

# Sentiment Analysis Motorku X using Applications Naive Bayes Classifier Method

<sup>1</sup>Akhmad Mustolih, <sup>2</sup>Primandani Arsi, <sup>3</sup>Pungkas Subarkah

<sup>1,2,3</sup>Departement of Informatics, Universitas Amikom Purwokerto

Email: <sup>1</sup>tolih282@gmail.com, <sup>2</sup>ukhti.prima@amikompurwokerto.ac.id, <sup>3</sup>subarkah@amikompurwokerto.ac.id

---

## Article Info

### Article history:

Received Jun 12<sup>th</sup>, 2023

Revised Jul 30<sup>th</sup>, 2023

Accepted Aug 28<sup>th</sup>, 2023

---

### Keyword:

Classification

Data Mining

Motorku X

Naive Bayes Classifier

Sentiment Analysis

---

## ABSTRACT

The rapid development of technology has brought convenience to humans in their daily lives. The continuously evolving technology generates large amounts of data. Data can provide valuable information if processed effectively. The Motorku X application is one of the innovations created by Astra Motor to facilitate consumers or potential customers in servicing and purchasing motorcycles. The Motorku X application generates review data every day. These review data can be utilized for future application development. To make the most of the reviews, sentiment analysis is one of the techniques used to process the review data. Sentiment analysis is a method to measure consumer sentiments in terms of positive or negative reviews. The algorithm used in this research is the Naïve Bayes classifier. One of the advantages of Naïve Bayes is its ability to work quickly and efficiently in terms of computational time. The research consists of several stages: data collection, data labeling, pre-processing, data splitting, tf-idf weighting, implementation of Naïve Bayes classifier, and evaluation of the results. The data comprises 1000 reviews divided into two classes: positive class (number) and negative class (number). The research was conducted with three scenarios of training and testing data sharing: 90%:10%, 80%:20%, and 70%:30%. The best results were achieved with the 90%:10% ratio, with an accuracy of 76%, precision of 76%, and recall of 97%.

Copyright © 2023 Puzzle Research Data Technology

---

### Corresponding Author:

Pungkas Subarkah,

Departement of Informatics,

Amikom Purwokerto University,

Jl. Letjend Pol. Soemarto No.127, Watumas, Purwanegara, Kec. Purwokerto Utara,

Banyumas Regency, Central Java.

Email: subarkah@amikompurwokerto.ac.id

DOI: <http://dx.doi.org/10.24014/ijaidm.v6i2.24864>

---

## 1. INTRODUCTION

The rapid development of technology can bring convenience to humans in living life. Technology that continues to develop certainly produces very large amounts of data. The data can provide useful information if it can be processed properly. The large number of active internet users today also makes the amount of data generated very large [1].

Google has a service called Play Store, which offers digital content such as games, apps, movies, music, and books in various categories. One of the Play Store features is the rating and review feature, where users of Play Store products can give their opinions about the products they use [2].

Motorku X stands as one of Astra Motor's innovative creations, strategically developed to thrive in the digital era's competitive landscape. Astra Motor is a key subsidiary of PT Astra International Tbk., primarily focusing on the distribution and retail sales of Honda's two-wheeled vehicles. The establishment of Motorku X aligns with Astra Motor's vision to adapt to the digital world's challenges and opportunities, providing customers with modern and user-friendly experiences while dealing with Honda's two-wheeled products. By embracing digital technologies and catering to evolving consumer preferences, Motorku X aims to elevate

customer satisfaction and strengthen Astra Motor's position in the market. The establishment of Motorku X aligns with Astra Motor's vision to adapt to the digital world's challenges and opportunities, providing customers with modern and user-friendly experiences while dealing with Honda's two-wheeled products. By embracing digital technologies and catering to evolving consumer preferences, Motorku X aims to elevate customer satisfaction and strengthen Astra Motor's position in the market. The goal is to make it easier for consumers or potential customers to service and purchase motorbikes. Astra Motor is aware of the busyness of consumers who cannot come directly to the location or motor showroom to find the motorbike they want [3]. The main purpose behind developing the Motorku X application is to foster interactive relationships among individuals within a system, leveraging information and communication technology, along with an internet connection. The ultimate goal is to facilitate more effective and efficient business processes, catering to people's requirements and demands. By utilizing this application, it is anticipated that seamless interactions will be established, enhancing overall user experience and meeting the needs of the users in a more streamlined manner [4]. Since its launch in 2019, Motorku X application users have continued to increase every year. The number of users grows to 100,000 per year. In 2022, the number of users in the South Sumatra region will increase to 350,000 [5].

Motorku X application review data can be obtained from Google Play [6]. Every user who downloads the Motorku X application can rate the application using the features offered by the Google Play Store. This review is freely available to everyone. Data from the Motorku X app can be useful if handled properly. The results of data processing contribute to further application improvement and development because the best criticism and suggestions come from the user's direct opinion. Sentiment analysis, also known as opinion mining, is a natural language processing (NLP) technique used to analyze and determine the sentiment or emotional information conveyed in textual data [7],[8]. The primary goal of sentiment analysis is to categorize the text as positive, negative, or neutral, based on the emotions expressed in opinionated sentences. By understanding and extracting emotional information from text, businesses, and organizations can gain valuable insights into public opinions, customer feedback, and overall sentiment toward their products, services, or brand. This information can be highly beneficial for making data-driven decisions and improving customer experiences [9].

