

# Classification of Football Players' Abilities Using The Naïve Baiyes Method

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## ABSTRACT

This study aims to classify the abilities of football players in the BRI Liga 1 Indonesia season 2023/2024 using the Naïve Bayes method. The player data used includes individual stats such as the number of goals, assists, passing accuracy, tackles, and overall performance in the match. The Naïve Bayes method was chosen because of its efficient ability to process data with independent features. In this study, players were classified into several ability categories, such as excellent, good, adequate, and poor, based on their performance during the current season. The results of this classification are expected to provide useful information for coaches and club management in determining strategies and player development. The study also provides insight into the key factors that affect a player's performance in the league. Model testing shows that Naïve Bayes' method has an adequate level of accuracy for the classification of football players' abilities in BRI Liga 1. The practical implications of this study are increased efficiency in the process of evaluating players and making strategic decisions in professional football teams.

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## 1. INTRODUCTION

The development of football in Indonesia today has gone in a better direction when compared to the development in previous years, where now Indonesia has a fairly professional league and is very popular in all regions in Indonesia [1]. Since Shin Tae-yong officially became a coach in January 2020, the Indonesia national team at that time was still entrenched in the 177th FIFA ranking. Less than a year to be precise in September 2022, the 52-year-old tactician was able to bring the Indonesia national team to a drastic rise. Based on the latest FIFA ranking update as of June 2022, the Indonesia national team is ranked 155th in the world ranking. Even for the latest update as of February 2023, the Indonesia national team is ranked 151st in the world [2].

In addition, the Indonesia national team managed to qualify for the 2023 Asian Cup which has been awaited for 18 years [3]. The last time they played in the Asian Cup was in 2007 with Viet Nam, Malaysia, and Thailand. In addition, FIFA has designated Indonesia as the host of the 2023 U-17 World Cup, which will take place in four stadiums in Indonesia from November 10 to December 2 with a crowd of 400 thousand [4].

From the perspective of football observers, the football players in the competition have some young players who have quite good quality [5]. This is proven when the senior national team playing in the Asian Cup is filled with good young players and the national team lineup playing in the 2024 Asian Cup consists of young players in the Indonesia League and Europa League competitions [6]. In the midst of increasingly fierce competition, an objective assessment of players' abilities is very important for clubs in designing strategies, selecting players, and improving team performance. Assessments of a football player's abilities have traditionally been based on subjective observations from coaches and technical teams. While experience and

intuition play an important role, this approach has limitations in terms of objectivity and consistency. Therefore, a more scientific and measurable method is needed to accurately and objectively classify the player's abilities.

The Naïve Bayes *classification method*, applied to Bayes' theorem, focuses on a very strong (naïve) assumption of the independence of any condition or event. Advantages of Naive Bayes: Its performance remains superior when tested on category data types[7]. The function of the Naïve Bayes Method is to categorize or group the abilities of football players in the BRI Liga 1 Indonesia and also provide the value of the matches that have been carried out by the players.

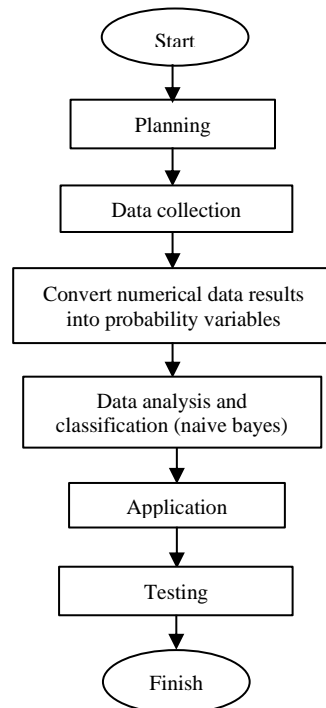
This research has the advantage of the data obtained on the website page PSSI.org very complete, in this research there is the ability of BRI Liga 1 indonesia 1 football players Full season not just 1 match and this research can classify 18 teams in BRI liga 1 Indonesia and the data from this research is generated from the ability of the football players themselves and Using more structured and objective player performance data[8].

Compared to the previous journal entitled "Comparison of CNN and Naïve Bayes' Performance on Manchester United's Performance Sentiment Analysis on Twitter" in 2023 where the previous study only classified 1 football club, namely Manchester United, and where the results of the football player ability data in the previous study were obtained in 1 match only. The data used focuses on only one specific topic (Manchester United's performance), Using data from Twitter, which may have large variations in opinion and language [9].

