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PREDICTIVE MODELING OF BROILER CHICKEN PRODUCTION USING THE NAIVE BAYES CLASSIFICATION ALGORITHM

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Abstract—*Serious challenges are faced by broiler chicken farmers in Seumirah Village, Nisam Antara Subdistrict, North Aceh Regency, in their efforts to create high-quality and productive chickens. These difficulties not only impact the farmers' income but also result in recurring losses every year. This research aims to design a system using the Naive Bayes Classifier algorithm to assess the capacity and classify production types based on specific criteria such as population, age, depletion, FCR (Feed Conversion Ratio), IP (Index Performance), and BW (Body Weight). The system aims to classify broiler chicken production as either increasing (profitable) or decreasing (unprofitable). In the development of this predictive system, the PHP programming language is employed, with a MySQL database as the data storage medium. The results of this broiler chicken production prediction system have proven effective in providing information in the form of profit or loss reports based on the harvest results for each monthly period. The implementation of this system is expected to assist in optimizing farmers' production management, increasing business profitability, and providing better guidance for future business decisions. The classification results using the Naive Bayes method indicate an accuracy rate of 86,67 and error rate of 13,3%.*

Keywords: *broiler chicken farming, classification, naive bayes, PHP.*

Intisari—*Tantangan serius telah dihadapi oleh peternak ayam potong di Desa Seumirah, Kecamatan Nisam Antara, dalam upaya menciptakan ayam berkualitas tinggi dan produktif. Kesulitan ini tidak hanya memberikan dampak pada pendapatan peternak, tetapi juga menyebabkan kerugian yang berulang setiap tahunnya. Penelitian ini bertujuan untuk merancang sistem dengan menggunakan metode algoritma Naive Bayes Classifier guna menilai kapasitas dan mengelompokkan jenis produksi berdasarkan kriteria tertentu, seperti populasi, usia, depleksi, FCR (Feed Conversion Ratio), IP (Index Performance), dan BW (Body Weight). Sistem ini dimaksudkan untuk mengklasifikasikan produksi ayam potong, apakah mengalami peningkatan (untung) atau penurunan (rugi). Dalam pengembangan sistem prediksi ini, digunakan bahasa pemrograman PHP, dengan database MySQL sebagai media penyimpanan data. Hasil dari sistem prediksi produksi ayam potong ini terbukti efektif dalam menyajikan informasi berupa laporan keuntungan atau kerugian berdasarkan hasil panen setiap periode bulanan. Dengan adanya implementasi sistem ini dapat membantu manajemen produksi peternak dioptimalkan dan profitabilitas usaha ditingkatkan, serta memberikan panduan yang lebih baik untuk keputusan bisnis di masa depan. Hasil klasifikasi menggunakan metode Naive Bayes menunjukkan tingkat akurasi sebesar 86,67% dan error 13,3%.*

Kata Kunci: *peternakan ayam potong, klasifikasi, naïve bayes, PHP.*

INTRODUCTION

Livestock farming is considered to be a business with promising prospects when developed optimally (Putro et al., 2023). The establishment of livestock businesses aims to enhance production, prioritizing the fulfillment of food and nutritional needs while simultaneously increasing income. Poultry farming in Indonesia has progressed significantly with the emergence of poultry trends such as broiler chickens, laying hens, and ducks, which serve as valuable livestock (Ridwan, 2020). However, the introduction of new poultry types has not deterred new farmers from choosing broiler chickens as their preferred livestock. Broiler chickens are renowned for their rapid growth, allowing them to yield meat in a relatively short period, typically within 5 to 6 weeks (Hamwar, et al., 2023).

In the village of Seumirah, Nisam Antara Subdistrict, broiler chicken farmers have encountered challenges in achieving productive and high-quality chickens (Mutasar, et al., 2022). These difficulties have not only impacted farmers' income but have also resulted in recurring financial losses (Alita, et al., 2021). In recent times, broiler chicken farmers have experienced annual losses. Addressing these issues necessitates the development of an appropriate livestock husbandry process (Singgalen, 2023). To achieve profitability, farmers are advised to carefully classify and choose materials such as seeds, feed, drugs or vitamins, cage placement, and other factors. This approach is expected to result in healthy broiler chickens with high-quality meat, positively influencing sales and benefiting farmers (Maulana, et al., 2020).