Sentiment analysis techniques can be carried out by applying NLP techniques [10] and machine learning using machine learning algorithms, one of which uses the Naive Bayes algorithm [11]. Naive Bayes is a simple probabilistic classification method intended to be used under the assumption that the explanatory variables are independent [12],[13]. One of the benefits of utilizing the Naive Bayes method is its ability to operate effectively with a limited amount of training data for estimating the required parameters during the classification process [14].

Several previous studies related to sentiment analysis used the Naive Bayes Classifier method. First, the research conducted by Artanti Inez Tanggraeni and Melkior N. N. Sitokdana used the Naive Bayes method with TF-IDF weighting to show an accuracy of 89%, a precision of 83%, and a recall of 87% [4]. Second, Cholid Fadilah Hasri and Debby Alita conducted a study to compare the Naive Bayes Classifier method, without additional features, to the Support Vector Machine (SVM) method. The research revealed that the Naive Bayes Classifier method outperformed the Support Vector Machine method, achieving a high accuracy of 81.07% [15].

Based on the problems described above, the authors propose to use the Naive Bayes Classifier algorithm to perform sentiment analysis on the Motorku X application using review data from application users on the Google Play Store.

## 2. RESEARCH METHOD

This research was conducted using the Naive Bayes Classifier algorithm. Naive Bayes is used to get accurate results from the Motorku X application review data from the Google Play Store and is used to classify positive and negative reviews from reviews or comments received. The following figure 1 are the stages of the research.

### 2.1. Data retrieval

This research utilizes secondary data, specifically reviews or comments extracted from the Google Play Store's Motorku X application. The data collected includes the most relevant reviews out of a total of 1000 reviews. Web scraping is employed to gather this data, which involves automatically extracting or collecting information from web pages [16]. The retrieved data contains several columns, but for this study, only two columns, the score column, and the content column, will be utilized. After extracting these columns, the data is then labeled accordingly.

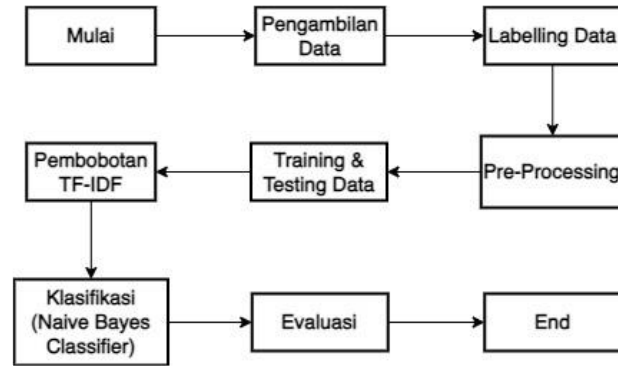


Figure 1. Research Flow Chart

## 2.2. Data Labeling

The acquired dataset will undergo a process of labeling or categorization. This labeling will be applied to 1000 reviews, dividing them into two classes the positive class and the negative class [17]. The positive class will be assigned a value of 1, while the negative class will be assigned a value of 0. Reviews with scores of 1, 2, and 3 will fall into the negative class (category 0), while reviews with scores of 4 and 5 will be categorized as the positive class (category 1) [18].

## 2.3. Pre-processing

The pre-processing stage is a stage that must exist in data preparation because the data structure generated at the collection stage is irregular so the process does not go well [19]. The following are the preprocessing stages in this study, namely case folding, tokenizing, stemming, and removing stopwords.

## 2.4. Split Data

At this stage, the data will be divided for the purpose of comparison. The data will be divided into training data and testing data. Training data is data that will later be used to build and train a classification model. Data testing is data that will be used to carry out tests on classifications that have been made using training data. The distribution of data in this study uses 3 data training and testing scenarios, namely 70%:30%, 80%:20%, and 90%:10% [20]. Three scenarios were carried out as an effort to find the best performance from the resulting method or model.

## 2.5. TF-IDF Weighting

TF-IDF weighting involves transforming textual data into numerical data by assigning weights to each word or feature. It is a statistical technique that assesses the significance of a word within a document. This method is employed to evaluate both the frequency of a word in a specific document and its occurrence across multiple documents [21],[22]. The following is the formula for the equation of tf-idf.

$$tfidf_{t,d} = tf_{t,d} * \log\left(\frac{n}{df_t}\right) \quad (1)$$

## 2.6. Naive Bayes Classifier Algorithm Classification

In this study, the authors used the naive Bayes classifier algorithm. The Naive Bayes algorithm makes very strong assumptions about the independence of each class. Naive Bayes is used to get an accuracy value from comments or reviews sourced from the Motorku X application available on the Google Play Store and is used to classify positive and negative comments. The following is a general classification process using the Naive Bayes Classifier equation.

$$P(c_i|w_j) = \frac{P(w_i|c_j) * P(c_j)}{P(w_i)} \quad (2)$$

## 2.7. Evaluation

During this phase, the assessment is conducted by analyzing the outcomes of the naive Bayes classifier algorithm applied to the reviews of the Motorku X application on the Google Play Store. The evaluation process involves utilizing tools such as the confusion matrix and word cloud. The parameters derived from the confusion matrix encompass accuracy, precision, recall, and ROC curve, which provide valuable insights into the performance and effectiveness of the classifier.

