580000,0	,8	positif
17	ITALLIrisky Pay me in DOGE	2021-08-17 14:58:56	142754043055290000,0	,1	negatif
18	ElenaCryptoBaby BNB Giveaway k will be over Follow ElenaCryptoBaby BSCGems doge BabyDoge	2021-08-17 14:58:55	1427540429333610000,0	,0	netral
19	Humans UNITY PROTOCOL FUTURE PROJECT LISTING ON CONSECROUSTING ON CMCNFT MARK	2021-08-17 14:58:54	1427540422749350000,0	,0	netral
20	DogeEducation Whos still HDOLing DOGE and watching it take off	2021-08-17 14:58:52	1427540418556830000,0	,0	netral
21	azziador GGG Easy xGigabyte Games is the unified casino platform on BSC to enjoy hold your shi	2021-08-17 14:58:51	142754041127620000,0	1,8	positif
22	InvestmentsCEO Amazon x DOGE	2021-08-17 14:58:51	142754041369560000,0	,2	positif
23	SafegameCash And the WINNERS are kumarsuccess TeetobharunarsheedCongratulations guys Y	2021-08-17 14:58:50	1427540408863790000,0	,5	positif
24	InvestmentsCEO The current price of one DOGE is now	2021-08-17 14:58:50	142754040812268000,0	,0	netral
25		2021-08-17 14:58:49	142754040430270000,0	,0	netral
26	BlockMonsters The Block Monsters private sale is on the th of August so this is your chance to wh	2021-08-17 14:58:44	1427540382594720000,0	,2	negatif
27	TheDogePoundNFT Welcome to The Doge Pound FloydMayweather and mcuban	2021-08-17 14:58:42	142754037899520000,0	,5	positif
28	AyPompin tokenculture Seemingly promising exciting new project CryptoHypemnova aywiire Ba	2021-08-17 14:58:40	1427540366316740000,0	1,0	positif
29	dogecola New ATH Again DogeCola MoonTaste Beverage cryptocurrency Vision Doge MiniDoge E	2021-08-17 14:58:39	1427540362281820000,0	,3	positif
30	TraderJay shibes incoming & B! for dogeCola Look at the chart doge dogecoin dogecola Conk	2021-08-17 14:58:36	1427540349438860000,0	,0	netral
31	MustacheTommy This is my Doge reward for days for staking the Dogo token for the Dogemonst	2021-08-17 14:58:34	14275403404133690000,0	,7	positif
32	DogeCoinNorway dogeforge DogeFrance BillyMK DogecoinTweet squarebush liquidseahorse Ami	2021-08-17 14:58:33	1427540337396960000,0	,0	netral

Figure 9. Data Labelling

Figure 9 is the result of data labeling using the Microsoft Excel application. Labeling this data is done manually in Microsoft Excel using the IF formula, where if the data is 0, it will be classified as neutral. If the data is above 0, it will be classified as positive. If the data is less than 0, then the data will be classified as negative. The following is an example of data labeling.

III. Remove Netral Sentimen

The third process at the Data labeling stage is eliminating classification with a score of 0 or is included in the neutral classification. This is done because, in this study, only two types of classification are compared, namely positive and negative classifications, so that neutral classifications will be deleted.

D. Modelling Phase

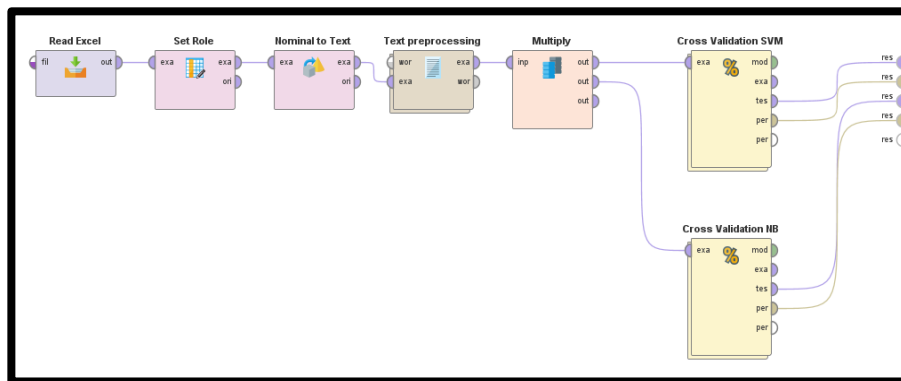


Figure 10. Modelling Phase

Figure 10 is Modeling which is used to select and determine the model that will later be used to achieve the objectives of the previously determined research. The models used in this sentiment analysis research are the Support Vector Machine and the Naïve Bayes. The following is the process at this Modeling Phase:

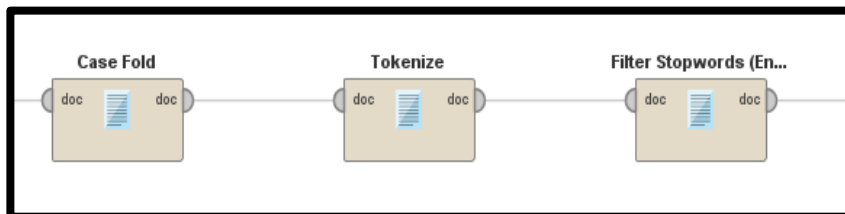


Figure 11. Text Preprocessing

Figure 11 is part of the sub-process of the Text Processing process; this sub-process has three parts, namely:

- 1) Case Fold
Case Fold is used to convert all capital letters into lowercase to not interfere with the weighting of TF - IDF.
- 2) Tokenize
Tokenize is used to convert all forms of tweets into text form. Tokenize is also used to break each sentence into word fractions.
- 3) Filter Stopwords (English)
The stopwords filter removes all English words that are not standard or abbreviated.

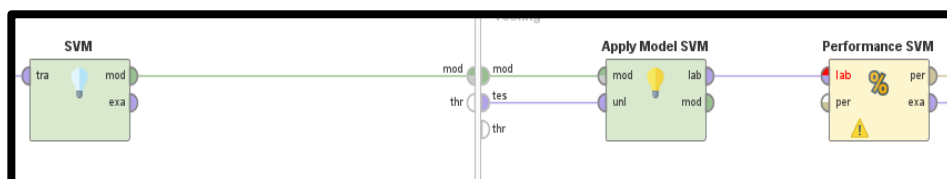


Figure 12. Cross-Validation using SVM

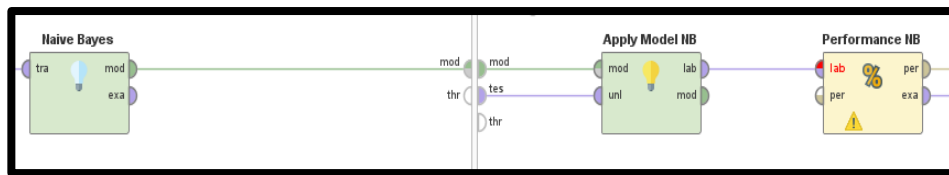


Figure 13. Cross Validation Using Naïve Bayes

Figures 12 and 13 are training data methods using K-Fold Cross Validation using Support Vector Machine and Naïve Bayes algorithms. At this stage, sentiment analysis will also be carried out using the Support Vector Machine and Naïve Bayes algorithms. The results obtained in this model are accuracy, precision, and recall.

E. Evaluation Phase

The fifth phase is an evaluation used to evaluate the modeling phase results that have previously been carried out by conducting data training using K-Fold Cross Validation using the Support Vector Machine and Naïve Bayes algorithms. The modeling results will be obtained in accuracy, precision, and recall. The following is the result of the confusion matrix consisting of accuracy, precision, and recall of cryptocurrencies Bitcoin, Ethereum, Binance Coin, DOGE, and Ripple:

1) Bitcoin

accuracy: 78.59% +/- 0.71% (micro average: 78.59%)			
	true positif	true negatif	class precision
pred. positif	602	164	78.59%
pred. negatif	0	0	0.00%
class recall	100.00%	0.00%	

Figure 14. Confusion Matrix using SVM on Bitcoin

Figure 14 shows the results of the Confusion Matrix calculations for Bitcoin cryptocurrency on the Support Vector Machine algorithm consisting of accuracy, precision (positive and negative classes), and recall (positive and negative classes. From Figure 4.21 above, it can be seen that the results of accuracy are 78.59 %, the precision in the positive class is 78.59%, the precision in the negative class is 0%, the recall in the positive class is 100%, and the recall in the negative class is 0%

accuracy: 83.81% +/- 3.15% (micro average: 83.81%)			
	true positif	true negatif	class precision
pred. positif	559	81	87.34%
pred. negatif	43	83	65.87%
class recall	92.86%	50.61%	

