



# Using Support Vector Regression Kernel Models for Cricket Performance Prediction in the Womens Premier League 2024

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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## Abstract

**Background.** The interest in women's premier league cricket has caused the need for advanced analytics to understand the multifaceted dynamics of the sport.

**Study Purpose.** This study aimed to contribute to sports analytics by assessing the efficacy of Support Vector Regression (SVR) kernel models in predicting the most valuable player. Such research methods as ANOVA, Bessel function, and Inverse MultiQuadratic kernel application have been deliberately chosen for their diverse mathematical approaches, aligning with the nuanced intricacies of women's premier league cricket.

**Materials and methods.** Player performance was analyzed by using the following study methods: ANOVA, Bessel function and Inverse MultiQuadratic kernel application. The data, sourced from espnricinfo.com and the International Cricket Council, includes essential metrics for five teams. Rigorous preprocessing techniques, such as imputation and outlier removal, enhance data reliability, ensuring robust predictive models.

**Results.** The application of the Inverse MultiQuadratic kernel exhibits exceptional predictive performance, surpassing ANOVA and Bessel function models. The kernel's radial basis function proves effective in capturing the intricate dynamics of women's premier league cricket. The findings underscore the suitability of kernel method for predicting standout performers in the Women's Premier League 2024 season.

**Conclusions.** The study revealed the dynamic interplay between sports analytics and machine learning in women's premier league cricket. The application of the Inverse MultiQuadratic kernel stands out as the most effective model, providing key insights into player predictions. This emphasizes the continual integration of advanced analytical techniques to enhance our understanding of the evolving landscape of women's premier league cricket. As the sport gains prominence on the global stage, such analytical endeavors become imperative for strategic decision-making and sustained growth.

**Keywords:** women's cricket, support vector regression, machine learning, comparative analysis, performance prediction.

## Introduction

The realm of women's premier league cricket has been experiencing unprecedented growth, attracting heightened attention from enthusiasts and stakeholders alike. In response to this surge, the significance of employing advanced predictive modeling techniques cannot be overstated

(Kapadia et al., 2022). This research endeavors to explore the application of Support Vector Regression (SVR) with distinct kernel models, namely ANOVA, Bessel function, and Inverse MultiQuadratic, to predict the player's performance of women's premier league cricket in the upcoming 2024 season (Sumathi et al., 2023; Aburas et al., 2018). Cricket, as a sport, is influenced by a multitude of factors, ranging from individual player form to team dynamics and external conditions. Leveraging sophisticated analytics and machine learning methodologies holds the potential to unravel the intricate relationships within these factors, surpassing

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traditional statistical approaches (Subburaj et al., 2023; Passi and Pandey, 2018a). This study seeks to contribute to the evolving field of sports analytics by examining the effectiveness of different SVR kernel models in forecasting the player's performance of women's cricket league (Passi and Pandey, 2018b; Bunker and Thabtah, 2019).

**Support Vector Regression and Kernel Models.** SVR is grounded in finding an optimal hyperplane that maximizes the margin between data points, accommodating a controlled margin of error to handle intricate, non-linear relationships within a dataset (Vetukuri et al., 2019). The core of SVR's efficacy lies in its utilization of kernel functions to map input data into higher-dimensional spaces. These kernels are pivotal in transforming input features, a choice that significantly impacts SVR's performance and is crucial for predictive modeling (Dogan and Birant, 2021; Abebe et al., 2020).

The ANOVA kernel, derived from Analysis of Variance, offers a distinctive approach to SVR by emphasizing the capture of variance in datasets. This kernel excels when intricate variations within the data play a pivotal role. By prioritizing the discernment of nuanced variances, the ANOVA kernel enhances SVR's ability to identify subtle patterns within the intricate dynamics of women's premier league cricket performances (Gu et al., 2023). Introducing an oscillatory behavior, the Bessel function kernel excels at capturing periodic patterns and cyclic variations in datasets. In the context of cricket performance predictions, where team dynamics may exhibit periodic fluctuations, the Bessel function kernel becomes a valuable mathematical tool. Its ability to resonate with cyclical patterns contributes to a holistic understanding of factors influencing women's cricket player's performances (Gu et al., 2023; Saikia, 2020). The Inverse MultiQuadratic kernel introduces a radial basis function, offering a unique perspective on the relationship between input features. By incorporating the inverse of the Euclidean distance between data points, this kernel underscores the significance of proximity in predictive modeling. In the domain of women's premier league cricket, where team dynamics and interactions significantly impact performance, the kernel's focus on proximity adds a layer of sensitivity to the SVR model (Gu et al., 2023; Wickramasinghe, 2014).