### 3. RESULTS AND ANALYSIS

#### 3.1. Data retrieval

Data obtained by scrapping. The data taken is the most relevant review of the Motorku X application. Data collection was carried out 3 times. The first data collection was carried out on March 11, 2023, the second data was collected on June 26, 2023, and the third data was collected on July 5, 2023. The data that will be used in this study is data taken on July 5, 2023. The data is still dirty and must go through the cleaning stage. The data cleaning stage is called pre-processing. Pre-processing is used to clean data that is not needed when processing data so that it can produce good quality and the mining process becomes more accurate.

**Table 1.** Data Retrieval

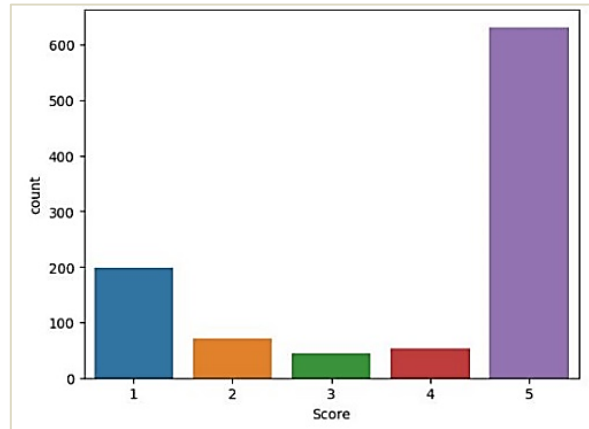
index	userName	at	score	content
0	Seovia Vee	2023-05-24 03:39:53	3	Aplikasinya bagus, namun untuk booking service di lokasi itu tidak berjalan sesuai yg diharapkan. Masih harus daftar manual dan masih mengantri seperti biasa. Estimasi cepat jadi makin lambat. Terimakasih aplikasinya yang bagus namun belum efektif dan efisien ðŸ˜Š
1	Heri Nur Ali Pratama	2023-06-25 08:07:14	5	Aplikasinya mudah digunakan n dipahami, namun aplikasinya terasa berat..padahal saya menggunakan handphone dgn ram 6GB..jaringan jg dalam kondisi baik, namun aplikasi tetap delay saat digunakan..mohon diperbaiki untuk kenyamanan penggunaan customer...terima kasih
2	Dwi Yoga S. Hadi (dwyoga)	2023-06-29 13:17:01	1	Aplikasi Naudzubillah lemotnya minta ampun..Sudah gonta ganti device, tetep aja nunggunya sampe kopi jadi dingin.. Moha aja respon cepat untuk peningkatan performa aplikasi. Sementara bintang 1 aja dulu.
3	Ana Sitatun266	2023-06-11 16:17:18	2	Maaap ka kenapa ya kan apk nya ke hapus, terus mau login lagi Malah katanya Terjadi kesalahan ( nomor telpon salah atau tidak terdaftar) padahal udah jelas2 itu benar, udah diulang2 tetep kaya gitu Dan mau ganti password juga kaya gitu
4	#R ROCHAYAT	2023-06-30 02:33:34	1	Aplikasi belum stabil, sering lola macet dan meski sudah booking service tidak masuk di sistem ahas tempat servicenya. Lebih efektif booking service lewat WA.ðŸ—¿
....	....	....	....	....
999	Deni Priatna	2021-06-18 02:39:44	5	Mudah dan cepat.... Tingkatkan terus pelayanannya.

Figure 2 is data taken by scraping. The data consists of 4 columns, namely userName, at, score, and content. In this study, the columns to be used are the score and content columns, the userName and at columns will be deleted. The following are the columns to be used:

**Table 2.** Column Score and Content

index	score	content
0	3	Aplikasinya bagus, namun untuk booking service di lokasi itu tidak berjalan sesuai yg diharapkan. Masih harus daftar manual dan masih mengantri seperti biasa. Estimasi cepat jadi makin lambat. Terimakasih aplikasinya yang bagus namun belum efektif dan efisien ðŸ˜Š
1	5	Aplikasinya mudah digunakan n dipahami, namun aplikasinya terasa berat..padahal saya menggunakan handphone dgn ram 6GB..jaringan jg dalam kondisi baik, namun aplikasi tetap delay saat digunakan..mohon diperbaiki untuk kenyamanan penggunaan customer...terima kasih
2	1	Aplikasi Naudzubillah lemotnya minta ampun..Sudah gonta ganti device, tetep aja nunggunya sampe kopi jadi dingin.. Moha aja respon cepat untuk peningkatan performa aplikasi. Sementara bintang 1 aja dulu.
3	2	Maaap ka kenapa ya kan apk nya ke hapus, terus mau login lagi Malah katanya Terjadi kesalahan ( nomor telpon salah atau tidak terdaftar) padahal udah jelas2 itu benar, udah diulang2 tetep kaya gitu Dan mau ganti password juga kaya gitu
4	1	Aplikasi belum stabil, sering lola macet dan meski sudah booking service tidak masuk di sistem ahas tempat servicenya. Lebih efektif booking service lewat WA.ðŸ—¿
....	....	....
999	5	Mudah dan cepat.... Tingkatkan terus pelayanannya.

Figure 3 is the result of taking the columns that will be used, namely the score and content columns. In Figure 3 there are reviews with various scores. In the picture above, the amount of data with each score is unknown. The following is a data visualization of the data that has been taken to determine the amount of data on each score.



**Figure 2.** Score Column Visualization

From the visualization obtained from Figure 2, it can be seen in the graph that the reviews that received a score of 5 which were positive were in the first highest order with a total of 631 data. Followed by reviews that received a score of 1 which were negative in second place with a total of 199 data. Then the reviews which received a score of 2 which were negative were in third place with a total of 71 data. Followed by reviews that received a score of 4 which were positive were in fourth place with a total of 54 data, and reviews with a score of 3 which were negative were in fifth place with a total of 45 data.