Figure 15. Confusion Matrix using Naive Bayes on Bitcoin

Figure 15 shows the results of the Confusion Matrix calculations for Bitcoin cryptocurrency on the Naïve Bayes algorithm, which consists of accuracy, precision (positive and negative classes), and recall (positive and negative classes. From Figure 4.22 above, it can be seen that the results of accuracy are 83.81%, the precision in the positive class is 87.34%, the precision in the negative class is 65.87%, the recall in the positive class is 92.86%, and the recall in the negative class is 50.61%

2) Ethereum

accuracy: 77.93% +/- 0.49% (micro average: 77.93%)			
	true negatif	true positif	class precision
pred. negatif	0	0	0.00%
pred. positif	141	498	77.93%
class recall	0.00%	100.00%	

Figure 16. Confusion Matrix using SVM on Ethereum

Figure 16 shows the results of the Confusion Matrix calculation for Ethereum cryptocurrency on the Support Vector Machine algorithm consisting of accuracy, precision (positive and negative classes), and recall (positive and negative classes. From Figure 4.24 above, it can be seen that the results of accuracy are 77.93 %, the precision in the positive class is 77.93%, the precision in the negative class is 0%, the recall in the positive class is 100%, and the recall in the negative class is 0%

accuracy: 84.67% +/- 3.94% (micro average: 84.66%)			
	true negatif	true positif	class precision
pred. negatif	80	37	66.38%
pred. positif	61	461	88.31%
class recall	56.74%	92.57%	

Figure 17. Confusion Matrix using Naive Bayes on Ethereum

Figure 17 shows the results of the Confusion Matrix calculations for Ethereum cryptocurrency on the Naïve Bayes algorithm, which consists of accuracy, precision (positive and negative classes), and recall (positive and negative classes. From Figure 4.25 above, it can be seen that the results of accuracy are 84.67%, the precision in the positive class is 88.31%, the precision in the negative class is 66.38%, the recall in the positive class is 92.57%, and the recall in the negative class is 56.74%

3) Binance Coin

accuracy: 92.02% +/- 0.56% (micro average: 92.02%)			
	true negatif	true positif	class precision
pred. negatif	0	0	0.00%
pred. positif	62	715	92.02%
class recall	0.00%	100.00%	

Figure 18. Confusion Matrix using SVM on Binance Coin

Figure 18 shows the results of the Confusion Matrix calculation for the Binance Coin cryptocurrency on the Support Vector Machine algorithm consisting of accuracy, precision (positive and negative classes), and recall (positive and negative classes. From Figure 4.27 above, it can be seen that the results of accuracy are 92, 02%, the precision in the positive class is 92.02%, the precision in the negative class is 0%, the recall in the positive class is 100%, and the recall in the negative class is 0%

accuracy: 92.67% +/- 3.87% (micro average: 92.66%)			
	true negatif	true positif	class precision
pred. negatif	32	27	54.24%
pred. positif	30	688	95.82%
class recall	51.61%	96.22%	

Figure 19. Confusion Matrix using Naive Bayes on Binance Coin

Figure 19 shows the results of the Confusion Matrix calculation for the Binance Coin cryptocurrency on the Naïve Bayes algorithm consisting of accuracy, precision (positive and negative classes), and recall (positive and negative classes. From Figure 4.28 above, it can be seen that the results of accuracy are 92.67 %, the precision in the positive class is 95.82%, the

precision in the negative class is 54.24%, the recall in the positive class is 96.22%, and the recall in the negative class is 51.61%

4) DOGE

accuracy: 86.61% +/- 0.44% (micro average: 86.61%)			
	true positif	true negatif	class precision
pred. positif	828	128	86.61%
pred. negatif	0	0	0.00%
class recall	100.00%	0.00%	

Figure 20. Confusion Matrix using SVM on DOGE

Figure 20 shows the results of the Confusion Matrix calculation for DOGE cryptocurrency on the Support Vector Machine algorithm consisting of accuracy, precision (positive and negative classes), and recall (positive and negative classes). From Figure 4.30 above, it can be seen that the results of accuracy are 86.61 %, the precision in the positive class is 86.61%, the precision in the negative class is 0%, the recall in the positive class is 100%, and the recall in the negative class is 0%

accuracy: 85.56% +/- 2.78% (micro average: 85.56%)			
	true positif	true negatif	class precision
pred. positif	770	80	90.59%
pred. negatif	58	48	45.28%
class recall	93.00%	37.50%	

