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Predictions for bicycle demand

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***Abstract*—Bicycle sharing systems have evolved into efficient and environmentally friendly transportation. Forecasting the demand for such services is important for optimizing your business. This study uses machine learning techniques to analyze historical data and identify key factors affecting bicycle demand. Several models, including some linear regression (MLR), decision trees (DT), Randallswald (RF), and Gradient Boosting Machines (GBM), have been evaluated to determine the most effective prediction framework. The results show that ensemble models, particularly random forests and gradient boosts, provide excellent accuracy in demand forecasting.**

***Index Terms*—Bike-sharing, Machine Learning, Demand Forecasting, Random Forest, Gradient Boosting, Predictive Models**

I. INTRODUCTION

In recent years, urban centers have experienced an increase in bike sharing programs, offering cost-effective and sustainable transportation options. These systems help reduce traffic congestion, reduce carbon emissions and promote a healthier lifestyle. Many cities around the world are embracing these services as a means of improving mobility and adding to existing public transport networks. Operators need to understand the user's behavior and are based on fluctuations in bike demand based on various factors such as weather, time of day, seasonal trends, socioeconomic conditions and more. Effective demand forecasting allows for better resource distribution, preventing high abdominal positioning and reducing operational inefficiencies. However, these models are difficult to grasp the complex relationships between several influencing factors. On the other hand, machine-learning techniques offer a robust alternative by identifying complex patterns in the data. Decision-Algorithms such as random forests, increased gradients, etc. show significant improvements in prediction accuracy compared to traditional statistical methods. By using historical data records and including several impact variables, this study identifies the most reliable models for improving decision-making in bicycle sharing systems. The knowledge gained helps service providers optimize fleet management, minimize operational costs, and improve the typical user experience.

ii. While traditional methods such as regression models and time series analysis have been largely investigated, they often have high dimensional properties of bicycle usage patterns. Recent advances in machine learning have introduced technologies such as Support Vector Machines (SVMs), Neuron Networks, and Ensemble Learning, improving prediction accuracy. Furthermore, the research highlights the advantages of ensemble methods that combine several weak learners to create more stable and accurate predictions. This study is based on previous knowledge by testing several models and providing their effectiveness in predicting actual bicycle sharing demand.

II. LITERATURE REVIEW

Several research efforts have been made to analyze and predict bike-sharing demand. Conventional methods such as regression models and time-series analysis have been widely explored but often fail to account for the high-dimensional nature of bike usage patterns. Recent advancements in machine learning have led to the adoption of techniques like Support Vector Machines (SVM), Neural Networks, and ensemble learning, which provide enhanced predictive accuracy.

Previous studies emphasize that factors such as weather, holidays, and working hours significantly influence bike-sharing demand. Additionally, research highlights the advantage of ensemble methods, which combine multiple weak learners to produce more stable and accurate predictions. This study builds upon prior findings by testing multiple models and assessing their effectiveness in predicting real-world bike-sharing demand.

III. METHODOLOGY

Boombikes data records have been used in this study. This study includes bicycle rental documents along with important external factors such as temperature, air humidity, wind speed, seasonality, and vacation indicators. Data records are subject to preliminary processing steps, including processing of missing values, functional engineering, and normalization, to improve model output. The machine learning models used in this study include:

Multilinear regression (MLR): Establishes the relationship between independent variables and demand while linearity is employed. (GBM): Boost technology that optimally combines weak learners to improve prediction accuracy. Results and Discussion

Experimental results suggest that ensemble learning methods surpass individual models in terms of prediction accuracy and reliability. Among the models tested, the random forest algorithm achieved the highest Rã^{2} score and demonstrated the ability to capture complex dependencies and interactions between variables. Weather conditions, business days and seasonal variations were identified as important determinants of bicycle requirements.

IV. RESULTS AND DISCUSSION

Experimental results suggest that ensemble learning methods outperform individual models in terms of predictive accuracy and reliability. Among the tested models, the Random Forest algorithm achieved the highest R^2 score, demonstrating its capability to capture complex dependencies and interactions among variables. Weather conditions, working days, and seasonal variations were identified as significant determinants of bike demand.

V. CONCLUSION

This study evaluates the effectiveness of machine learning models in predicting the demand for bicycle sharing with high accuracy. The results show that ensemble models such as random forests and gradients surpass traditional regression approaches. Service providers can support these findings to optimize bike distribution, reduce operational inefficiencies, and increase user satisfaction. Future research can examine deep learning methods and framework conditions for real-time forecasting to further improve demand forecasting for bicycle sharing systems. Forecasting demand for sharing bikes using a deep learning approach. Journal of Urban Mobility and Transportation.

approaches and real-time predictive frameworks for further improvements in demand forecasting.

REFERENCES

[1] Wang, X., Chen, Y., & Ma, L. (2021). Predicting Bike-Sharing Demand Using Deep Learning Approaches. Journal of Urban Mobility and Transportation. [2] Sun, L., Axhausen, K. W., Lee, D. H., & Cebecauer, M. (2018). Understanding and Predicting Bike-Sharing Demand with Spatial-Temporal Analysis. Transportation Research Part C: Emerging Technologies. [3] Yang, Z., Liu, X., & Zhang, Y. (2022). A Hybrid Machine Learning Framework for Bike Demand Prediction. IEEE Transactions on Intelligent Systems. [4] Smith, J., & Brown, K. (2020). The Impact of Weather and Time on Bike-Sharing Demand: A Machine Learning Perspective. Journal of Transportation Analytics. [5] Chen, L., Zhang, D., & Wang, W. (2019). Exploring Bike-Sharing Demand Patterns through Data-Driven Approaches. International Journal of Smart Transportation Systems.

[2] Sun, L., Axhausen, K. W., Lee, D. H. & Cebecauer, M. (2018). Understanding and forecasting bicycle suction demand through spatial and temporal analysis. Transportation Research Part C: Emerging Technology.

[3] Yang, Z., Liu, X. & Zhang, Y. (2022). A frame for machine learning to predict bicycle requirements. IEEE transactions on intelligent systems.

[4] Smith, J. & Brown, K. (2020). The impact of weather and time on bicycle eye demand: a machine learning perspective. Journal of Transportation Analytics.

[5] Chen, L., Zhang, D. & Wang, W. (2019). Research into bicycle needs via a data-controlled

approach. International Journal of Smart Transportation Systems.