The Naive Bayes method offers several advantages compared to other classification algorithms (Fadhilah, 2020). Firstly, Naive Bayes is computationally efficient and relatively simple to implement. This simplicity also reduces the risk of overfitting, especially when dealing with limited data samples (Hasri et al., 2022). Secondly, Naive Bayes handles both numerical and categorical data well. Additionally, Naive Bayes assumes independence between features, although this may not always hold true in many real-world scenarios (Lishania et al., 2020). However, it often performs well in practice, especially when there are strong feature dependencies.

Previous studies on the Naive Bayes method have demonstrated its effectiveness in various fields, including agriculture and livestock management (Lubis et al., 2021). Researchers have applied Naive Bayes Classifier to predict and classify outcomes based on specific criteria, providing valuable insights for decision-making (Rinestu et al., 2022). The utilization of Naive Bayes in livestock farming, especially broiler chicken production, has shown promise in enhancing classification accuracy and optimizing management practices (Siddik et al., 2020). Research conducted by Septianingrum et al., 2021. In their study, noted that in the era of the Fourth Industrial Revolution, where the internet has become an essential necessity, rapid information dissemination has become common. Sentiment analysis, often employing the Naive Bayes algorithm, is increasingly crucial for understanding public opinion. Through a Systematic Literature Review (SLR), the Particle Swarm Optimization (PSO) feature selection method was considered the most optimal when used alongside the Naive Bayes algorithm, achieving an average accuracy of 89.08%. The research conducted by (Ridwan, 2020) explains that Diabetes Mellitus, or diabetes, is a metabolic disease caused by high blood sugar levels. The study utilized the UCI Machine Learning dataset on Early Stage Diabetes Risk from 2020, comprising 17 attributes. The classification method employed was Naïve Bayes Classification, resulting in an accuracy of 90.20% and an AUC value of 0.95.

In their study, Putra et al. (2022) highlight the high school student selection process, where students are categorized into Science (IPA) and Social Sciences (IPS) streams based on subject averages. They compare Naïve Bayes and K-Nearest Neighbor algorithms for classifying 11th-grade students into IPA and IPS. Utilizing second-semester scores from 277 students in PPKN, History, Crafts, and PAI, Rapidminer facilitated analysis. K-Nearest Neighbor achieved 92.73% accuracy, surpassing Naïve Bayes at 81.82%, aiding schools in precise student classification based on their interests and talents. (Dinata, et al., 2023) conducted research aiming to classify students into normal and partially color blind categories using the Naïve Bayes algorithm. The dataset included 24 Ishihara Tests from students at SMA Negeri 1 Lhokseumawe, totaling 140 data points split into 110 training and 30 testing data. Results indicated 69 students classified as normal and 41 as partially color blind. Testing with the Naïve Bayes Algorithm achieved an accuracy of 86.67% with a 13.33% error rate.

The Naive Bayes Classifier algorithm is one of the classification methods that can be used in prediction systems (Susana, 2022). This algorithm is based on probability and statistics theory, using a set of attributes to predict the class of an object. The algorithm operates by calculating the probability of an object's class based on its attributes, and then determining the class with the highest probability (Handayani & Sulistiyawati, 2021).

Considering the aforementioned issues, the researcher has built upon the foundation laid by previous studies and developed a classification system to determine the best practices in broiler chicken husbandry. The system focuses on indicators such as chicken seeds, feed, drugs or vitamins, and strategic cage environments. The classification is performed using data mining techniques with the Naive Bayes Classifier method. It is hoped that this system will effectively address classification challenges and contribute to the continuous improvement of broiler chicken farming practices. To predict the rise (profit) and fall (loss) of broiler chickens, six criteria are considered: population, age, depletion, FCR (Feed Conversion

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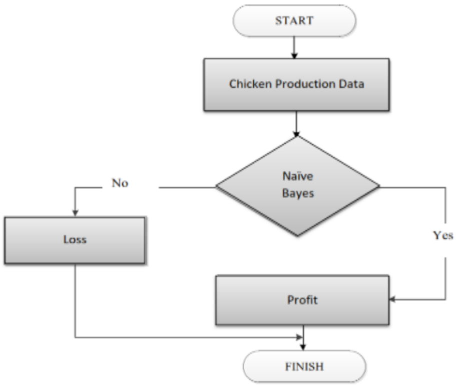
Ratio), IP (Index Performance), and BW (Body Weight).