Figure 21. Confusion Matrix using Naive Bayes on DOGE

Figure 21 shows the results of the Confusion Matrix calculation for DOGE cryptocurrency on the Naïve Bayes algorithm consisting of accuracy, precision (positive and negative classes), and recall (positive and negative classes). From Figure 4.31 above, it can be seen that the results of accuracy are 85.56%, the precision in the positive class is 90.59%, the precision in the negative class is 45.28%, the recall in the positive class is 93%, and the recall in the negative class is 37.5%

5) Ripple

accuracy: 72.85% +/- 0.56% (micro average: 72.85%)			
	true negatif	true positif	class precision
pred. negatif	0	0	0.00%
pred. positif	208	558	72.85%
class recall	0.00%	100.00%	

Figure 22. Confusion Matrix using SVM on Ripple

Figure 22 shows the results of the Confusion Matrix calculation for Ripple cryptocurrency on the Support Vector Machine algorithm consisting of accuracy, precision (positive and negative classes), and recall (positive and negative classes). From Figure 4.33 above, it can be seen that the results of accuracy are 72.85 %, the precision in the positive class is 72.85%, the precision in the negative class is 0%, the recall in the positive class is 100%, and the recall in the negative class is 0%

accuracy: 72.85% +/- 0.56% (micro average: 72.85%)			
	true negatif	true positif	class precision
pred. negatif	0	0	0.00%
pred. positif	208	558	72.85%
class recall	0.00%	100.00%	

Figure 23. Confusion Matrix using Naive Bayes on Ripple

Figure 23 shows the results of the Confusion Matrix calculation for Ripple cryptocurrency on the Naïve Bayes algorithm consisting of accuracy, precision (positive and negative classes), and recall (positive and negative classes). From Figure 4.34 above, it can be seen that the results of accuracy are 85.56%, the precision in the positive class is 90.59%, the precision in the negative class is 45.28%, the recall in the positive class is 93%, and the recall in the negative class is 37.5%

F. Deployment Phase

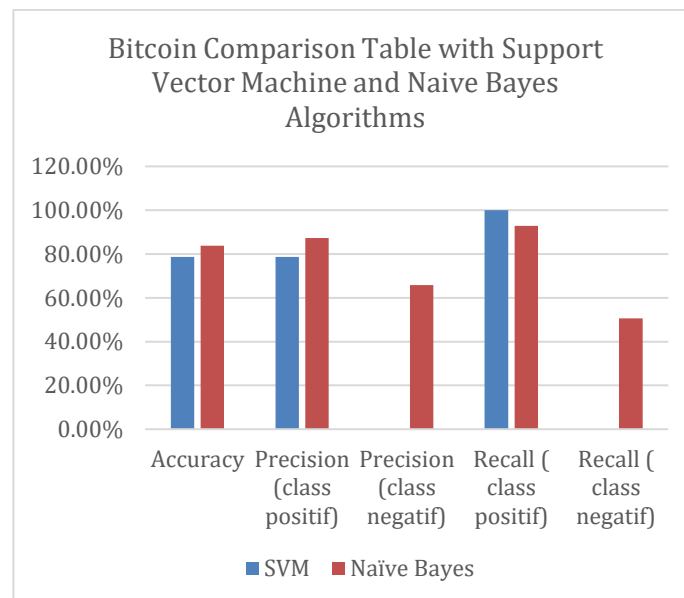


Figure 24. Comparison Chart with SVM and Naive Bayes on Bitcoin

From figure 24, it can be seen that the comparison of accuracy given by SVM is 78.59%, and Naïve Bayes is 83.81%. Precision in the positive class given by SVM is 78.59%, and Naïve Bayes is 87.34%. The negative class precision given by SVM is 0%, and Naïve Bayes is 65.87%. SVM's positive class recall is 100%, Naive Bayes is 92.86%, negative class recalls on SVM is 0%, and Naive Bayes is 50.61%. This calculation shows that of the 5 Confusion Matrix SVM calculations, 1 is superior in the positive class recall, and Naïve Bayes is superior to four inaccuracies, positive class precision, negative class precision, and negative class recall.