So that in this study, we can introduce and apply the Naïve Bayes method in the context of classifying the abilities of football players. The main difference between this study and previous studies is the focus on the use of the Naive Bayes method, which is known for its ability to efficiently handle large datasets and large variables. This method also provides a clear interpretation of how each variable affects the final classification, which can be very useful for trainers and analysts in making tactical and strategic decisions. And this research can also increase knowledge in the field of data analysis and machine learning with concrete case studies in BRI Liga 1 Indonesia.

## 2. RESEARCH METHOD

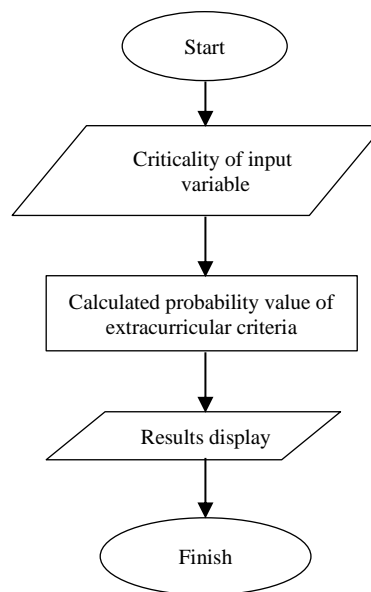
In the framework of research, a research stage containing a research model is needed. This is done so that the research stages are structured [10]. Relationship between variables. This research uses quantitative, namely research that tests theory by researching In the framework of the research there is an overview of the steps taken when conducting the research, so that the research is carried out systematically and the expected goals can be achieved [11].



**Figure 1.** Research Method

The following are the stages of the research framework:

1. This research process begins with planning, namely determining the topic to be discussed. The topic of this research is Classification Analysis of the ability of soccer players in BRI Liga 1 Indonesia 2023/2024 data through the PSSI.org website using the Naïve Bayes algorithm / method.
2. Pssi.org page data collection In this study, researchers used 540 ± data. And 270 data will be training data and 198 more data will be used as test data. In collecting this data using statistical data on players on the Pssi.org website.
3. In this research, data analysis and classification, namely the ability of soccer players in BRI Liga1 Indonesia as an initial process for data processing, this process is used for data collection Start by collecting data about soccer players, including attributes such as age, playing position, game statistics, attendance in matches. Make sure the data has a label that indicates the player's ability, for example, "talented", and "untalented".



**Figure 2.** Flow of Research

The stages in this study include:

1. The application of this research begins with retrieving data from Websie pssi.org regarding the ability of soccer players in BRI Liga1 which will be analyzed and classified,
2. then calculate the weight of Passing, Intercaption, Shooting and goal
3. After calculating the data, categorize the contents of the data that has been calculated and then the results of the data are processed/applied using the Naïve Bayes method.
4. Then the data that has been applied using the Naïve ayes method then the data also produces a statistical graph of the ability results of all players.

### 2.1. Naïve Bayes

Naive Bayes is a classification method based on Bayes' Theorem with the assumption of independence between features. Although this assumption is rarely met in practice, Naive Bayes often gives good and efficient results in various classification applications. Bayes' Theorem states that:

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

Naive Bayes is a classification method based on Bayes' Theorem, which measures the probability of data belonging to a particular class based on available information. The algorithm is known as "naive" due to the assumption that each feature in the data is independent of the other features, which is often not true in real-world applications but makes calculations simpler and more efficient.

Naive Bayes classifier is a probabilistic classifier based on Bayes' theorem with an assumption of independence among features. Despite the simplicity of its assumption of independence, Naive Bayes performs surprisingly well for many real-world problems, particularly in text classification and spam filtering

Naive Bayes Classifier is a classification method based on Bayes' theorem. This classification method uses probability and statistical methods first proposed by an English scientist named Thomas Bayes, which is a method for predicting future opportunities based on previous experience, so this method is known as Bayes' Theorem.

Naive Bayes Classifier has better accuracy than other classifier models. Research conducted by Xhemali, Hinde and in his journal "Naive Bayes vs. Decision Trees vs. Neural Networks in the Classification of Training Web Pages" said that "Naïve Bayes Classifier has a better accuracy rate than other classifier models" (Mustafa et al., 2018).

