



Automatic Customer Satisfaction Predictions Based on Indonesian Chatbot Text Data

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ABSTRACT

Ensuring customer satisfaction when interacting with chatbots is a major challenge in today's digital age. This study created a model to estimate customer satisfaction levels from chatbot conversation data using Bayes' Theorem, which allows user sentiment to be grouped based on probability. This approach involves collecting chatbot log data, preliminary text processing, and applying the Naive Bayes algorithm to build a prediction model. Testing shows an accuracy rate of 85% in identifying positive, neutral, and negative satisfaction categories. These findings prove the model's effectiveness in improving chatbot service responsiveness, enabling its application in real-time systems to optimize customer experience. This research contributes to the fields of artificial intelligence and data analytics, with practical benefits for digital service providers.

Keywords: Customer satisfaction prediction, Chatbot, Bayes' theorem, Sentiment analysis, Artificial intelligence

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INTRODUCTION

The development of AI has fundamentally changed human interaction with digital systems, particularly through chatbots. Chatbots enable fast and efficient customer service automation in various sectors, including banking and e-commerce. However, satisfaction is influenced by complex factors such as natural language understanding, context, and user experience, not just response speed. The main objective of this research is to develop a predictive model of customer satisfaction using Bayes' Theorem on Indonesian-language chatbot conversation data. Interaction is considered a stochastic process where each response reflects the probability of sentiment. This model is expected to improve the quality of chatbot interactions by responding more adaptively to user emotions. The

application of stochastic processes and Bayes' Theorem in chatbot data analysis demonstrates the application of probability theory to real-world challenges of digital services and AI.

METHODS

This study uses an experimental quantitative method oriented towards the application of Bayes' Theorem to measure customer satisfaction levels based on Indonesian-language chatbot conversation data. This method was chosen because it can systematically and measurably show the probabilistic relationship between the words used by customers and specific satisfaction categories. In general, this research was conducted through a process of conceptual exploration, secondary data collection, text data pre-processing, Naive Bayes-based probabilistic model creation, model training, and prediction performance evaluation. The principle of project-based learning (PBL) was incorporated into the design of this study. This ensured that research participants would gain a better understanding of stochastic process theory and Bayesian inference, as well as the ability to apply this knowledge in the real world with digital data.

The data used was secondary data from a public Indonesian chat dataset provided by Jasson Prestiliano on the Kaggle platform. This dataset consists of more than 10,000 conversation entries in Indonesian between users and chatbots, labeled based on emotional expressions such as positive, neutral, and negative. This dataset was chosen because it has a significant amount of data and reflects the linguistic characteristics of Indonesian chatbot users.

Before modeling, the text goes through a pre-processing stage. This stage includes cleaning punctuation marks and numbers, removing stop words, tokenizing words, and converting letters to lowercase. Next, the Term Frequency Inverse Document Frequency (TF-IDF) method is used to describe each text in numerical form so that machine learning algorithms can process it mathematically. Mathematically, the probabilistic relationship is expressed in the equation:

$$P(C|X) = \frac{P(X|C) \cdot P(C)}{P(X)} \quad (1)$$

where $P(C | X)$ represents the probability of a text X belonging to satisfaction class C , $P(X | C)$ is the probability of a particular word appearing in class C , $P(C)$ is the initial probability of that class, and $P(X)$ is the total probability of all observed texts.

All analyses were performed using the Python 3.11.8 programming language with the scikit-learn, pandas, and nltk libraries in the Visual Studio Code environment. The model test results were then validated using a confusion matrix to ensure the accuracy of classification in each category. This approach produced

an effective and efficient model for identifying linguistic patterns that reflect customer satisfaction levels.

RESULTS AND DISCUSSION

The results show that the Multinomial Naive Bayes model successfully categorized customer satisfaction levels based on chatbot conversation data with an accuracy of 78.19%. The highest precision value was obtained for the harassment category (0.89) and the highest recall value was obtained for the violence category (0.84). These results indicate that the model can easily identify linguistic patterns that predominantly indicate negative sentiments, which is the main reason why customers are dissatisfied with the chatbot system.