MATERIALS AND METHODS

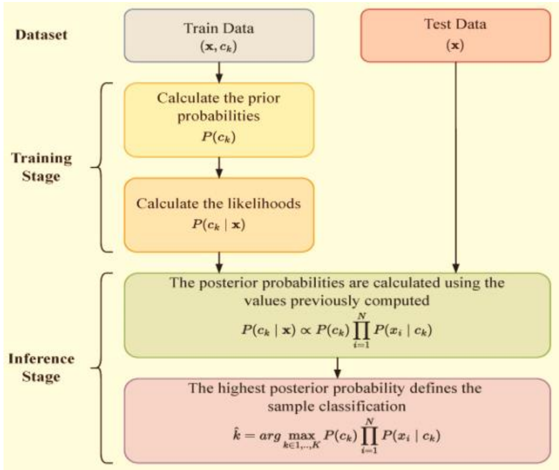
In this research, the data utilized consists of chicken production data. The chicken data will be processed using data mining methods to obtain accurate results that can be used as rules in predicting chicken quality. The following are the stages involved in conducting the research as depicted in the flowchart diagram in Figure 1.



Source : (Research Results, 2024)
Figure 1. Research Flowchart

This study utilizes the Naive Bayes algorithm to classify broiler chicken production data. The research stages employing Naive Bayes are presented as shown in Figure 2.

Based on Figure 2, the Naive Bayes algorithm is a classification method that utilizes Bayes' theorem to categorize objects based on their attributes or features. Its steps involve data collection, computation of class and feature probabilities, and the use of Bayes' theorem to calculate posterior probabilities determining the predicted class. Despite its simplicity with the assumption of independent features, Naive Bayes often yields good results, particularly in text classification and categorization. This model is quickly implementable and effective for predicting the class of an object based on its attribute information.



Source : (Research Results, 2024)
Figure 2. Naïve Bayes Algorithm

RESULTS AND DISCUSSION

Research Dataset

In the research data, six criteria are considered, each designated by a specific code: Population (C1), Age (C2), Depletion (C3), FCR (Feed Conversion Ratio) (C4), IP (Index Performance) (C5), and BW (Body Weight) (C6). These criteria collectively form the basis for analyzing and evaluating various aspects within the study. The data utilized in this research was obtained from a broiler chicken farm in Nisam Village, North Aceh Regency. The details of the data are presented in Table 1.

Table 1. Research Dataset

Dataset	C1 (Population)	C2 (Age)	C3 (Depletion)	C4 (FCR)	C5 IP	C6 BW	Class
A1|January	1000-5000	27-32 Days	0 - 5.00	1400-1700	0-250	1.06 -1.55	1
A10|January	1000-5000	27-32 Days	0 - 5.00	1400-1700	0-250	1.06 -1.55	1
A11|February	1000-5000	33-40 Days	0 - 5.00	1701-2000	0-250	1.06 -1.55	2
A12|February	1000-10000	27-32 Days	0 - 5.00	1400-1700	0-250	1.56 -2.00	1
A13|March	1000-15000	27-32 Days	5.1 - 10.00	1400-1700	301-350	1.06 -1.55	2
A14|April	1000-5000	27-32 Days	0 - 5.00	1400-1700	0-250	1.06 -1.55	2
A15|May	1000-5000	27-32 Days	0 - 5.00	1400-1700	0-250	1.06 -1.55	2
A2|March	5000-10000	33-40 Days	0 - 5.00	1400-1700	301-350	1.56 -2.00	1
A3|April	5000-10000	33-40 Days	15.01 -30.00	1400-1700	0-250	1.06 -1.55	2
A4|April	1000-5000	33-40 Days	0 - 5.00	1400-1700	251-300	1.06 -1.55	2
A5|April	1000-15000	27-32 Days	0 - 5.00	1400-1700	0-250	1.56 -2.00	1
A6|May	1000-10000	27-32 Days	0 - 5.00	1701-2000	0-250	1.06 -1.55	1
A7|May	1000-15000	27-32 Days	10.01 - 15.00	1701-2000	0-250	1.56 -2.00	1
A8|May	1000-5000	33-40 Days	0 - 5.00	1400-1700	0-250	1.56 -2.00	1
A9|May	1000-10000	27-32 Days	5.1 - 10.00	1400-1700	0-250	1.06 -1.55	2

Source : (Research Results, 2024)

The calculation of Naive Bayes

In the manual calculation of broiler chicken production prediction using the Naïve Bayes Classifier algorithm, the process is similar to the calculations performed within the system. Prior to conducting the calculation, a small amount of training data is required to determine the estimated parameters needed in the classification process of predicting whether the production will increase (profit) or decrease (loss). Sample Data (X|May Period) is tested for the A15 May criteria based on the dataset.