## 2.2. Liga 1 Football Indonesia

Football is a sport that has tremendous appeal in Indonesia, and Liga 1 Indonesia is the top football competition in the country. Liga 1, known as Shopee Liga 1 for sponsorship purposes, is a professional league that brings together the best clubs from across the country in a prestigious competition. Launched in 2017, Liga 1 replaced the Indonesian Super League (ISL) as the premier league, with the aim of raising the standard of domestic competition and creating a more professional platform for local clubs and players [7].

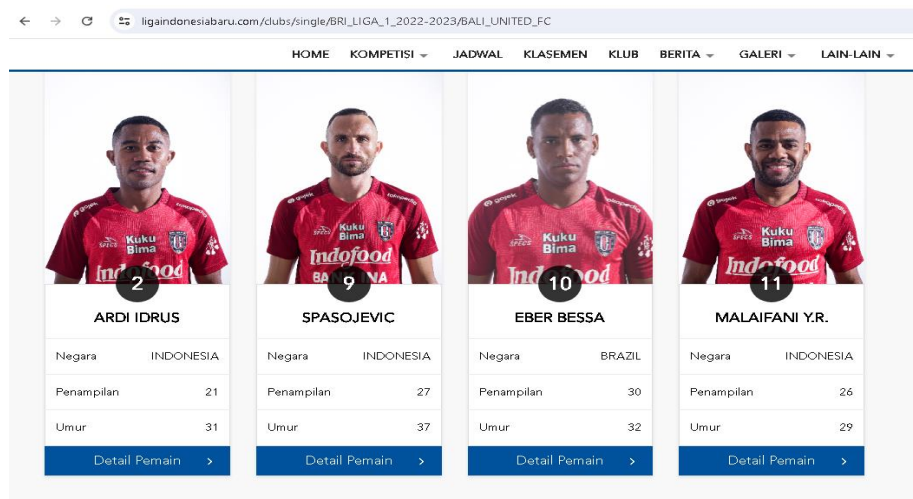
## 3. RESULTS AND ANALYSIS

### 3.1. Data Processing

The data used in this study is sourced from the official PSSI website (pssi.org) and focuses on the BRI Liga 1 2023/2024 season. This data includes a variety of information that is relevant for player analysis [13]. Player data for the BRI Liga 1 Season 2023/2024 (figure 3), there are 18 participating clubs. Based on data from the official PSSI website, each club is allowed to register up to 35 players in their squad. Thus, if all clubs maximize the number of registered players, there are a total of up to 630 players registered for this season's BRI Liga 1 competition matches in the league. Here are the types of data variables used.

Player Dataset:

1. Player name  
The player name is used to uniquely identify each player in the dataset. This is important to ensure that the performance data being analyzed corresponds to the player in question. Allows tracking and cross-referencing with other data or external sources of information if needed for data validation or updates.
2. Age  
A player's age can affect their physical abilities and playing experience. Young players may have better speed and stamina, while older players may have better experience and strategy.
3. Origin Club  
Origin clubs can reflect the quality of a player's training and playing environment. Bigger clubs may have better facilities and training programs, which can affect a player's performance.
4. Number of Passes  
The number of passes reflects a player's technical ability to pass the ball and his contribution to teamwork. Players with high passing usually play an important role in the flow of the game.
5. Number of Shots  
The number of shots shows a player's attacking ability and his courage to try to score. It is a direct indicator of a player's scoring potential.
6. Number of Interceptions  
The number of interceptions reflects a player's ability in defensive aspects, such as reading the opponent's game and cutting off the flow of the ball. An important indicator for defenders or defensive midfielders, showing their contribution in keeping the team balanced.
7. Number of appearances  
The number of appearances shows how often a player is played in matches, reflecting the coach's confidence and the consistency of the player's performance. Players with a high number of appearances usually have good fitness and discipline in maintaining their condition to be able to play regularly.



**Figure 3.** Player data on the Pssi.Org Website

*PSSI.org website* presents complete data on Indonesia football athletes, including national team players of different age and gender categories and Player Profiles: Each player has a profile page that contains personal and professional information such as full name, date of birth, playing position, current club, and career statistics. This information is available to players from the senior team to the junior team.