**3.2. Data Labeling**

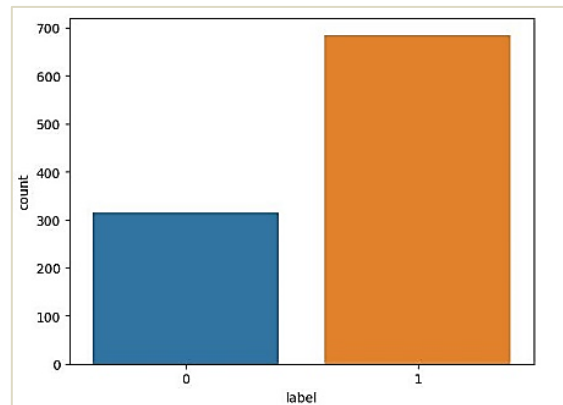
The dataset that has been obtained will be labeled. Labeling is done by dividing the value into 2 categories. Reviews rated 1, 2, and 3 will be labeled 0 as a negative category. Reviews rated 4 and 5 will be labeled 1 as positive. The following is the text data that has been labeled:

**Table 3.** Result Labeling

index	score	content	label
0	3	Aplikasinya bagus, namun untuk booking service di lokasi itu tidak berjalan sesuai yg diharapkan. Masih harus daftar manual dan masih mengantri seperti biasa. Estimasi cepat jadi makin lambat. Terimakasih aplikasinya yang bagus namun belum efektif dan efisien ðŸ˜Š	0
1	5	Aplikasinya mudah digunakan n dipahami, namun aplikasinya terasa berat..padahal saya menggunakan handphone dgn ram 6GB..jaringan jg dalam kondisi baik, namun aplikasi tetap delay saat digunakan..mohon diperbaiki untuk kenyamanan penggunaan customer...terima kasih	1
2	1	Aplikasi Naudzubillah lemotnya minta ampun.. Sudah gonta ganti device, tetep aja nunggunya sampe kopi jadi dingin.. Moha aja respon cepat untuk peningkatan performa aplikasi. Sementara bintang 1 aja dulu.	0
3	2	Maaap ka kenapa ya kan apk nya ke hapus, terus mau login lagi Malah katanya Terjadi kesalahan ( nomor telpon salah atau tidak terdaftar) padahal udah jelas2 itu benar, udah diulang2 tetep kaya gitu Dan mau ganti password juga kaya gitu	0
4	1	Aplikasi belum stabil, sering lola macet dan meski sudah booking service tidak masuk di sistem ahas tempat servicenya. Lebih efektif booking service lewat WA.ðŸ—;	0
....	....	....	....
999	5	Mudah dan cepat.... Tingkatkan terus pelayanannya.	1

Table 3 is the result of the text that has been labeled. It can be seen that the labeling given is in accordance with the specified score, where scores 1, 2, and 3 will be labeled 0, while scores 4 and 5 will be labeled 1. The following is a visualization of the amount of data that has been labeled 0 and 1.

Figure 3 is the amount of data that has been labeled negative with category 0, and data that has been labeled positive with category 1. Data with category 0 obtained 315 data from the sum of the data with scores 1, 2, and 3. Meanwhile, data with category 1 obtained 685 data from the sum of the data with scores 4 and 5.



**Figure 3.** Visualization Label

### 3.3. Pre-Processing

Pre-processing is the stage where the processed data will be cleaned and corrected so that the data is structured. The following are the pre-processing steps:

Case Folding is useful for eliminating differences that may arise from using different uppercase and lowercase letters. For example, the words "Application" and "application" may be considered different words by a word processing model or algorithm even though they are semantically the same.

**Table 4.** Case Folding Result

index	score	content	label	cleaned_case_text
0	3	Aplikasinya bagus, namun untuk booking service di lokasi itu tidak berjalan sesuai yg diharapkan. Masih harus daftar manual dan masih mengantri seperti biasa. Estimasi cepat jadi makin lambat. Terimakasih aplikasinya yang bagus namun belum efektif dan efisien ðŸ˜Š	0	aplikasinya bagus namun untuk booking service di lokasi itu tidak berjalan sesuai yg diharapkan masih harus daftar manual dan masih mengantri seperti biasa estimasi cepat jadi makin lambat terimakasih aplikasinya yang bagus namun belum efektif dan efisien
1	5	Aplikasinya mudah digunakan n dipahami, namun aplikasinya terasa berat..padahal saya menggunakan handphone dgn ram 6GB..jaringan jg dalam kondisi baik, namun aplikasi tetap delay saat digunakan..mohon diperbaiki untuk kenyamanan penggunaan customer...terima kasih	1	namun aplikasinya terasa berat padahal saya menggunakan handphone dgn ram gb jaringan jg dalam kondisi baik namun aplikasi tetap delay saat digunakan mohon diperbaiki untuk kenyamanan penggunaan customer terima kasih
2	1	Aplikasi Naudzubillah lemotnya minta ampun.. Sudah gonta ganti device, tetep aja nunggunya sampe kopi jadi dingin.. Moha aja respon cepat untuk peningkatan performa aplikasi. Sementara bintang 1 aja dulu.	0	aplikasi naudzubillah lemotnya minta ampun sudah gonta ganti device tetep aja nunggunya sampe kopi jadi dingin moha aja respon cepat untuk peningkatan performa aplikasi sementara bintang aja dulu
3	2	Maaap ka kenapa ya kan apk nya ke hapus, terus mau login lagi Malah katanya Terjadi kesalahan ( nomor telpon salah atau tidak terdaftar) padahal udah jelas2 itu benar, udah diulang2 tetep kaya gitu Dan mau ganti password juga kaya gitu	0	maap ka kenapa ya kan apk nya ke hapus terus mau login lagi malah katanya terjadi kesalahan nomor telpon salah atau tidak terdaftar padahal udah jelas itu benar udah diulang tetep kaya gitu dan mau ganti password juga kaya gitu
4	1	Aplikasi belum stabil, sering lola macet dan meski sudah booking service tidak masuk di sistem ahas tempat servicenya. Lebih efektif booking service lewat WA.ðŸ— ì	0	aplikasi belum stabil sering lola macet dan meski sudah booking service tidak masuk di sistem ahas tempat servicenya lebih efektif booking service lewat wa
....	....	....	..	...
999	5	Mudah dan cepat.... Tingkatkan terus pelayanannya.	1	mudah dan cepat tingkatkan terus pelayanannya