Population = 1000-10000
Age = 27-32 Days
Depletion = 5.1 - 10.00
FCR (Feed Conversion Ratio) = 1400-1700
IP (Index Performance) = 251-300
BW (Body Weight) = 1.06 - 1.55

a. Class
Class represents the classification condition of whether the chicken is "Loss" or "Profit."
Class C1: Decreased Production (Loss)
Class C2: Increased Production (Profit)

b. Calculation
P(Ci): P(Chicken Status = Decreased Production)

(Loss)) = 7/15 = 0.4666666.
P(Chicken Status = Increased Production (Profit)) = 8/15 = 0.5333333.

c. Calculate P(X|Ci) for Each Class:
Population (C1): 1000-10000
P(Population=1000-10000 | Class: Decreased Production (Loss)) = 1/7 = 0.142.
P(Population=1000-10000 | Class: Increased

Production (Profit)) = 2/8 = 0.25
Age (C2): 27-32 Days.
P(Age=27-32 Days | Class: Decreased Production
(Loss)) = 4/7 = 0.5714.
P(Age=27-32 Days | Class: Increased Production
(Profit)) = 6/8 = 0.75.

Depletion (C3): 5.1 - 10.00
P(Depletion=5.1 - 10.00 | Class: Decreased Production (Loss)) = 0/8 = 0.
P(Depletion=5.1 - 10.00 | Class: Increased Production (Profit)) = 2/7 = 0.2857.

FCR (C4): 1400-1700
P(FCR=1400-1700 | Class: Decreased Production
(Loss)) = 6/7 = 0.8571.
P(FCR=1400-1700 | Class: Increased Production
(Profit)) = 6/8 = 0.75

IP (C5): 251-300
P(IP=251-300 | Class: Decreased Production (Loss)) = 1/7 = 0.1428.
P(IP=251-300 | Class: Increased Production (Profit)) = 0/8 = 0.

BW (C6): 1.06 - 1.55.
P(BW=1.06 - 1.55 | Class: Decreased Production (Loss)) = 7/7 = 1.
P(BW=1.06 - 1.55 | Class: Increased Production (Profit)) = 3/8 = 0.375.

d. P(X|Ci):
P(X|Class Status = Decreased Production (Loss))
=C1+C2+C3+C4+C5+C6
= 0.14...+0.57...+0.28+0.85+0.14+1
= 3

P(X|Class Status = Increased Production (Profit))
=C1+C2+C3+C4+C5+C6
= 0.25+0.75+0+0.75+0+0.375
= 2.125

e. P(X|Ci) * P(Ci):
P(X|Class Status = Decreased Production (Loss)) * P(Class Status = Decreased Production (Loss))
= 0.4666666667 x 3 = 1.4000000002.

P(X|Class Status = Increased Production (Profit)) * P(Class Status = Increased Production (Profit))
= 0.5333333333 x 2.125
= 1.1333333333

Therefore, since the sample X in the Decreased Production (Loss) class is greater than the Increased Production (Profit) class, the predicted result is that chicken production is expected to decrease (loss).

System Implementation

The following is a step-by-step process of calculating Naive Bayes in the classification of village broiler chicken production in Nisam Subdistrict, North Aceh Regency.

Entering criteria data

The criteria data page is a form for displaying sample assessment criteria data. In this case, data

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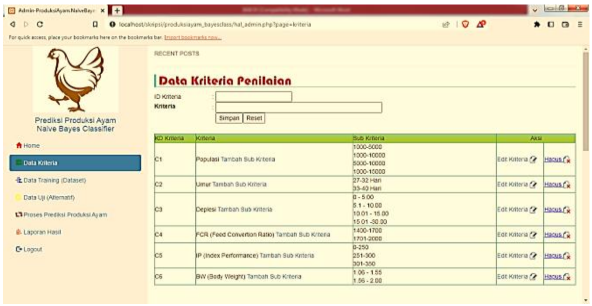
can be inputted directly as well as viewed. The appearance is as shown in Figure 3.



Source : (Research Results, 2024)

Figure 3. Entering Criteria Data Form

In the research, there are six criteria considered, each identified by a specific code: Population (C1), Age (C2), Depletion (C3), FCR (Feed Conversion Ratio) (C4), IP (Index Performance) (C5), and BW (Body Weight) (C6).

Training Data Input

The training data form is a form for displaying and inputting training data, which includes the historical production data of broiler chickens and the classification of that historical data. The appearance is as shown in Figure 4.

