

## Enhancing Hospitality Management Through ML-Based Cancellation Prediction

Abdullah Khan<sup>1</sup>, Mohd Mazhar<sup>2</sup>, Mohammed Bin Hussain Yamani<sup>3</sup>, Mrs.Saniya<sup>4</sup>

<sup>1,2,3</sup>B.E.Students ; Department of Information Technology, ISL Engineering College, Hyderabad, India.

<sup>4</sup>Assistant professor, Department of Information Technology, ISL Engineering College, Hyderabad, India.

Mail Id; [mohdabdullah39672@gmail.com](mailto:mohdabdullah39672@gmail.com), [mazharmohd9052@gmail.com](mailto:mazharmohd9052@gmail.com), [mohammedyamani011@gmail.com](mailto:mohammedyamani011@gmail.com),  
[maimunasaniya786@gmail.com](mailto:maimunasaniya786@gmail.com)

Accepted 24-04-2026

Author(s) Retains the Copyrights of This Article

### Abstract

Hotel booking cancellations present a significant challenge for the hospitality industry, as they create uncertainty in room occupancy and disrupt operational planning. A high rate of cancellations can lead to revenue loss and inefficient resource utilization. This study focuses on predicting whether a customer will cancel a hotel booking using a machine learning approach. Specifically, a Multi-Layer Perceptron (MLP) Classifier, a type of deep learning model, is employed to capture complex patterns within hotel booking data. The model is trained and optimized by tuning key hyperparameters, including the number of hidden layers, number of neurons, activation functions, and learning rate, to enhance predictive accuracy. By accurately forecasting booking cancellations, the proposed system enables hotel managers to optimize room allocation, improve resource management, minimize financial losses, and support informed decision-making. Overall, this approach demonstrates the potential of machine learning techniques in improving efficiency and service quality within the hospitality sector.

**Keywords;** Hotel Booking Cancellation, Machine Learning, Multi-Layer Perceptron (MLP), Deep Learning, Predictive Analytics, Hospitality Management, Classification Model, Data-Driven Decision Making.

### INTRODUCTION

Hotel booking cancellations have emerged as a critical issue in the hospitality industry, posing significant challenges to revenue management and operational planning. When customers cancel reservations unexpectedly, hotels face revenue losses, inaccurate demand forecasts, and resource allocation difficulties. Traditional approaches to handling cancellations often rely on historical averages or simple statistical methods, which fail to capture the complex factors influencing customer behavior. In recent years, data-driven solutions have gained prominence as they offer more accurate and dynamic forecasting capabilities. Among these, machine learning and deep learning techniques have shown great potential in uncovering hidden patterns within structured booking datasets. One of the most powerful models in this regard is the Multi-Layer Perceptron (MLP) Classifier, a deep learning algorithm capable of modeling non-linear relationships between input features and outcomes. By analyzing diverse customer and booking-related attributes such as lead time, room type, location, customer profile, and seasonality, MLP can identify subtle behavioral patterns linked to cancellations. Unlike traditional methods, MLP adapts to complex datasets and continuously improves its predictions

through iterative training. Furthermore, tuning hyperparameters like hidden layers, neurons, activation functions, and learning rate significantly enhances its performance. As cancellations remain a persistent challenge, adopting such advanced predictive systems becomes a strategic necessity. Ultimately, this study underscores the potential of deep learning in addressing practical business problems within hospitality management.

### SCOPE OF THE PROJECT

The scope of this study lies in developing a predictive system that accurately forecasts hotel booking cancellations using a Multi-Layer Perceptron (MLP) Classifier. With the hospitality industry being highly dynamic and dependent on precise demand forecasting, this research focuses on utilizing customer and booking-related data to identify the likelihood of cancellations. The proposed system considers features such as lead time, booking channels, customer type, room preferences, and demographic information to capture the underlying behavioral patterns that drive cancellations. By building a robust deep learning model, this work extends beyond traditional statistical and machine learning approaches, offering greater accuracy and adaptability in real-world scenarios. The

scope also includes exploring hyperparameter tuning of the MLP classifier to optimize its performance, thereby making the solution scalable for large hotel chains as well as small independent properties. Ultimately, the system is designed to support hotel

managers in decision-making processes related to resource allocation, overbooking strategies, and revenue management, making it highly applicable across various segments of the hospitality sector