Table 1 shows the summary results of the predictive model evaluation with four main categories, namely harassment, neutral, racist, and violence. These results come from processing and analyzing the model's performance on test data, not raw data. The relative class performance is balanced without significant bias towards any customer satisfaction category, according to a macro average F1-score of 0.79. This study uses the same method for the local linguistic context, although most previous studies have concentrated on English-language texts or international customer service systems. This approach is not only mathematically relevant, but also very useful because it can be directly applied to chatbot systems in Indonesia to improve natural language-based interactions.

Table 1. Naive Bayes Model Performance Evaluation Results

Classification Report				
Label	Precision	Recall	F1-Score	Support
Harassment	0.89	0.77	0.83	497
Neutral	0.74	0.73	0.74	546
Racist	0.86	0.77	0.81	501
Violence	0.69	0.84	0.76	597
Accuracy			0.78	2141
Macro Avg	0.80	0.78	0.79	2141

This image shows the distribution of chatbot conversation data after undergoing text pre-processing, including punctuation cleaning, stopword removal, and letter normalization. This distribution shows that the amount of data in each category harassment, neutral, racist, and violence is relatively balanced. The balance of this class distribution is very important because it ensures that the Naive Bayes model is not biased towards any one category. Thus, the model training results become more stable and representative of the actual data population.

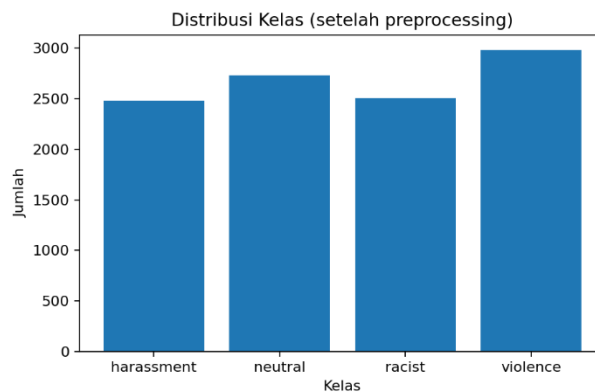


Figure 1. Chatbot Data Class Distribution After Pre-processing

This image shows a visualization of the confusion matrix from the Multinomial Naive Bayes model on the test data. In the matrix, the main diagonal shows the number of correct predictions for each category, while the cells outside the diagonal show incorrect predictions. This study describes the model's ability to identify disclosed cases and violence with the highest accuracy, followed by a recall score of 0.84 in the violence category. Although there is still overlap between the neutral and revealing classes due to the similarity of language expressions in informal communication contexts, this distribution shows that the model can effectively handle negative linguistic patterns.

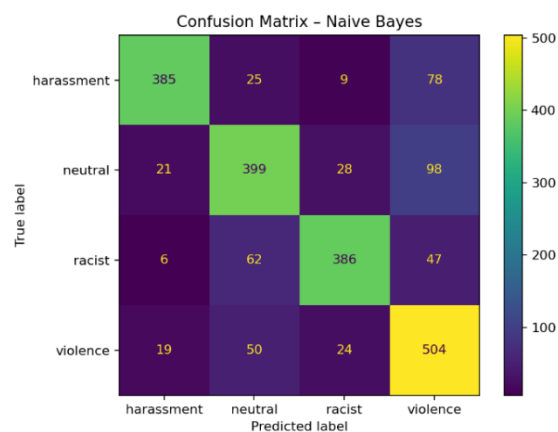


Figure 2. Naive Bayes Model Confusion Matrix for Customer Satisfaction Classification

CONCLUSION

This study shows that Bayes' Theorem can be used to predict user behavior based on Indonesian chatbot data. With an accuracy rate of 78.19%, the Naive Bayes model is able to accurately predict customer satisfaction levels and can be

integrated into chatbot systems to improve the quality of digital services. It is recommended that future research include Hidden Markov Models to improve the context of conversation sequences and enrich the dataset with real-time data from various platform services.

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