This research's intentional focus on women's premier league cricket underscores the importance of gender-inclusive sports research (Subburaj et al., 2023). As women's cricket continues to ascend on the global stage, understanding and predicting team dynamics become imperative for various stakeholders (Passi and Pandey, 2018b). These include team management making strategic decisions, sponsors assessing investment opportunities, and fans engaging in the sport. Through our comparative analysis, we aim to provide a nuanced understanding of the strengths and weaknesses of distinct SVR kernel models concerning predicting the most valuable player in women's premier league cricket 2024 (Bunker and Thabtah, 2019; Wickramasinghe, 2014). The selected kernels for this study, ANOVA, Bessel function, and Inverse MultiQuadratic, represent diverse mathematical approaches. ANOVA, emphasizing variance analysis, aims to capture nuanced variations in player's performances. Bessel function, known for its oscillatory behavior, brings a unique perspective to the analysis (Hudnurkar & Rayavarapu, 2022).

The Inverse MultiQuadratic kernel introduces a radial basis function that may enhance predictive capabilities. The objective in comparing these kernels is to identify the model that best aligns with the complex dynamics inherent in women's premier league cricket (Van Eetvelde et al., 2021; Anam et al., 2021).

**The purpose of the research.** The Support Vector Regression (SVR) with ANOVA, Bessel function, and Inverse MultiQuadratic kernels to predict player performance in the Women's Premier League Cricket 2024 season.

## Materials and Methods

### Study Participants

The dataset is meticulously curated from two reliable sources: espncricinfo.com and the official website of the International Cricket Council (ICC). The dataset metrics for five teams and a total of 90 players participating in the WPL, including the number of matches played, batting averages, bowling averages, catches taken, and the T20 status of the 18 players in each squad, as shown in Figure 1 (International Cricket Council; ESPNcricinfo; Women's Premier League).

Matches	Batting_Avg	Bowling_Avg	Catches	Performance_Prediction
44	16.529382	29.409980	7.535972	43.356918
78	7.888586	23.961124	17.246971	75.019049
30	7.841652	20.171912	5.598902	56.491503
90	8.529467	24.112106	13.446212	69.412674
94	7.768144	25.286781	29.203114	55.396902
25	43.827092	1.262447	11.341412	55.140026

Fig. 1. Sample Dataset

### Study organization

This investigation aims to predict the most valuable player of the upcoming Women's Premier League (WPL) 2024 season, focusing on essential performance metrics using three different SVR kernel models such as ANOVA, Bessel function, and Inverse MultiQuadratic. Data preprocessing to address missing values is fundamental to the reliability of predictive models. Robust imputation methods, such as mean or median imputation, are employed to fill in missing values. Additionally, data integrity checks are performed to identify and rectify any anomalies in the dataset. Identifying and removing outliers is critical for refining the dataset. Outliers can distort model training, and their removal enhances the robustness and generalization capabilities of the SVR models (Subburaj et al., 2023).

The data splitting adheres to a well-established principle, allocating 80% of the acquired dataset for training the Support Vector Regression (SVR) models, while reserving the remaining 20% for rigorous testing and evaluation. This meticulous division ensures a robust and comprehensive training phase, allowing the SVR models to glean intricate patterns and relationships from the majority of the data. Subsequently, the earmarked 20% functions as an independent dataset, remaining untouched during the training process, thereby facilitating an unbiased assessment of the models' predictive capabilities (Kapadia et al., 2022; Men,