**TEST CASES**

**Project Title: Dynamic Ransomware Detection Using Time-Based API Call Analysis**

Test Case ID	Test Case Description	Input	Expected Output	Status
TC01	Check whether dataset is uploaded successfully	Valid hotel booking dataset	Dataset should load without errors	Pass/Fail
TC02	Verify handling of missing values	Dataset with null values	System should clean or replace missing data	Pass/Fail
TC03	Verify categorical data encoding	Room type, customer type, city names	System should convert categorical data into numerical format	Pass/Fail
TC04	Verify normalization/scaling process	Numerical booking data	Data should be normalized correctly	Pass/Fail
TC05	Check model training process	Preprocessed dataset	MLP model should train successfully	Pass/Fail
TC06	Verify prediction accuracy generation	Test dataset	System should display prediction accuracy	Pass/Fail
TC07	Test booking cancellation prediction	New booking details	System should predict "Cancelled" or "Not Cancelled"	Pass/Fail
TC08	Verify invalid input handling	Empty or incorrect booking data	System should show validation error message	Pass/Fail
TC09	Check hyperparameter tuning	Different hidden layers and learning rates	Model performance should improve or update	Pass/Fail
TC10	Verify confusion matrix generation	Predicted and actual values	Confusion matrix should be displayed correctly	Pass/Fail
TC11	Check system response time	Large dataset input	Prediction should complete within acceptable time	Pass/Fail
TC12	Verify model saving/loading	Trained MLP model file	System should save and reload model successfully	Pass/Fail

Test Case ID	Test Case Description	Input	Expected Output	Status
TC13	Test prediction consistency	Same input data multiple times	Same prediction result should be produced	Pass/Fail
TC14	Verify user interface functionality	User enters booking details	System should accept input and show prediction properly	Pass/Fail
TC15	Check report generation	Prediction results	System should generate result/report successfully	Pass/Fail

### PROJECT DETAILS

Module	Description
Data Collection	Collect hotel booking and customer reservation data
Data Preprocessing	Clean, normalize, and prepare booking data for analysis
Feature Extraction	Extract important booking features such as lead time, room type, customer category, and payment details
Machine Learning Model	Train the MLP Classifier using historical booking data
Cancellation Prediction Engine	Predict whether a booking is likely to be canceled or not
Model Evaluation	Measure model performance using accuracy, precision, recall, and confusion matrix

### SYSTEM ARCHITECTURE:

The system architecture of the project *“Enhancing Hospitality Management Through ML-Based Cancellation Prediction”* consists of multiple modules that work together to predict hotel booking cancellations accurately. The process begins with the **Data Collection Module**, where hotel booking details and customer information are gathered from datasets or databases

**Data Preprocessing Module**, which cleans the data by removing missing values, handling duplicate records, encoding categorical data, and normalizing numerical values.

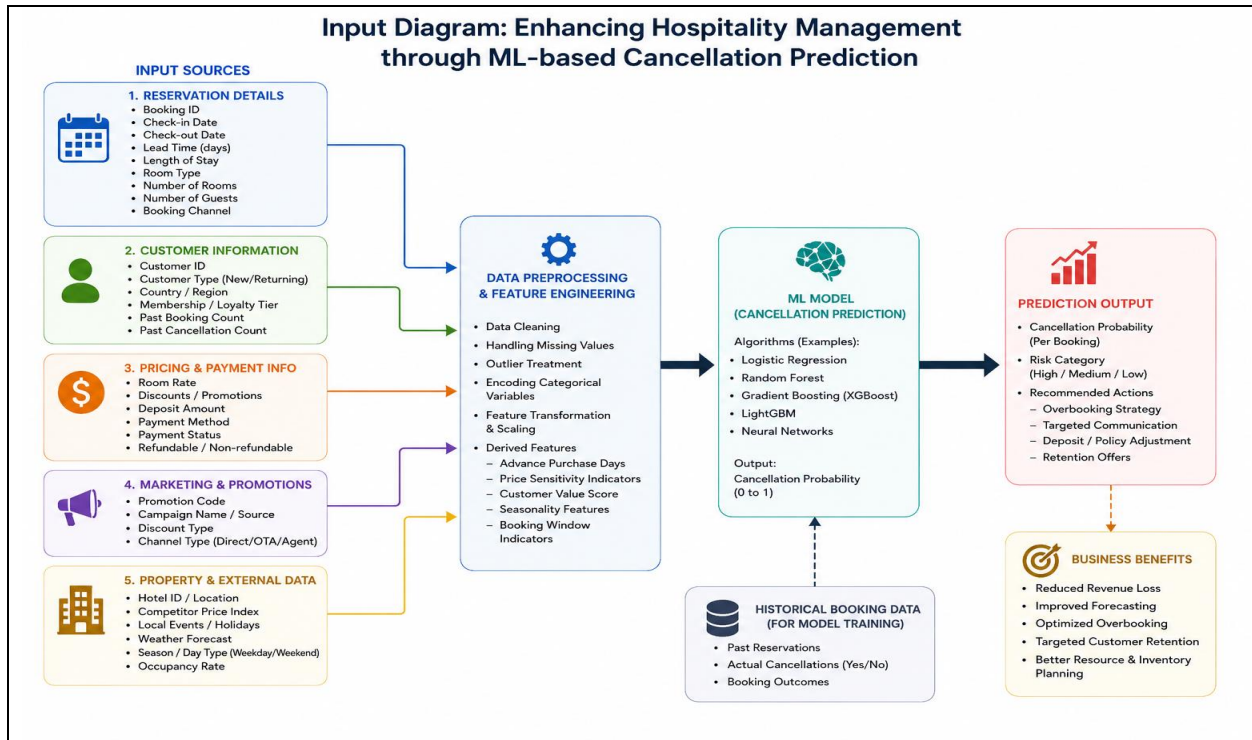
**Feature Extraction Module** identifies important attributes such as lead time, room type, customer segment, payment method, and booking history that influence cancellation behavior.