**Table 1.** Datast of the abilities of existing football players in BRI Liga1 Indonesia

No	Name	Club	Age Category	Passing	Shooting	Inter Caption	Appearances
1	Joko Susilo	Arema	Senior	275	2	36	9
2	Bayu Aji	Arema	Senior	71	1	9	5
3	Sergio	Arema	Senior	1116	21	172	30
4	Bagas Adi	Arema	Senior	1205	14	88	28
...	...	...	...	...	...	...	...
554	Bagas Kara	Rans Cilegon	Senior	280	37	12	31

Table 1 dataset focuses more on individual player statistics, such as the number of passes, shots, and interceptions. This data is taken from the PSSI.org website. The amount of data collected is 554 player data.

**Table 2.** Dataset of football goalkeeper abilities in BRI Liga1 Indonesia

No	Name	Club	Age Category	Passing	Shooting	Inter Caption	Appearances
1	Galih. F	Arema	Senior	0	0	0	0
2	Amiruddin	Arema	Senior	186	0	1	9
3	Nadeo Winata	Bali United	Senior	272	0	0	17
4	Yogi	Borneo	Junior	0	0	0	0
...	...	...	...	...	...	...	...
64	Wahyudi	Rans Cilegon	Senior	0	0	0	0

This table is data on the ability of football goalkeepers in BRI Liga1 Indonesia. This display contains data on the name of the goalkeeper, club, age, number of passing, shooting, saves and attendance. The data that was lumpy was 64 goalkeeper data.

**Table 3.** Dataset of the ability of BRI Liga1 Indonesia football players that have changed the value of the Variable to Probability

No	Name	Club	Age Category	Passing	Shooting	Inter Caption	Appearances	Target Variabel
1	Joko Susilo	Arema	Senior	Very Good	Very Less	Less	Less	No Quality
2	Bayu Aji	Arema	Senior	Very Good	Very Less	Very Less	Very Less	No Quality
3	Sergio	Arema	Senior	Very Good	Very Good	Very Good	Very Good	Quality
4	Evan Dimas Darmono	Arema	Senior	Very Good	Very Good	Mid	Good	Quality
...	...	...	...	...	...	...	...	...
554	Bagas Kara	Rans Cilegon	Senior	Very Good	Very Less	Very Good	Very Good	Quality

**Tabel 4.** Dataset of the ability of the BRI Liga1 Indonesia Goalkeeper (Probablility)

No	Name	Club	Age Category	Passing	Inter Caption	Appearances	Target Variabel
1	Galih F.	Arema	Senior	Very less	Very less	Very less	No Quality
2	Amiruddin	Arema	Senior	Very good	Very less	Less	No Quality
3	Maringa	Arema	Senior	Very good	Very less	Very good	Quality
4	Nadeo Winata	Bali United	Senior	Very good	Very less	Good	Quality
...	...	...	...	...	...	...	...
67	Wahyudi	Rans Cilegon	Senior	Very less	Very less	Very less	No Quality

### 3.2. Processing Results

In this study, the researcher used as many as  $540 \pm$  data. And 270 data will be used as training data and another 198 data will be used as test data. In this data collection, player statistics data is used on Pssi.org website[14]. The data collection process in this study takes the data on the Pssi.org website and after taking data from the players and then categorizing the results of the variables that have been determined, then the researcher applies this Naïve Bayes method into Microsoft excel and also displays statistical graphs.

#### 3.2.1. Application of Probability Calculation

Naïve Bayes uses probability calculations to predict the category or class of new data based on previously given training data. The process involves the following steps:

1. Calculating A Priori Probabilities

The initial probability of each class is calculated based on the frequency of that class in the training data. For example, if we have two classes (e.g. "spam" and "not spam"), we calculate how many examples in the training data belong to each class.

2. Calculating Likelihood (Conditional Probability)

For each feature or attribute, we calculate its probability of occurring in each class. For example, in spam email classification, we might calculate the probability that a particular word (e.g. "free") appears in spam emails compared to non-spam emails.

3. Calculating Posterior Probabilities with Bayes' Theorem

Using Bayes' Theorem, we calculate the probability that new data belongs to each possible class.

#### 3.2.2. Calculate Conditional Probability

Conditional probability is an important concept in probability theory and statistics that is often used to understand the relationship between two or more events in the context of uncertainty. An understanding of conditional probability is not only essential in academia, but also has wide practical applications in a variety of fields, including data science, machine learning, finance, and more.

Conditional probability is important in many contexts, as we often need to take into account additional information when calculating the probability of an event. Some examples of applications are: Medical Diagnosis: In the medical world, doctors often use conditional probabilities to predict the likelihood of an illness based on existing test results. For example, if a patient has certain symptoms, conditional probabilities help in determining whether the patient might have a particular disease.