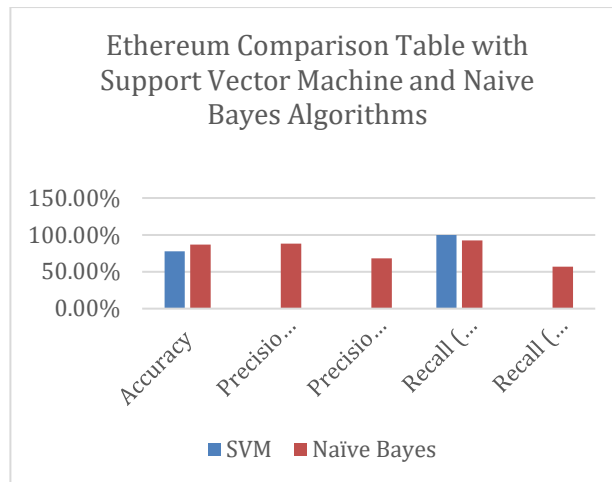


Figure 25. Comparison Chart with SVM and Naive Bayes on Ethereum

From figure 25, it can be seen that the comparison of accuracy given by SVM is 77.93%, and Naive Bayes is 86.67%. Precision in the positive class given by SVM is 77.93%, and Naive Bayes is 88.31%. The negative class precision given by SVM is 0%, and Naive Bayes is 68.38%. SVM's positive class recall is 100%, Naive Bayes is 92.57%, negative class recalls on SVM is 0%, and Naive Bayes is 56.74%. In the Confusion Matrix calculation above, it can be seen that SVM excels 1 in the calculation of positive class recall, and Naive Bayes excels 4 in the calculation of accuracy, positive class precision, negative class precision, and negative class recall.

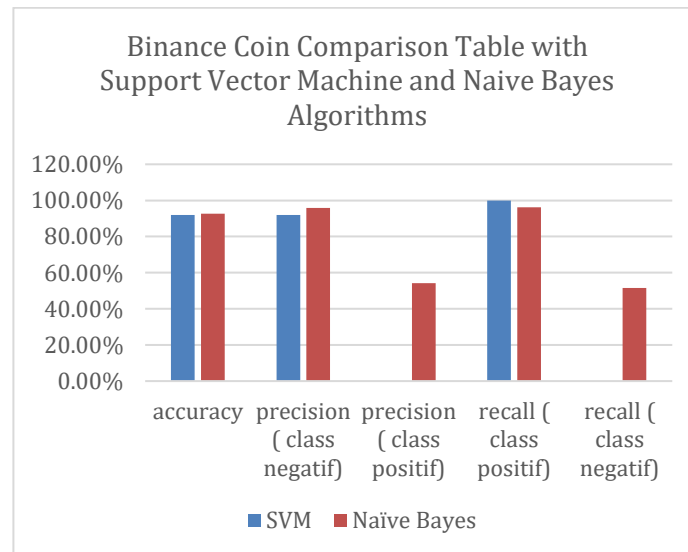


Figure 26. Comparison Chart with SVM and Naive Bayes on Binance Coin

From figure 26, it can be seen that the comparison of accuracy given by SVM is 92.02%, and Naive Bayes is 92.67%. Precision in the positive class given by SVM is 92.02%, and Naive Bayes is 95.82%. The negative class precision given by SVM is 0%, and Naive Bayes is 54.24%. SVM's positive class recall is 100%, Naive Bayes is 96.22%, negative class recalls on SVM is 0%, and Naive Bayes is 51.61%. In the Confusion Matrix calculation above, it can be seen that SVM excels 1 in the calculation of positive class recall, and Naive Bayes excels 4 in the calculation of accuracy, positive class precision, negative class precision, and negative class recall.