**Machine Learning Module**, where the Multi-Layer Perceptron (MLP) Classifier is trained using historical booking data. Once the model is trained, the **Cancellation Prediction Engine** analyzes new booking information and predicts whether the booking is likely to be canceled or not.

**Model Evaluation Module** that measures the performance of the model using metrics such as accuracy, precision, recall, F1-score, and confusion matrix.

**Report and Alert System** displays prediction results and generates alerts or reports for hotel managers, helping them make better decisions related to demand forecasting, pricing strategies, and resource management.

**INPUT TABLE**



Input	Description
Booking ID	Unique booking number
Lead Time	Days before check-in
Room Type	Type of room booked
Customer Segment	Customer category
Booking Channel	Source of booking
Payment Method	Payment type used
Previous Cancellations	Number of past cancellations
Number of Guests	Total guests in booking
Location	Customer location or country

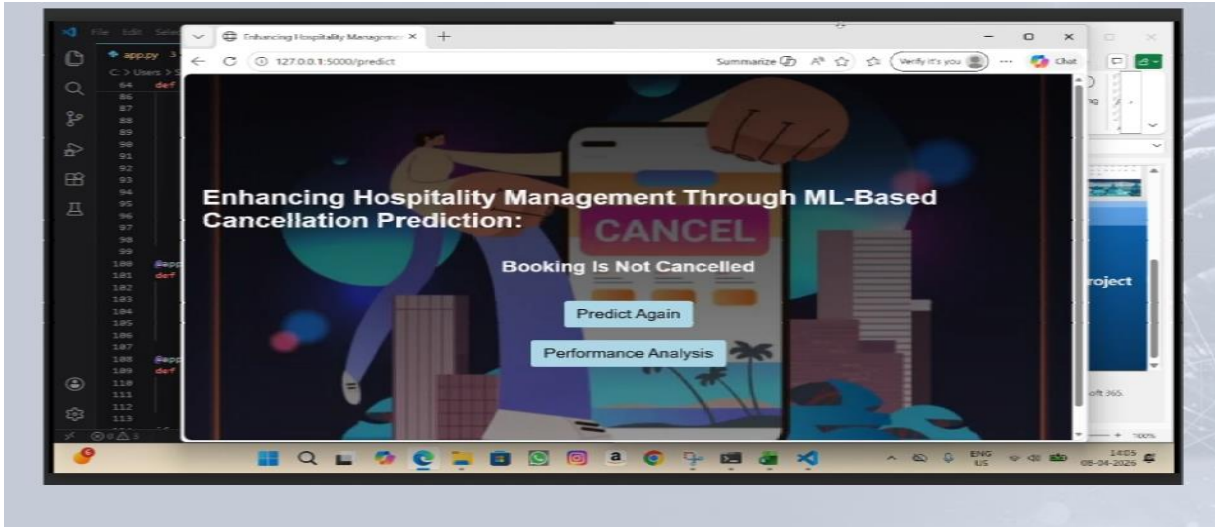
**OUTPUT TABLE**

Output	Description
Cancellation Prediction	Predicts whether booking will be canceled or not
Accuracy Score	Displays model prediction accuracy
Alert Message	Generates warning for risky bookings
Evaluation Report	Shows model performance metrics