Tokenizing is the process of breaking text into small tokens, or simple words. The purpose of tokenizing is to assist word-processing models or algorithms in analyzing and understanding text. Tokens can be words, phrases, or sentences, depending on the needs and desired level of precision.

**Table 5.** Tokenizing Results

index	cleaned_case_text	tokens
0	aplikasinya bagus namun untuk booking service di lokasi itu tidak berjalan sesuai yg	aplikasinya, bagus, namun, untuk, booking, service, di, lokasi, itu, tidak,

index	cleaned_case_text	tokens
	diharapkan masih harus daftar manual dan masih mengantri seperti biasa estimasi cepat jadi makin lambat terimakasih aplikasinya yang bagus namun belum efektif dan efisien	berjalan, sesuai, yg, diharapkan, masih, harus, daftar, manual, dan, masih, mengantri, seperti, biasa, estimasi, cepat, jadi, makin, lambat, terimakasih, aplikasinya, yang, bagus, namun, belum, efektif, dan, efisien

Stemming is removing suffixes or word endings in the text. The goal is to reduce the dimensions of textual data and increase the efficiency of the models or algorithms that use it. Word endings usually have no special meaning and do not provide useful information for word processing models or algorithms. In addition, suffixes or word endings can also be a source of noise or interference which can reduce the accuracy of the model or algorithm used.

**Table 6.** Stemming Results

Tokens	Stemming	Tokens	Stemming
aplikasinya	aplikasi	masih	masih
bagus	bagus	mengantri	antri
namun	namun	seperti	seperti
untuk	untuk	biasa	biasa
booking	booking	estimasi	estimasi
service	service	cepat	cepat
di	di	jadi	jadi
lokasi	lokasi	makin	makin
itu	itu	lambat	lambat
tidak	tidak	terimakasih	terimakasih
berjalan	jalan	aplikasinya	aplikasi
sesuai	sesuai	yang	yang
yg	yg	bagus	bagus
diharapkan	harap	namun	namun
masih	masih	belum	belum
harus	harus	efektif	efektif
daftar	daftar	dan	dan
manual	manual	efisien	efisien
dan	dan		

Remove Stopwords, namely removing words from the text that have no meaning or useful information. These words are usually called stopwords or useless words. Examples of commonly used stopwords are words like "and", "or", "the", and "in".

**Table 7.** Remove Stopwords Results

index	Stemming	Remove stopwords
0	aplikasi, bagus, namun, untuk, booking, service, di, lokasi, itu, tidak, jalan, sesuai, yg, harap, masih, harus, daftar, manual, dan, masih, antri, seperti, biasa, estimasi, cepat, jadi, makin, lambat, terimakasih, aplikasi, yang, bagus, namun, belum, efektif, dan, efisien	aplikasi bagus booking service lokasi jalan sesuai harap daftar manual antri estimasi cepat lambat terimakasih aplikasi bagus efektif efisien

### 3.4. Split Data

Once the data has undergone pre-processing, the subsequent step involves dividing the data into training and testing sets, commonly known as split data. Prior to splitting the data, the initial action is to import the necessary library. The library employed for this purpose is the `train_test_split` library, sourced from the `sklearn` library module. Following the library import, the subsequent steps entail creating variables for the training and testing data, denoted as `X_train`, `X_test`, `y_train`, and `y_test`.

Next, the `train_test_split` command is implemented, utilizing the `X` and `y` arrays as parameters. Furthermore, additional parameters are specified, such as `test_size` and `random_state`. In this study, three scenarios for dividing the training and testing data are employed 70% training data and 30% testing data, 80% training data and 20% testing data, and 90% training data and 10% testing data. To achieve these ratios, the

test\_size parameter is set to 0.3 for the 70%:30% scenario, 0.2 for the 80%:20% scenario, and 0.1 for the 90%:10% scenario. The random\_state parameter can be assigned the value of 0.

**3.5. TF-IDF weighting**

Once the data has been divided into training and testing sets, the subsequent stage involves performing tf-idf weighting. The primary objective of tf-idf weighting is to determine the frequency value of a word in a document. Here are the outcomes of tf-idf weighting achieved through data division with a ratio of 90% training data and 10% testing data.