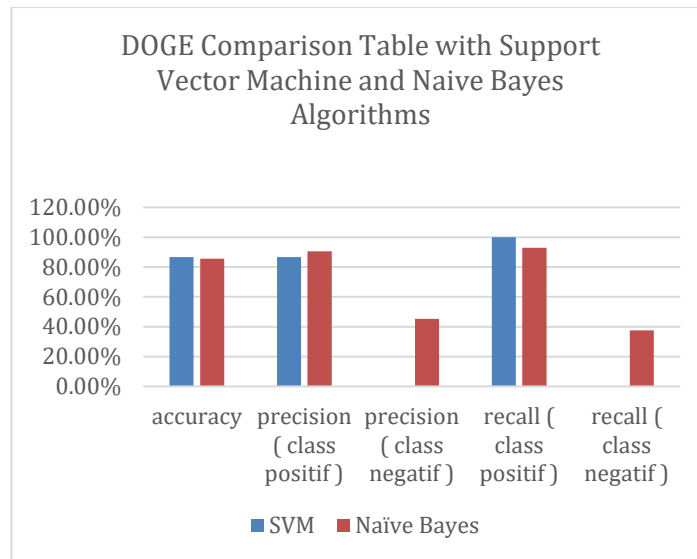


Figure 27. Comparison Chart with SVM and Naive Bayes on DOGE

From figure 27, it can be seen that the comparison of accuracy given by SVM is 86.61%, and Naïve Bayes is 85.56%. Precision in the positive class given by SVM is 86.61%, and Naïve Bayes is 90.59%. The negative class precision given by SVM is 0%, and Naïve Bayes is 45.28%. The positive class recall given by SVM is 100%, Nave Bayes is 93%, the negative class recall on SVM is 0%, and Nave Bayes is 37.5%. In the Confusion Matrix calculation above, it can be seen that SVM excels 2 in the calculation of accuracy and positive class recall, and Naïve Bayes excels 3 in the calculation of positive class precision, negative class precision, and negative class recall.

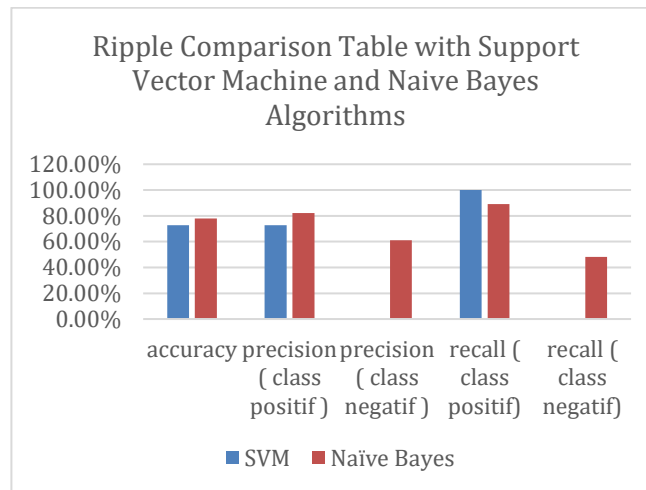


Figure 28. Comparison Chart with SVM and Naive Bayes on Ripple

From figure 28, it can be seen that the comparison of accuracy given by SVM is 72.85%, and Naïve Bayes is 77.94%. Precision in the positive class given by SVM is 72.85%, and Naïve Bayes is 82.15%. The negative class precision given by SVM is 0%, and Naïve Bayes is 61.11%. SVM's positive class recall is 100%, Nave Bayes is 89.07%, negative class recalls on SVM is 0%, and Nave Bayes is 48.08%. In the Confusion Matrix calculation above, it can be seen that SVM excels 1 in the calculation of positive class recall, and Naïve Bayes excels 4 in the calculation of accuracy, positive class precision, negative class precision, and negative class recall.

Overall, it can be seen that of the 25 Confusion Matrix calculations, the Support Vector Machine algorithm only excels in 6 calculations, and the Naïve Bayes algorithm excels in 19 calculations. It can be concluded that the Naïve Bayes algorithm has a better performance in this study.

V. CONCLUSION

The conclusions obtained from this research are:

1. Sentiment analysis is carried out using the RapidMiner application to perform text mining, data management, data assessment/labeling, and create a model to perform sentiment analysis using the Support Vector Machine and Naïve Bayes algorithms. The two algorithms can be used to classify positive and negative sentiments towards Twitter users' tweets against cryptocurrencies
2. Comparing the use of the Support Vector Machine and Naïve Bayes algorithms overall, the Naïve Bayes algorithm gives better results than the Support Vector Machine algorithm. The Support Vector Machine algorithm excels at 6 Confusion Matrix calculations, and Naive Bayes excels at 19 Confusion Matrix calculations
3. Based on the results obtained from label income, the cryptocurrencies that have the most positive sentiment if sorted are Binance Coin, DOGE, Bitcoin, Ethereum, and Ripple

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