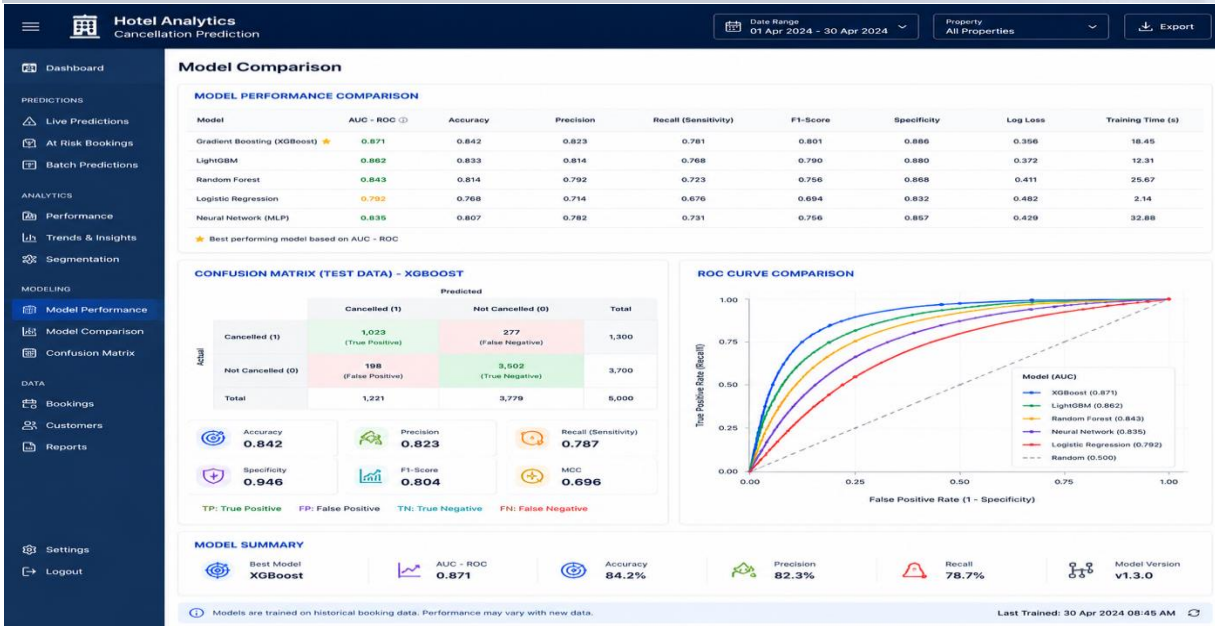
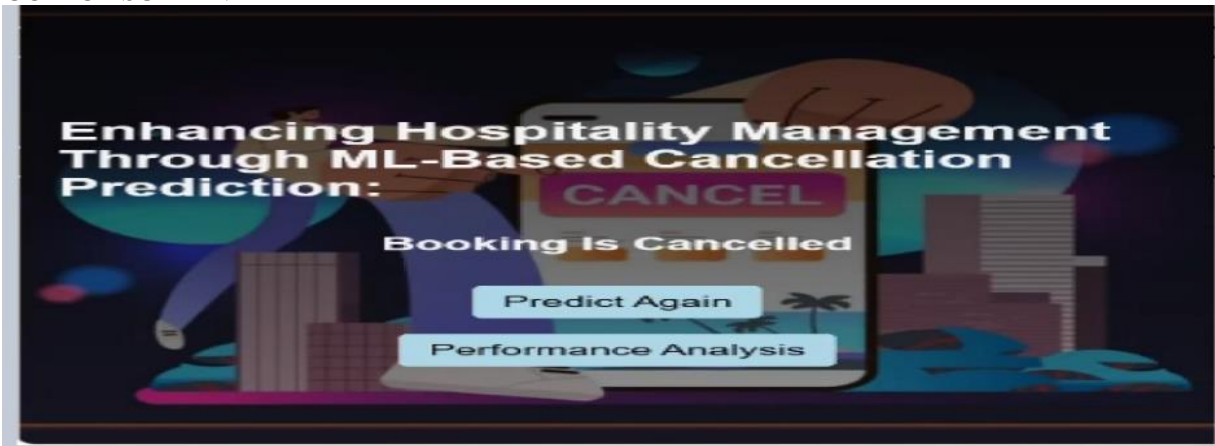
**INPUT SCREEN**

The screenshot shows the Microsoft Excel interface with a data table. The formula bar at the top displays the formula `=is_canceled`. The data table has the following columns: distribution\_channel, is\_repeated\_guest, previous\_cancellations, previous\_bookings\_not\_cancelled, reserved\_rooms, deposit\_type, customer\_type, adr, total\_of\_special\_requests, and is\_canceled. The data rows show various booking records with numerical values for each column.