Financial Risk Assessment: Conditional probabilities are used in financial risk models to calculate the likelihood of credit default by a borrower, based on additional information such as credit history or economic changes. Machine Learning: Many machine learning algorithms, including Naïve Bayes, use conditional probabilities to make predictions based on training data. For example, conditional probabilities are used to predict the category of an email (spam or not spam) based on the words that appear in the email.

Information Security: In cryptography and information security, conditional probabilities are used to analyse and predict threats to security systems based on known patterns of behaviour. Calculating Conditional Probability: Steps

#### 3.2.3. Naïve Bayes' Calculation

For new players with features: Age = Young, Goals = Many, Appearance = Many, we will calculate the probabilities of each class using the Naïve Bayes formula Here are the steps to determine the probability values in each category:

- Number of qualified players / Total players =  $256/619 = 0.41$
- Number of quality players who are young / Number of quality players =  $55/ 256 = 0.21$
- Number of quality players who score a lot of goals / Number of quality players =  $2041/$

- number of quality players who provide a lot of assists / Number of quality players = 34/ 256 = 0.13
- Calculating the Combined Probability  $0.41 \times 0.21 \times 7.9 \times 0.13 =$
- $P(\text{Quality Player}|\text{Young}, \text{Many Goals}, \text{Many Assists}) \approx 0.0884 P(\text{Quality Player} | \text{Young}, \text{Many Goals}, \text{Many Assists}) \approx 0.0884$

**3.3. Analysis and Evaluation**

The determination or classification of whether someone or something is a "player" based on the analysed data. For example, the algorithm can be used to determine whether an individual is suitable to be a "player" in a game or competition based on certain features, can view table 5.

**Table 5.** Output of the Naive Bayes algorithm of soccer player score results

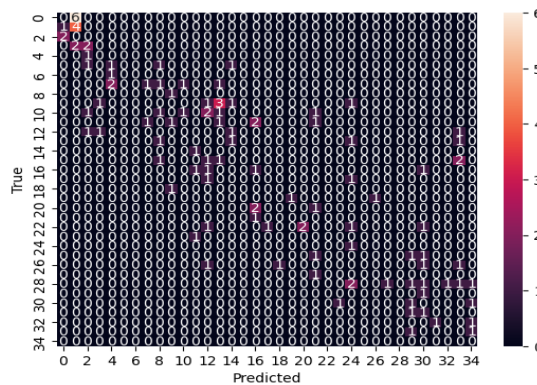
No	Precision	Recal	F1-Score	Support
1	0.00	0.00	0.00	6
2	0.33	0.00	0.47	5
3	0.00	0.00	0.00	2
4	0.00	0.00	0.00	4
5	1.00	0.00	0.00	4
6	1.00	0.00	0.00	1
7	0.50	0.14	0.22	6
8	0.00	0.00	0.00	1
9	0.00	0.00	0.00	7
10	0.50	0.14	0.22	7
20	0.00	0.00	0.00	3

The output of the Naive Bayes algorithm includes posterior probabilities for each class, the final prediction based on the highest probability, conditional probabilities of the features, as well as evaluation metrics that assess the performance of the model. All these provide a comprehensive overview of how the data is classified and how effective the model is in predicting the correct class.

The determination of whether an individual or object should be assigned the role of "keeper." For example, in sports team data analysis, the algorithm can be used and The results of applying the Naive Bayes algorithm to goalkeeper data provide information on how goalkeepers are classified into different performance categories based on their statistical features. This includes posterior probabilities, class predictions, and model performance evaluation. With these results, team managers or coaches can make more informed decisions about game strategy or player

**Table 6.** Naive Bayes algorithm output of soccer goalkeeper score result

No	Precision	Recal	F1-Score	Support
1	1.00	0.00	0.00	3
2	0.00	1.00	0.00	0
6	0.00	1.00	0.00	0
13	1.00	0.00	0.00	1
14	1.00	0.00	0.00	2
15	1.00	0.00	0.00	1
17	0.00	1.00	0.00	0
21	0.00	1.00	0.00	0
27	0.00	1.00	0.00	0
30	1.00	0.00	0.00	1
33	1.00	0.00	0.00	1



**Figure 4.** Results of Naive Bayes' Algorithm

Figure 4, Calculation refers to the output or final result produced after the Naive Bayes algorithm is run on a dataset. states that the result of a calculation using the Naive Bayes algorithm is the final output or result produced after the algorithm is applied to a dataset. This includes Final Output: Posterior probabilities for each class based on the features in the data, Class, PredictionThe class selected as the final result of the classification process, Model Evaluation: A measurement of the model's performance based on how accurate its predictions are.

