Food Delivery Time Prediction and Analysis

we have dataset is designed for predicting food delivery times based on various factors such as distance, weather, traffic conditions, and time of day.

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importing necessary modules and Data Acquisition

```
# importing necessary modules
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
```

```
df=pd.read_csv('/content/Food_Delivery_Times (1).csv')
df.head()
```

	Order_ID	Distance_km	Weather	Traffic_Level	Time_of_Day	Vehicle_Type	Preparation_Time_min	Courier_Experience_yrs	Delivery_Time_min
0	522	7.93	Windy	Low	Afternoon	Scooter	12	1.0	43
1	738	16.42	Clear	Medium	Evening	Bike	20	2.0	84
2	741	9.52	Foggy	Low	Night	Scooter	28	1.0	59
3	661	7.44	Rainy	Medium	Afternoon	Scooter	5	1.0	37
4	412	19.03	Clear	Low	Morning	Bike	16	5.0	68

Understanding,describing the data and Checking for null values

The dataset contains 9 columns and 1000 entries, with some columns missing values such as:

- Weather: Weather conditions (30 missing values).
- Traffic_Level: Traffic conditions (30 missing values).
- Time_of_Day: Time of the day for delivery (30 missing values).
- Courier_Experience_yrs: Courier's experience in years (30 missing values).

```
[26] df.shape

(1000, 9)

[27] df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 9 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Order_ID                1000 non-null   int64
 1   Distance_km             1000 non-null   float64
 2   Weather                 970 non-null    object
 3   Traffic_Level           970 non-null    object
 4   Time_of_Day             970 non-null    object
 5   Vehicle_Type            1000 non-null   object
 6   Preparation_Time_min    1000 non-null   int64
 7   Courier_Experience_yrs  970 non-null    float64
 8   Delivery_Time_min       1000 non-null   int64
dtypes: float64(2), int64(3), object(4)
memory usage: 70.4+ KB
```

```
[29] df.isna().sum()
```

	0
Order_ID	0
Distance_km	0
Weather	30
Traffic_Level	30
Time_of_Day	30
Vehicle_Type	0
Preparation_Time_min	0
Courier_Experience_yrs	30
Delivery_Time_min	0

dtype: int64

- Data Pre-Processing
Data Cleaning

- Handle Missing Values by Fill with the mode at Weather,Traffic_Level,Time_of_Day (Categorical).
- Handle Missing Values by Fill with the mean at Courier_Experience_yrs (Numeric).

```
[30] df['Weather'] = df['Weather'].fillna(df['Weather'].mode()[0])
     df['Traffic_Level'] = df['Traffic_Level'].fillna(df['Traffic_Level'].mode()[0])
     df['Time_of_Day'] = df['Time_of_Day'].fillna(df['Time_of_Day'].mode()[0])

[31] x= df['Courier_Experience_yrs'].mean()
     df['Courier_Experience_yrs'].fillna(x,inplace=True)
```

check again null value and duplicate values

- no null values and no duplicate values.

```
[32] df.isnull().sum()
```

	0
Order_ID	0
Distance_km	0
Weather	0
Traffic_Level	0
Time_of_Day	0
Vehicle_Type	0
Preparation_Time_min	0
Courier_Experience_yrs	0
Delivery_Time_min	0