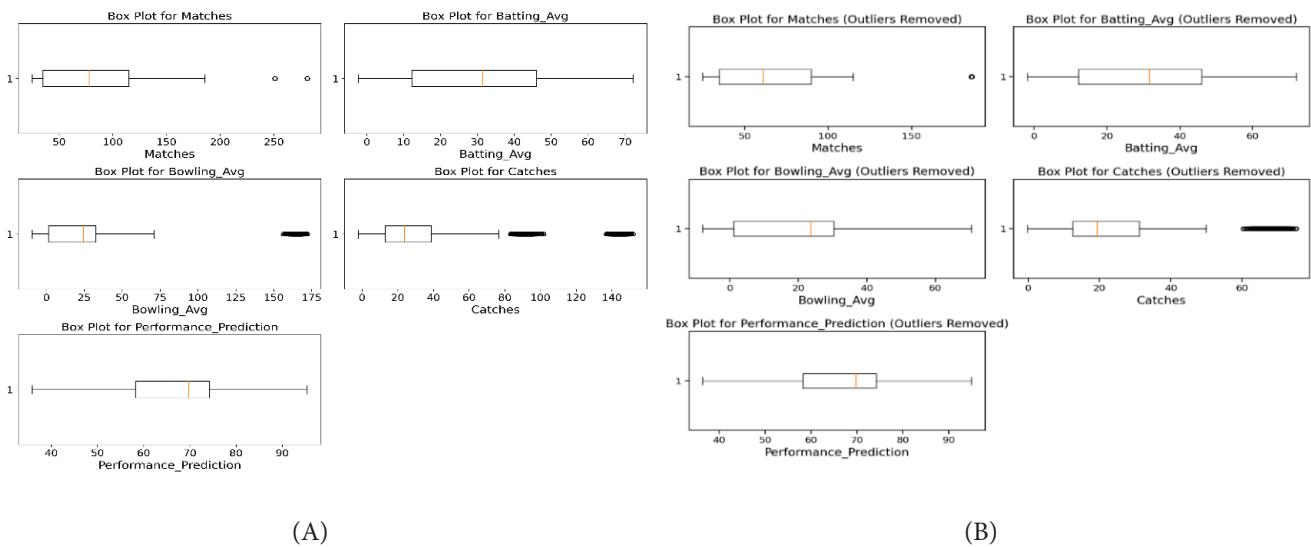


Fig. 2. In the presence of outliers, the dataset is graphically displayed as a boxplot (A), and outliers were eliminated as shown in (B)

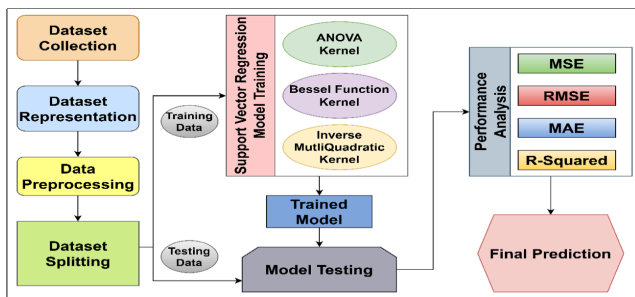


Fig. 3. Methodological process overview

2022). The training process involved the application of three distinct kernels - ANOVA Kernel, Bessel Function Kernel and Inverse MultiQuadratic Kernel. Parameters were fine-tuned through methods like grid search, ensuring optimal model performance. Testing involved making predictions on the independent dataset, and the models' effectiveness was evaluated using metrics such as Mean Squared Error and R-squared (Sanjaykumar et al., 2023). The ultimate aim is to contribute to the creation of reliable and precise predictive models capable of accurately forecasting the performance of women's premier league cricket players in the anticipated 2024 season.

**Statistical analysis**

Mean Squared Error (MSE) calculates the average squared difference between predicted ( $A_{predict}$ ) and actual ( $A_{actual}$ ) values, while Root Mean Squared Error (RMSE) is its square root. Mean Absolute Error (MAE) measures the average absolute difference. R-Squared ( $R^2$ ) evaluates predictive accuracy by comparing actual and predicted values to the mean.

$$\begin{aligned} \text{Mean Squared Error (MSE)} &= \frac{1}{x} \sum (A_{predict} - A_{actual})^2 \\ \text{Root Mean Squared Error (RMSE)} &= \sqrt{MSE} \\ \text{Mean Absolute Error (MAE)} &= \frac{1}{x} \sum (A_{predict} - A_{actual}) \\ \text{R-Squared (R}^2\text{)} &= 1 - \frac{\sum (A_{actual} - A_{predict})^2}{\sum (A_{actual} - A_{mean})^2} \end{aligned}$$

In the given equation,  $A_{actual}$  signifies observed performance values,  $A_{predict}$  represents predicted performance,  $A_{mean}$  stands for the mean of actual performance values, and  $x$  denotes the number of data points (Sanjaykumar et al., 2023; Rajendiran and Rethnaraj, 2023).

