

# Food Delivery Time Prediction

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## Objective

The goal is to predict food delivery times based on customer location, restaurant location, weather, traffic, and other factors. This involves both **data preprocessing** and building predictive models using **linear regression** and **logistic regression**.

## Phase 1: Data Collection and Exploratory Data Analysis (EDA)

### Step 1 - Data Import and Preprocessing

#### 1. Dataset

Load the dataset (`Food_Delivery_Time_Prediction.csv`).

#### 2. Handle Missing Values

Check for any missing or inconsistent values in columns such as `Distance`, `Delivery_Time`, etc. and decide how to handle them, either through imputation or deletion.

#### 3. Data Transformation

- **Encode Categorical Variables:** Use one-hot encoding or label encoding for variables like `Weather Conditions`, `Traffic Conditions`, `Vehicle Type`.
- **Normalize/Standardize Numeric Columns:** Normalize or standardize continuous features like `Distance`, `Delivery_sTime`, and `Order_Cost` for consistency.

### Step 2 - Exploratory Data Analysis (EDA)

#### 1. Descriptive Statistics

Calculate the basic statistics for numerical features such as mean, median, mode, and variance.

#### 2. Correlation Analysis

Visualize correlations between features and the target variable (`Delivery_Time`) to identify the most relevant predictors.

#### 3. Outlier Detection

Detect outliers in numerical features using boxplots and handle them appropriately.

### Step 3 - Feature Engineering

#### 1. Distance Calculation

If the dataset doesn't contain an actual distance metric, calculate the distance between the customer and restaurant using latitudes and longitudes (Haversine formula).

#### 2. Time-Based Features

Create new features related to the time of day, such as `Rush Hour` vs `Non-Rush Hour`, to improve predictions.

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## Phase 2: Predictive Modeling

### Step 4 - Linear Regression Model

#### 1. Train-Test Split

Split the dataset into training and testing sets (e.g., 80/20 split).

#### 2. Model Building

Use **Linear Regression** to predict the `Delivery Time` based on features like `Distance`, `Traffic_Conditions`, and

Order\_Priority.

### 3. Evaluation Metrics

Evaluate the model using:

- **Mean Squared Error (MSE)**
- **R-squared (R²)**
- **Mean Absolute Error (MAE)**

## Step 5 - Logistic Regression Model (for Categorization)

### 1. Model Objective

Classify deliveries as "Fast" or "Delayed" based on binary features such as **Traffic**, **Weather**, **Delivery\_Person\_Experience**, etc.

### 2. Model Implementation

Use **Logistic Regression** to predict the delivery status.

### 3. Evaluation Metrics

Evaluate using metrics such as:

- **Accuracy**
- **Precision**
- **Recall**
- **F1-score**
- **Confusion Matrix**

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## Phase 3: Reporting and Insights

### Step 6 - Model Evaluation and Comparison

- Compare the **Linear Regression** and **Logistic Regression** models based on their performance (e.g., accuracy, confusion matrix).
- Visualize the results using **confusion matrices** and **ROC curves**.

### Step 7 - Actionable Insights

- Based on model predictions, suggest operational improvements such as:
  - Optimizing delivery routes.
  - Adjusting staffing during high-traffic periods.
  - Providing better training to delivery staff

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## Final Deliverables

### 1. Jupyter Notebook (.ipynb):

- Complete code for data preprocessing, model training, and evaluation.

### 2. Data Visualizations:

- Visual representations such as **scatter plots**, **pair plots**, **confusion matrices**, and **ROC curves** to interpret the results.

### 3. Final Report:

- A detailed summary of the project, including:
  - Description of the dataset and preprocessing steps.
  - Model evaluation and comparisons.
  - Actionable insights and recommendations for optimization.