**Table 8.** TF-IDF Result

index	tf-idf					
	0	1	2	3	4	.... 887
0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
....	....	....	....	....	....	....
899	0.0	0.0	0.0	0.0	0.0	0.0

Table 8 is the result of tf-idf weighting. Furthermore, to find out how to find the tf-idf value in a document, the following is an example of a calculation to find the tf-idf value.

**Table 9.** TF-IDF Calculation Data Sample

Document	Sentence
D1	aplikasi bagus booking service lokasi jalan sesuai harap daftar manual antri estimasi cepat lambat terimakasih aplikasi bagus efektif efisien
D2	aplikasi mudah paham aplikasi asa berat handphone ram jaring jg kondisi aplikasi delay mohon nyaman customer terima kasih
D3	aplikasi naudzubillah lot ampun gonta ganti device tetep nunggunya sampe kopi dingin moha respon cepat tingkat performa aplikasi bintang

Table 9 is an example of a review that will later be used to calculate the value of the tf-idf. In Table 9 it is known that the number of documents used is 3. From Table 9, the following calculation results are obtained.

**Table 10.** Example of TF-IDF Calculation

Term	TF			df <sub>t</sub>	D/df <sub>t</sub>	IDF	W		
	D1	D2	D3				TF-IDF1	TF-IDF2	TF-IDF3
aplikasi	2	3	2	3	1	0	0	0	0
bagus	2	0	0	1	3	0.477	0.954	0	0
	Search Rank						0.954	0	0

“aplikasi” Term Calculation :

$$D/df = \frac{\text{jumlah dokumen}}{\text{dokumen frekuensi}} = \frac{3}{3} = 1$$

$$IDF_d = \log\left(\frac{D}{df_t}\right) = \log\left(\frac{3}{3}\right) = 0$$

$$TF-IDF1 = tf_{t,d} * idf_d = 2 * 0 = 0$$

$$TF-IDF2 = tf_{t,d} * idf_d = 3 * 0 = 0$$

$$TF-IDF3 = tf_{t,d} * idf_d = 2 * 0 = 0$$

“bagus” Term Calculation :

$$D/df = \frac{\text{jumlah dokumen}}{\text{dokumen frekuensi}} = \frac{3}{1} = 3$$

$$IDF_d = \log\left(\frac{D}{df_t}\right) = \log\left(\frac{3}{1}\right) = 0.477$$



$$TF-IDF = tf_{t,d} * idf_d = 2 * (0.477) = 0.954$$

### 3.6. Classification Naive Bayes Classifier

Following the tf-idf weighting process, the subsequent step involves classifying the data using the Naive Bayes algorithm. This phase is aimed at determining the accuracy value based on the data that has undergone preprocessing and tf-idf weighting. Here are the accuracy results for the three different scenarios of data distribution for training and testing.

**Table 11.** Classification Result Using Scenario 3 Data Ratio

Rasio Data	Precision	Recall	Accuracy
90%:10%	0.76	0.97	0.76
80%:20%	0.75	0.96	0.75
70%:30%	0.75	0.95	0.75

In Table 11 it can be seen that the distribution of data with a ratio of 90%:10% in this study is better than the ratios of 80%:20% and 70%:30%. Distribution of data with a ratio of 90%:10% has a value of precision 0.76, recall 0.97, and accuracy of 0.76, division of data with a ratio of 80%:20% has a value of precision 0.75, recall 0.96, and accuracy 0.75, while for division of data with a ratio of 70%:30% has a value of precision 0.75, recall 0.95, and accuracy 0.75.

### 3.7. Evaluation

The confusion matrix is a tabular representation utilized in machine learning to evaluate the performance of a classification model. It enables the comparison between the actual values and the predicted values generated by the model, facilitating the production of evaluation metrics. Here are the results of the confusion matrix obtained from the classification conducted in the preceding stage.

**Table 12.** Prediction Confusion Matrix 90:10

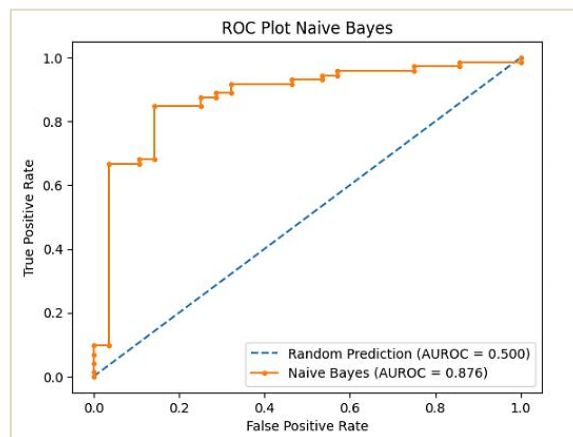
	True	False
Pred. True	70	22
Pred. False	2	6

Table 12 shows the value obtained from the results of the confusion matrix with a data division of 90:10, namely TP (True Positive) gets a score of 70, FP (False Positive) gets a score of 22, FN (False Negative) gets a score of 2, and TN (True Negative) gets a score of 6. Next is to calculate accuracy, precision, and recall. The following is a calculation of accuracy, precision, and recall.

