

Food Delivery Time Prediction Report

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1. Objective

To predict whether a food delivery will be "Fast" or "Delayed" using machine learning techniques.

The models explore the influence of factors like distance, weather, traffic, and restaurant/customer locations using:

- Clustering techniques (KMeans, Hierarchical)
- Neural Networks for classification

2. Dataset Overview

The dataset 'Food_Delivery_Time_Prediction.csv' contains delivery records with features like:

- Customer_Location, Restaurant_Location
- Distance (km), Weather, Traffic_Condition
- Order Priority, Delivery Time

Target Variable:

- Delivery_Status: "Fast" or "Delayed"

3. Data Preprocessing

- Loaded data using Pandas
- Handled missing values using imputation or row removal
- Categorical encoding using One-Hot/Label Encoding for: Traffic, Weather, Order Priority
- Normalized numerical features: Distance, Delivery Time
- Feature Engineering: Haversine formula for distance, Rush/Non-rush hour feature

4. Clustering Models

K-Means Clustering

- Used to segment similar delivery patterns
- Optimal k determined via Elbow Method
- Clustered based on delivery duration, traffic, weather, etc.

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- Visualized clusters via scatter plots

Hierarchical Clustering

- Agglomerative Clustering and Dendrogram used
- Explained nested grouping of deliveries

5. Neural Network Model

Feedforward Neural Network

- Built using Keras/TensorFlow
- Input Features: Distance, Traffic, Weather, Priority
- Output: 0 for "Fast", 1 for "Delayed"

Model Evaluation

- Accuracy, Precision, Recall, F1-score
- Hyperparameter tuning: layers, activation, learning rate

6. Model Comparison

Method	Purpose	Highlights
KMeans	Unsupervised grouping	Grouped deliveries into types
Hierarchical	Nested clustering	Proximity analysis
Neural Network	Binary classification	Best accuracy

7. Conclusion & Recommendations

Best Performing Model:

- Neural Network for delivery prediction
- KMeans + Hierarchical clustering gave delivery group insights

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Recommendations:

- Use clustering to optimize delivery zones
- Monitor rush hour, traffic, and weather for real-time updates
- Integrate GPS/traffic API in future

8. Tools & Libraries Used

- Python, Jupyter Notebook
- pandas, numpy, sklearn, matplotlib, seaborn, tensorflow, keras