Source : (Research Results, 2024)

Figure 4. Training Data Form

Test Data

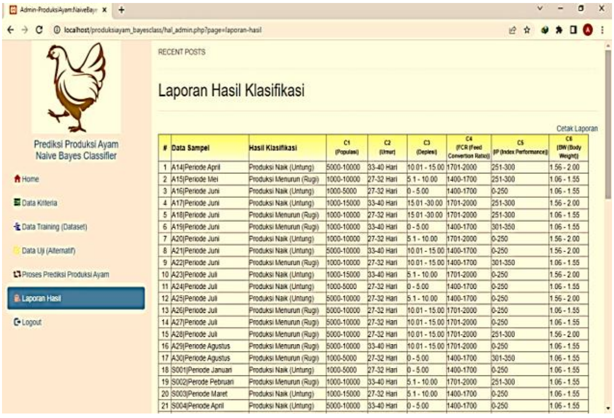
This form serves to add test data to the sample value setting form, including the sample code (kd_sampel) and sample name, in order to facilitate the process of inputting criteria values. The appearance is as shown in Figure 5.

Source : (Research Results, 2024)

Figure 5. Test Data Form

Page of Results Data

The results data page is a page that displays the outcomes of the naive Bayes classifier data mining process. Subsequently, this data can be used to generate reports and be printed. The appearance is shown in Figure 6.



Source : (Research Results, 2024)

Figure 6. Results Data Form

Accuracy Score

Accuracy calculations are carried out to assess the performance of the Naïve Bayes algorithm in the system (Dinata, et al., 2023).

$$acuracy = \frac{\text{number of true prediction}}{\text{number of data}} \quad \text{.................................} (1)$$

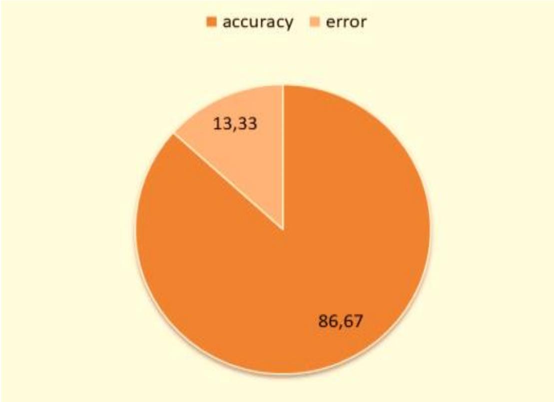
$$= \frac{13}{15} \times 100 = 86{,}67$$

$$Error = \frac{\text{number of false prediction}}{\text{number of data}} \quad \text{.................................} (2)$$

$$= \frac{2}{15} \times 100 = 13{,}33$$

In the accuracy measurement of Naive Bayes above, there were 15 data evaluated. Out of these 15 data, 13 were predicted correctly, while 2 were predicted incorrectly. Thus, the accuracy measurement of the Naive Bayes model indicates that it has an accuracy rate of 86.67%, with an error rate of 13.33%. This suggests that the Naive Bayes model tends to perform well in predicting and classifying data.

The assessment of accuracy involves determining the effectiveness of the Naïve Bayes algorithm within the system. The accuracy is calculated by dividing the number of correct predictions by the total number of data points and expressing it as a percentage. Additionally, the error rate is determined by dividing the number of incorrect predictions by the total number of data points and expressing it as a percentage as shown in Figure 7.



Source : (Research Results, 2024)
Figure 7. Accuracy Score

CONCLUSION

This research successfully addresses these challenges by introducing a predictive system utilizing the Naive Bayes Classifier algorithm. The system evaluates critical factors such as population, age, depletion, FCR (Feed Conversion Ratio), IP (Index Performance), and BW (Body Weight) to classify broiler chicken production as either increasing (profitable) or decreasing (unprofitable). Developed with the PHP programming language and utilizing a MySQL database for data storage, the system has proven its effectiveness in generating timely and insightful reports. By achieving an accuracy rate of 86.67% and an error rate of 13.3%, the Naive Bayes method demonstrates its reliability in predicting production outcomes. The implementation of this system is expected to revolutionize broiler chicken farming in the region, offering farmers valuable insights to optimize production management, enhance business profitability, and make informed decisions for sustainable growth. Ultimately, this research contributes to the advancement of agricultural practices, providing a robust foundation for future endeavors in the ever-evolving landscape of poultry farming.

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