**Results**

The research study unfold the outcomes on predicting the most valuable player in the upcoming Women's Premier League (WPL) 2024 season. The research focus lies on leveraging Support Vector Regression (SVR) with distinctive kernel models – ANOVA, Bessel function, and Inverse MultiQuadratic. This segment serves as an exclusive platform to present our analyses and engage in a comprehensive discussion, dissecting the performance of each SVR kernel model in forecasting women's premier league cricket.

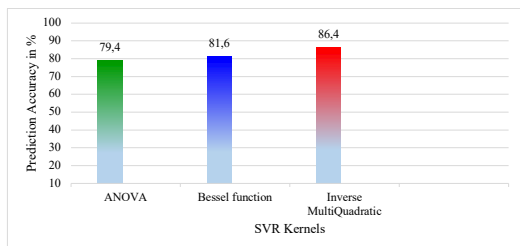
**Comparative analysis**

The Comparative Analysis section unfolds a detailed assessment of the diverse Support Vector Regression (SVR) kernel types ANOVA, Bessel function, and Inverse MultiQuadratic based on essential metrics such as Mean Squared Error (MSE), Root Mean Squared Error (RMSE), Mean Absolute Error (MAE) and R-Squared ( $R^2$ ) Table 1. These metrics serve as pivotal indicators in gauging the precision and efficacy of each kernel in predicting the most valuable player for the Women's Premier League 2024 season. The ensuing discourse meticulously explores the distinctive characteristics of each kernel, presenting unique insights into their individual strengths and areas where refinement may enhance predictive capabilities.

The Support Vector Regression (SVR) kernel types ANOVA, Bessel function, and Inverse MultiQuadratic reveals the distinct performance metrics crucial for assessing their predictive capabilities in the context of the Women's Premier League 2024 season. In analyzing the Mean Squared Error (MSE), the average squared disparity between predicted and actual values, it emerges as the most proficient

**Table 1.** Performance metrics of support vector regression with different kernels

Support Vector Regression – Kernel Type	Mean Squared Error (MSE)	Root Mean Squared Error (RMSE)	Mean Absolute Error (MAE)	R Squared (R <sup>2</sup> )
ANOVA	20.1357	4.4872	8.0684	0.79386
Bessel function	18.2389	4.2707	7.1290	0.81563
Inverse MultiQuadratic	13.6294	3.6918	2.5639	0.86392

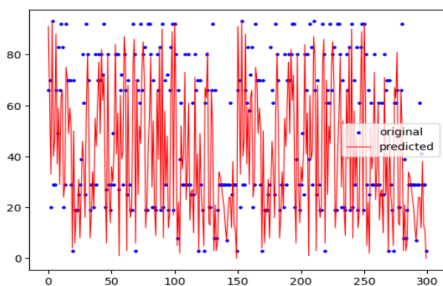


**Fig. 4.** Accuracy analysis of support vector regression with different kernels

with the lowest MSE of 13.6294. Root Mean Squared Error (RMSE), emphasizing prediction accuracy, echoes this trend, where it attains the smallest RMSE of 3.6918. Mean Absolute Error (MAE), indicating average absolute differences, further underscores Inverse MultiQuadratic’s superiority with the smallest MAE of 2.5639. R-squared (R<sup>2</sup>) gauging explanatory power, consistently position with the highest values, signifying its adeptness in capturing variance and making precise predictions (Table 1). In essence, these findings accentuate the exceptional predictive performance of the kernel in this comparative analysis (Figure 4).