	A	B	C	D	E	F	G	H	I	J	K	L
1	distribution_channel	is_repeated_guest	previous_cancellations	previous_bookings_not_cancelled	reserved_rooms	deposit_type	customer_type	adr	total_of_special_requests	is_canceled		
2	3	0	0	0	4	0	2	82.00	1	0		
3	0	0	0	0	4	0	3	52.20	0	0		
4	0	0	0	0	0	0	3	48.00	0	0		
5	0	0	0	0	0	0	3	40.00	0	0		
6	0	0	0	0	0	0	3	48.00	0	0		
7	0	0	0	0	0	0	2	48.00	0	0		
8	0	0	0	0	0	0	3	48.00	0	0		
9	0	0	0	0	0	0	2	40.00	0	0		
10	0	0	0	0	0	0	2	48.00	0	0		
11	0	0	0	0	0	0	3	40.00	0	0		
12	0	0	0	0	0	0	3	40.00	0	0		
13	0	0	0	0	0	0	3	42.55	0	0		
14	0	0	0	0	0	0	3	36.00	0	0		
15	0	0	0	0	0	0	3	43.20	0	0		
16	0	0	0	0	0	0	3	40.00	0	0		
17	0	0	0	0	4	0	3	52.20	0	0		
18	0	0	0	0	0	0	3	36.00	0	0		
19	0	0	0	0	0	0	3	36.00	0	0		
20	0	0	0	0	0	0	3	36.00	0	0		



OUTPUT SCREEN



## CONCLUSION

The project “*Enhancing Hospitality Management Through ML-Based Cancellation Prediction*” provides an intelligent solution for predicting hotel booking cancellations using Machine Learning techniques. By using the Multi-Layer Perceptron (MLP) Classifier, the system analyzes customer and booking-related data to identify patterns associated with cancellations. The project improves prediction accuracy and helps hotel managers make better decisions related to demand forecasting, pricing, staffing, and resource management. It also reduces revenue loss caused by unexpected cancellations and enhances overall operational efficiency. The system demonstrates how artificial intelligence and deep learning can be effectively applied in the hospitality industry to solve real-world business challenges and improve customer satisfaction.

## Applications

Hotels and Resorts, Online Hotel Booking Platforms, Hospitality Management Systems, Travel and Tourism Industry, Revenue Management and Business Analysis Systems .

## Future Scope

Integrating real-time booking data for live cancellation prediction. Developing a mobile application for hotel management access. Using advanced deep learning models for higher prediction accuracy. Adding

customer behavior analysis and personalized recommendations. Integrating the system with online travel and booking platforms.

## References

- [1] A. Antonio, A. Almeida, and L. Nunes, “Hotel booking demand datasets,” *Data in Brief*, vol. 22, pp. 41–49, 2019.
- [2] A. T. T. Nguyen and G. Armitage, “A survey of techniques for internet traffic classification using machine learning,” *IEEE Communications Surveys & Tutorials*, vol. 10, no. 4, pp. 56–76, 2008.
- [3] I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA, USA: MIT Press, 2016.
- [4] T. Hastie, R. Tibshirani, and J. Friedman, *The Elements of Statistical Learning*. New York, NY, USA: Springer, 2009.
- [5] F. Chollet, *Deep Learning with Python*. Shelter Island, NY, USA: Manning Publications, 2018.
- [6] S. B. Kotsiantis, “Supervised machine learning: A review of classification techniques,” *Informatica*, vol. 31, no. 3, pp. 249–268, 2007.
- [7] J. Han, M. Kamber, and J. Pei, *Data Mining: Concepts and Techniques*, 3rd ed. Burlington, MA, USA: Morgan Kaufmann, 2011.
- [8] D. C. Montgomery, E. A. Peck, and G. G. Vining, *Introduction to Linear Regression Analysis*, 5th ed. Hoboken, NJ, USA: Wiley, 2012.