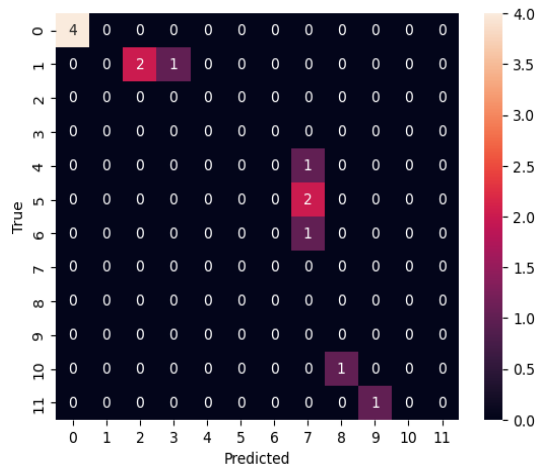


Figure 5. Goalkeeper Bayes Naive Algorithm Calculation Results

After going through the stages of data collection, preprocessing, and application of the Naive Bayes method in classifying the abilities of football players in the BRI Liga 1 Indonesia, we obtained some interesting results. To visualize and further understand the performance of the model used, we present the results of the analysis in the form of graphs. The Figure 6 provide a clearer picture of the data distribution, prediction accuracy, and performance comparison based on predefined evaluation metrics[15]. The following is a graph of the ability of BRI Liga Indonesia football players for the 2023/2024 season.

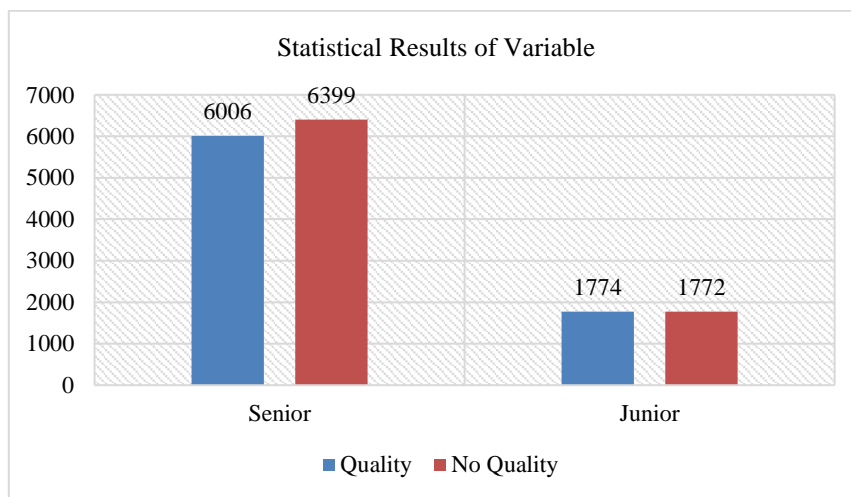


Figure 6. Statistical Results of variable status Ability of soccer player BRI League Indonesia season 2023/2024

Refers to the results of statistical analysis related to the status of soccer player ability variables in the BRI League Indonesia competition for the 2023/2024 season. This means that data has been collected and analyzed to assess various aspects of a soccer player's ability during the season. The results of this analysis may include information on player performance, ability trends, and factors that influence their play.

The sentence implies that a study or report has been conducted to analyze the ability of football players in the BRI League Indonesia for the 2023/2024 season, using statistical methods to evaluate the various variables that affect their performance.



#### 4. CONCLUSION

This study shows that the Naive Bayes method is effective in classifying the abilities of football players in the BRI Liga 1 Indonesia season 2023/2024. The manual data processing process requires attention to detail, especially in data cleaning and normalization, which greatly affects the classification results. The developed model is capable of classifying players with sufficient accuracy, making it a potential tool for player evaluation. Thus, this study provides a solid basis for further exploration in the classification of football players' abilities using the Naive Bayes method and the development of a more comprehensive model. The results show that the number of quality players is around 7180, of which senior players are around 6006 players and 1174 junior players.

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