#### Performance Prediction Based on Inverse MultiQuadratic kernel.

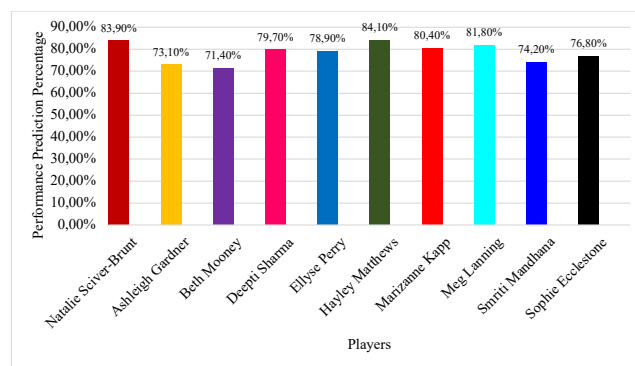
The application of the Inverse MultiQuadratic kernel in Support Vector Regression (SVR) emerges as a standout feature in our research, showcasing an impressive predictive accuracy of 86.4%. This surpasses the performance of other kernels, specifically ANOVA and Bessel function, in anticipating the most valuable player for the Women’s Premier League 2024 season. This kernel, characterized by its radial basis function, proves to possess an exceptional capability to discern intricate patterns within the dataset, leading to heightened precision in performance predictions.



**Fig. 5.** Visualizing the performance prediction graph of the Inverse MultiQuadratic kernel model, the predicted values (donated in red) and actual value (represented in blue color) with slight deviation

#### Most Valuable Player prediction based on Inverse MultiQuadratic kernel.

The predictions based on the Inverse MultiQuadratic kernel for the most valuable player in the upcoming Women’s Premier League (WPL) season 2024 reveal intriguing insights into the potential standout performers. Hayley Matthews emerges as a front-runner with a substantial prediction percentage of 84.1%, indicating a high likelihood of her securing the coveted title. Following closely are players like Natalie Sciver-Brunt (83.9%), Marizanne Kapp (80.4%), and Meg Lanning (81.8%), showcasing strong predictions for their significant impact on the league. Notably, the kernel anticipates consistent performances from key players such as Ellyse Perry (78.9%), Deepti Sharma (79.7%), and Smriti Mandhana (74.2%) (Figure 6).



**Fig. 6.** Prediction of Most Valuable Players for WBL 2024 season based on Inverse MultiQuadratic kernel

#### Discussion

We looked at how well Support Vector Regression (SVR) kernel models ANOVA, Bessel function, and Inverse MultiQuadratic worked at predicting who would be the most valuable player in the 2024 Women’s Premier League (WPL) season. Notably, the kernel exhibits superior predictive accuracy, boasting the lowest mean squared error (MSE), root mean squared error (RMSE), and mean absolute error (MAE), alongside the highest R-squared (R<sup>2</sup>) (Table 1) (Kaur et al., 2021; Xu et al., 2023).

The implementation of the Inverse MultiQuadratic kernel, which stands out for its radial basis function, displays an impressive predictive accuracy of 86.4% (Figure 4). This outperforms alternatives like ANOVA and the Bessel function, emphasizing its proficiency in identifying intricate patterns within the dataset. The visual representation of the performance prediction graph reinforces the reliability of the model, aligning predicted values closely with actual outcomes. Predictions for the most valuable player,

based on this kernel, offer compelling insights. With an 84.1% prediction percentage, Hayley Matthews pulls ahead of Natalie Sciver-Brunt, Marizanne Kapp, and Meg Lanning as the leading contender. Additionally, consistent performances are anticipated from key players such as Ellyse Perry, Deepti Sharma, and Smriti Mandhana, providing valuable information for various stakeholders. The Inverse MultiQuadratic kernel proves to be a standout choice for predicting the most valuable player in the WPL 2024 season. Its efficacy in capturing the dynamics of women's premier league cricket positions it as a valuable tool for stakeholders, aiding in strategic decision-making and enhancing overall understanding of player performances in this evolving sporting landscape (Mandoli et al., 2021; Passi and Pandey, 2018c).