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} = \frac{70+6}{70+6+22+2} = \frac{76}{100} = 0.76$$

$$Precision = \frac{TP}{TP+FP} = \frac{70}{70+22} = \frac{70}{92} = 0.76$$

$$Recall = \frac{TP}{TP+FN} = \frac{70}{70+2} = \frac{70}{72} = 0.97$$



**Figure 4.** ROC Results

Figure 9 is a graph of the confusion matrix curve with a data ratio of 90%:10%. The ROC curve is said to be good if the empty space on the upper left of the curve is getting smaller, the better[23]. In Figure 9, it is concluded that the classification model created is quite good when viewed from the ROC curve because the empty space in the upper left area is quite small. Another way to determine whether a classification model is good or not, apart from looking at the ROC curve, can also be seen from AUC or AUROC. AUC is the empty area under the ROC curve. The wider the empty area under the ROC, the better the AUC. As seen in Figure 9, the AUC value is 0.876, which is a pretty good value.

The word cloud in this study represents the occurrence or level of importance of words. The bigger a word appears, the more often a word is mentioned in a document. The following is a world cloud from the results of data that has gone through the pre-processing stage.



Figure 5. Word Cloud Positive Results

Figure 5 is a positive word cloud from data that has gone through the preprocessing stage. The word that often comes up in positive reviews is aplikasi, antri, motorku x, and service.



Figure 6. Word Cloud Negative Results

Figure 6 is a negative word cloud from data that has gone through the preprocessing stage. The word that often comes up in negative reviews is aplikasi, motor, daftar, service, and bengkel.

#### 4. CONCLUSION

Based on the results and discussion, it can be concluded that The performance of the Naive Bayes method in this study used 1000 review data taken from the Motorku X application on Google Play which was then divided into 2 classes, namely the positive and negative classes which were quite good. The research was conducted with 3 training and testing data sharing scenarios, namely 90%:10%, 80%:20%, and 70%:30%, producing the best results at a ratio of 90%:10% with 76% accuracy, 76% precision, and 97% recall.

#### REFERENCES

- [1] N. C. Agustina, D. Herlina Citra, W. Purnama, C. Nisa, and A. Rozi Kurnia, "MALCOM: Indonesian Journal of Machine Learning and Computer Science The Implementation of Naïve Bayes Algorithm for Sentiment Analysis of Shopee Reviews on Google Play Store Implementasi Algoritma Naive Bayes untuk Analisis Sentimen Ulasan Shopee pada Goo," vol. 2, no. April, pp. 47–54, 2022.
- [2] N. Herlinawati, Y. Yuliani, S. Faizah, W. Gata, and S. Samudi, "Analisis Sentimen Zoom Cloud Meetings di Play Store Menggunakan Naïve Bayes dan Support Vector Machine," *CESS (Journal Comput. Eng. Syst. Sci.)*, vol. 5, no. 2, p. 293, 2020, doi: 10.24114/cess.v5i2.18186.
- [3] I. Nilasari, "Aplikasi Motorku X Platform Beli Motor Lebih Mudah, Ini Fiturnya," *HarapanRakyat.com*, 2022.