dtype: int64

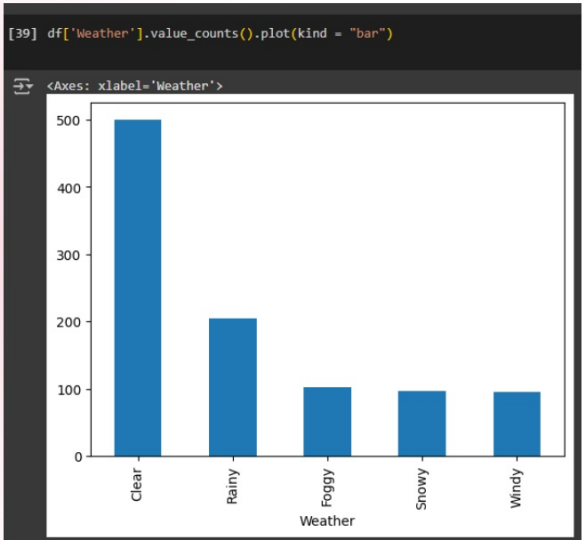
```
[33] df.duplicated().sum()
```

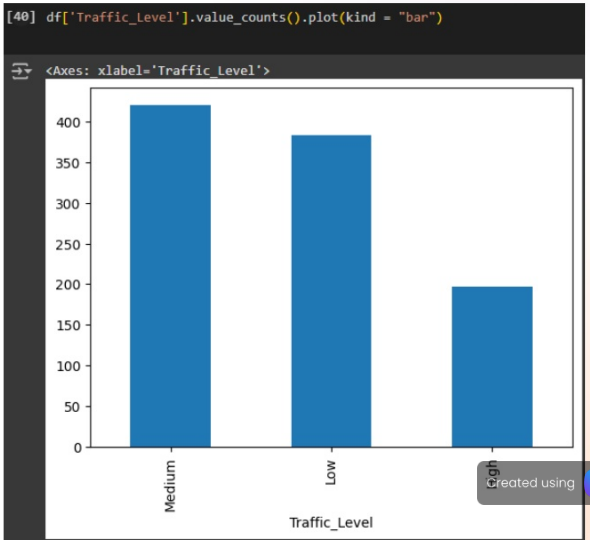
```
0
```

Exploratory data analysis (EDA)

(univarient)

- Most of the cases are clear weather.(Weather)
- Data is distributed between low and medium congestion, with low congestion being the most common. (Traffic_Level)

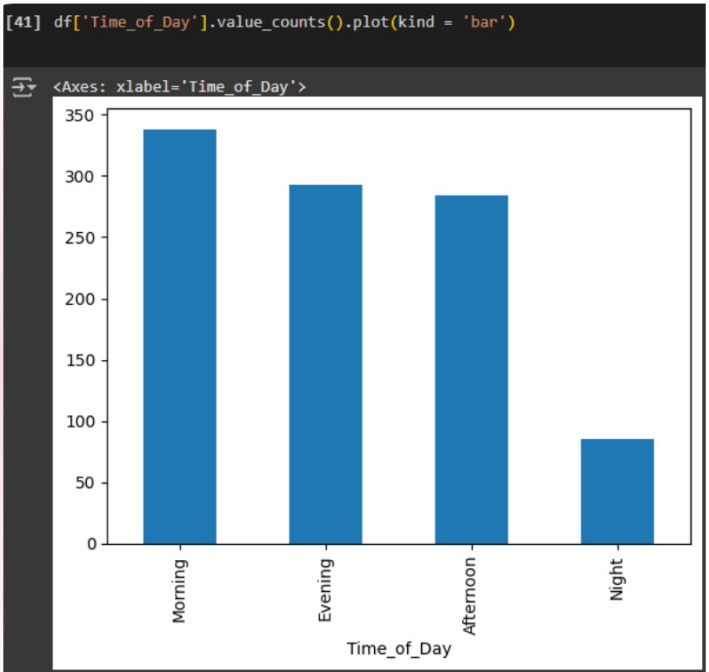




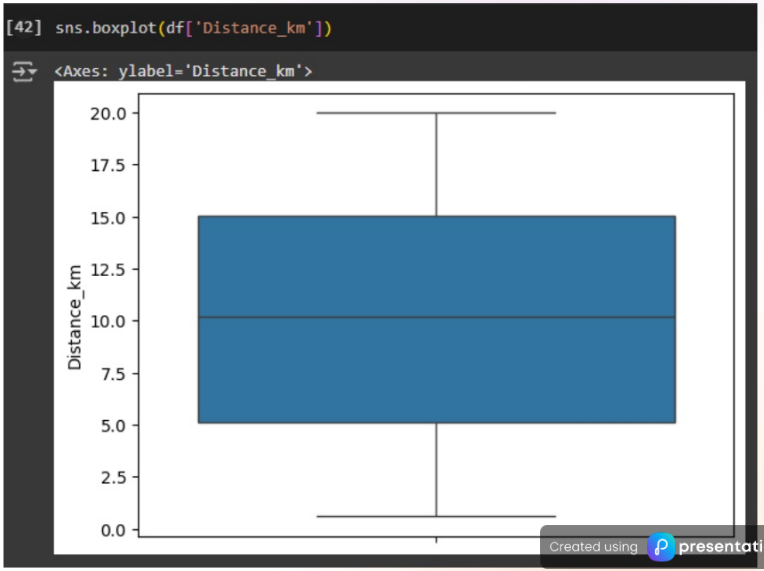
EDA (univarient)