While this research study provides valuable insights, there are opportunities for future exploration and refinement of predictive modeling in women's premier league cricket (Awan et al., 2021). The inclusion of additional features, such as player fitness, team strategies, and external factors like weather conditions, could enhance predictive models. Exploring ensemble methods and hybrid models may further amplify predictive accuracy. Ongoing advancements in data analytics and machine learning techniques call for continuous adaptation and refinement of models. Future research could extend to other cricket leagues or sports, expanding the applicability of predictive analytics in women's sports (Kruglov and Khudolii, 2022; Bullock et al., 2022). In essence, this research lays the groundwork for a dynamic interplay between sports analytics and machine learning in women's premier league cricket. As the sporting landscape evolves, predictive modeling becomes an indispensable tool, offering strategic insights and fostering a deeper understanding of the intricate dynamics influencing player performances (Aburas et al., 2018). Through ongoing research and refinement, the field of sports analytics is poised for continuous growth and contribution to the expanding domain of women's cricket (Simsek et al., 2021).

## Conclusions

The Inverse MultiQuadratic kernel emerges as the top performer, displaying superior results across key metrics, including Mean Squared Error (MSE), Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and R-Squared (R<sup>2</sup>). Its unique radial basis function and emphasis on proximity contribute to its adeptness in capturing nuanced patterns within the dataset. The predictions based on this kernel for the most valuable player in the upcoming Women's Premier League (WPL) season 2024 reveal intriguing insights into the potential standout performers. Hayley Matthews emerges as a front-runner with a substantial prediction percentage of 84.1%, indicating a high likelihood of her securing the coveted title.

## Acknowledgement

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## Conflict of interest

The authors declare that there is no conflict of interest.

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## Застосування ядрових моделей опорно-векторної регресії для прогнозування результатів гри в крикет у Жіночій прем'єр-лізі 2024 року

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 7 с., 1 табл., 6 рис., 29 джерел.

**Історія питання.** Інтерес до жіночої прем'єр-ліги з крикету викликав потребу в застосуванні розширеної аналітики для розуміння багатогранної динаміки даного виду спорту.

**Мета дослідження.** Метою дослідження є внесок у спортивну аналітику шляхом оцінки ефективності застосування ядрових моделей опорно-векторної регресії (ОВР) у прогнозуванні визначення найбільш результативного гравця. Такі

методи дослідження, як дисперсійний аналіз (ANOVA), функція Бесселя та застосування зворотніх мультикватратичних ядер, були свідомо обрані через їхні різноманітні математичні підходи, що відповідають тонкощам гри в крикет у жіночій прем'єр-лізі.

**Матеріали та методи.** Результативність гравців було проаналізовано за допомогою наступних методів дослідження: дисперсійний аналіз (ANOVA), функції Бесселя та застосування зворотніх мультикватратичних ядер. Дані, отримані з сайту [espn.cricinfo.com](http://espn.cricinfo.com) та Міжнародної ради крикету, включають основні показники для п'яти команд. Ретельні методи попереднього опрацювання, такі як імпутація та виключення відхилень, підвищують достовірність даних, забезпечуючи отримання надійних прогнозних моделей.

**Результати.** Застосування зворотного мультикватратичного ядра демонструє виняткову прогностичну ефективність, перевершуючи моделі дисперсійного аналізу (ANOVA) та функції Бесселя. Радіально-базисна функція ядра ефективно відображає складну динаміку жіночої прем'єр-ліги з крикету. Отримані результати підкреслюють доцільність застосування ядрового методу з метою прогнозування найбільш результативних гравців у сезоні Жіночої прем'єр-ліги 2024 року.

**Висновки.** В результаті дослідження було встановлено динамічну взаємодію між спортивною аналітикою та машинним навчанням у жіночій прем'єр-лізі з крикету. Застосування зворотного мультикватратичного ядра показало найбільшу ефективність, надаючи ключову інформацію щодо прогнозування результатів гравців. Це підкреслює постійну інтеграцію сучасних аналітичних методів для покращення нашого розуміння динаміки розвитку жіночої прем'єр-ліги з крикету. Оскільки цей вид спорту набуває все більшої популярності на світовій арені, такі аналітичні дослідження стають необхідними для прийняття стратегічних рішень та стало розвитку.

**Ключові слова:** жіночий крикет, опорно-векторна регресія, машинне навчання, порівняльний аналіз, прогнозування результатів.

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