- [https://www.harapanakyat.com/2022/07/aplikasi-motorku-x/#:~:text=Aplikasi Motorku X merupakan aplikasi,mendapatkan berbagai kemudahan dalam bertransaksi.](https://www.harapanakyat.com/2022/07/aplikasi-motorku-x/#:~:text=Aplikasi%20Motorku%20X%20merupakan%20aplikasi,mendapatkan%20berbagai%20kemudahan%20dalam%20bertransaksi.)
- [4] A. I. Tanggraeni and M. N. N. Sitokdana, "Analisis Sentimen Aplikasi E-Government pada Google Play Menggunakan Algoritma Naïve Bayes," *JATISI (Jurnal Tek. Inform. dan Sist. Informasi)*, vol. 9, no. 2, pp. 785–795, 2022, doi: 10.35957/jatisi.v9i2.1835.
  - [5] T. Rusli, "Jumlah Pengguna Aplikasi MotorkuX," *Palpres.com*, 2022. <https://palpres.disway.id/read/605785/jumlah-pengguna-aplikasi-motorkux-capai-350-ribu>.
  - [6] J. Effendi and M. Jorgi Ramadhan, "Analisa Cluster Aplikasi pada Google Play Store dengan Menggunakan Metode K-Means," *Pros. Annu. Res. Semin. 2018*, vol. 4, no. 1, pp. 103–106, 2018, [Online]. Available: <http://seminar.ilkom.unsri.ac.id/index.php/ars/article/view/1982>.
  - [7] S. Nayak and Y. Kumar, "A modified Bayesian boosting algorithm with weight-guided optimal feature selection for sentiment analysis," *Decis. Anal. J.*, vol. 8, no. March, p. 100289, 2023, doi: 10.1016/j.dajour.2023.100289.
  - [8] N. Kewsuwun and S. Kajornkasirat, "A sentiment analysis model of agritech startup on Facebook comments using naive Bayes classifier," *Int. J. Electr. Comput. Eng.*, vol. 12, no. 3, pp. 2829–2838, 2022, doi: 10.11591/ijece.v12i3.pp2829-2838.
  - [9] S. Masturoh, Achmad, and B. Pohan, "Sentiment Analysis Against the Dana E-Wallet on Google Play Reviews Using the K-Nearest Neighbor Algorithm," *J. PILAR Nusa Mandiri*, vol. 17, no. 1, pp. 53–57, 2021, [Online]. Available: [www.bsi.ac.id](http://www.bsi.ac.id).
  - [10] P. Arsi, B. A. Kusuma, and A. Nurhakim, "Analisis Sentimen Pindah Ibu Kota Berbasis Naive Bayes Classifier," *J. Inform. Upgris*, vol. 7, no. 1, pp. 1–6, 2021, doi: 10.26877/jiu.v7i1.7636.
  - [11] P. Subarkah, W. R. Damayanti, and R. A. Permana, "Comparison of Correlated Algorithm Accuracy Naive Bayes Classifier and Naive Bayes Classifier for Classification of heart failure," *Ilk. J. Ilm.*, vol. 14, no. 2, pp. 120–125, 2022, doi: 10.33096/ilkom.v14i2.1148.120-125.
  - [12] B. J. Katiandhago, A. Mustolih, W. D. Susanto, P. Subarkah, and C. I. Satrio Nugroho, "Sentiment Analysis of Twitter Cases of Riots at Kanjuruhan Stadium Using the Naive Bayes Method," *J. Comput. Networks, Archit. High Perform. Comput.*, vol. 5, no. 1, pp. 302–312, 2023, doi: 10.47709/cnahpc.v5i1.2196.
  - [13] E. D. Sri Mulyani, D. Rohpandi, and F. A. Rahman, "Analysis of Twitter Sentiment Using the Classification of Naive Bayes Method about Television in Indonesia," *2019 1st Int. Conf. Cybern. Intell. Syst. ICORIS 2019*, vol. 1, no. August, pp. 89–93, 2019, doi: 10.1109/ICORIS.2019.8874896.
  - [14] Mochammad Haldi Widiyanto, "Algoritma Naive Bayes," *Binus University*, 2019. <https://binus.ac.id/bandung/2019/12/algoritma-naive-bayes/>.
  - [15] C. F. Hasri and D. Alita, "Penerapan Metode Naïve Bayes Classifier Dan Support Vector Machine Pada Analisis Sentimen Terhadap Dampak Virus Corona Di Twitter," *J. Inform. dan Rekayasa Perangkat Lunak*, vol. 3, no. 2, pp. 145–160, 2022, [Online]. Available: <http://jim.teknokrat.ac.id/index.php/informatika>.
  - [16] T. Kudo, T. Yamamoto, and T. Watanabe, "Three-Step Master Data Creation Method from Big Data: Scraping, Semi-Structuring, and Extraction," *Procedia Comput. Sci.*, vol. 207, no. Kes, pp. 360–369, 2022, doi: 10.1016/j.procs.2022.09.070.
  - [17] R. Kusumaningrum, I. Z. Nisa, R. Jayanto, R. P. Nawangsari, and A. Wibowo, "Deep learning-based application for multilevel sentiment analysis of Indonesian hotel reviews," *Heliyon*, vol. 9, no. 6, p. e17147, 2023, doi: 10.1016/j.heliyon.2023.e17147.
  - [18] Raksaka Indra Alhaqq, I Made Kurniawan Putra, and Yova Ruldeviyani, "Analisis Sentimen terhadap Penggunaan Aplikasi MySAPK BKN di Google Play Store," *J. Nas. Tek. Elektro dan Teknol. Inf.*, vol. 11, no. 2, pp. 105–113, 2022, doi: 10.22146/jnteti.v11i2.3528.
  - [19] F. Hadaina and U. Budiyanto, "Implementasi Metode Multinomial Naïve Bayes Untuk Sentiment Analysis Terhadap Data Ulasan Produk Colearn Pada Google Play Store Implementation Of Multinomial Naive Bayes Method For Sentiment Analysis Of Colearn Product Review Data On Google Play Store," *Semin. Nas. Mhs. Fak. Teknol. Inf. Jakarta-Indonesia*, no. September, pp. 660–666, 2022, [Online]. Available: <https://senafiti.budiluhur.ac.id/index.php>.
  - [20] D. P. Santoso and W. Wibowo, "Analisis Sentimen Ulasan Aplikasi Buzzbreak Menggunakan Metode Naïve Bayes Classifier pada Situs Google Play Store," *J. Sains dan Seni ITS*, vol. 11, no. 2, 2022, doi: 10.12962/j23373520.v11i2.72534.
  - [21] J. A. Septian, T. M. Fachrudin, and A. Nugroho, "Analisis Sentimen Pengguna Twitter Terhadap Polemik Persepakbolaan Indonesia Menggunakan Pembobotan TF-IDF dan K-Nearest Neighbor," *J. Intell. Syst. Comput.*, vol. 1, no. 1, pp. 43–49, 2019, doi: 10.52985/insyst.v1i1.36.
  - [22] A. Mee, E. Homapour, F. Chiclana, and O. Engel, "Sentiment analysis using TF-IDF weighting of UK MPs' tweets on Brexit[Formula presented]," *Knowledge-Based Syst.*, vol. 228, p. 107238, 2021, doi: 10.1016/j.knosys.2021.107238.
  - [23] K. Anam, *Evaluasi Model ROC dan AUV*. 2022.

**BIBLIOGRAPHY OF AUTHORS**

Akhmad Mustolih Born in Cilacap. currently a student at Amikom University Purwokerto. Received S1 Informatics Engineering at Amikom University, Purwokerto.



Primandani Arsi is a lecturer in Informatics Study Program, Amikom Purwokerto University. Education The author conducted undergraduate studies at Electrical Engineering ITB Bandung and Postgraduate Dian Nuswantoro University Semarang. Research interests in Data Mining; Text Mining; Sentiment Analysis.



Pungkas Subarkah is a lecturer at the Informatics Study Program, Amikom Purwokerto University. The author's education continued his S-1 Study at Amikom Purwokerto University and S-2 Master of Informatics Engineering at Amikom University Yogyakarta. Research interests in Data Mining, Machine Learning, and Information System.