- Orders are distributed almost evenly over the different periods except for the night.
- The distribution shows most of the requests within a range of 5-15 km.

```
[41] df['Time_of_Day'].value_counts().plot(kind = 'bar')
```



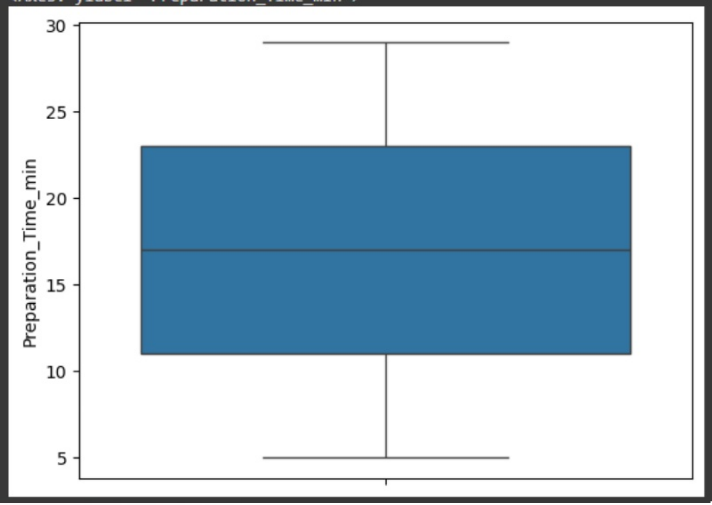

```
[42] sns.boxplot(df['Distance_km'])
```



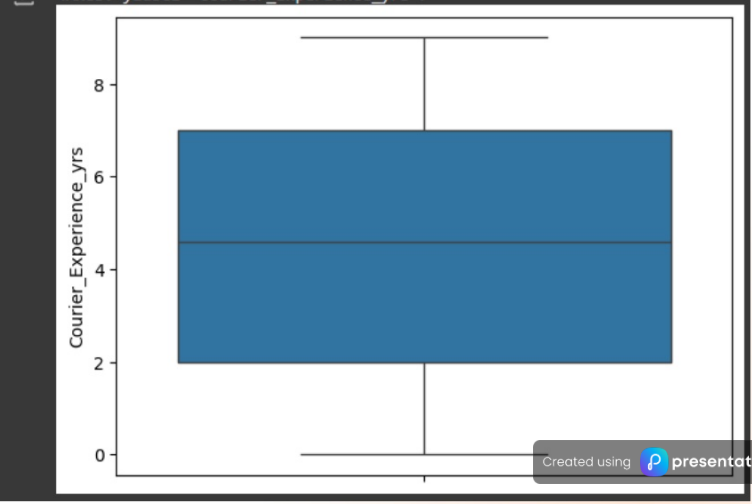
EDA (univarient)

- Preparation time varies greatly, with many concentrating in under 20 minutes.
- Most drivers have less than 5 years experience.

```
[44] sns.boxplot(df['Preparation_Time_min'])
```




```
[45] sns.boxplot(df['Courier_Experience_yrs'])
```

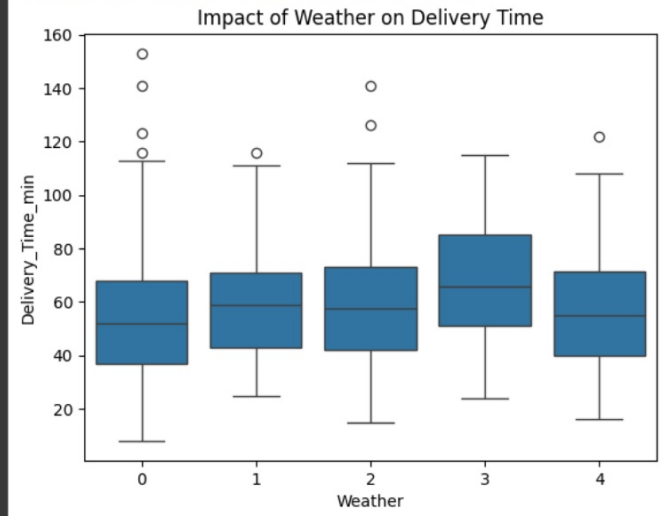


Bivarient

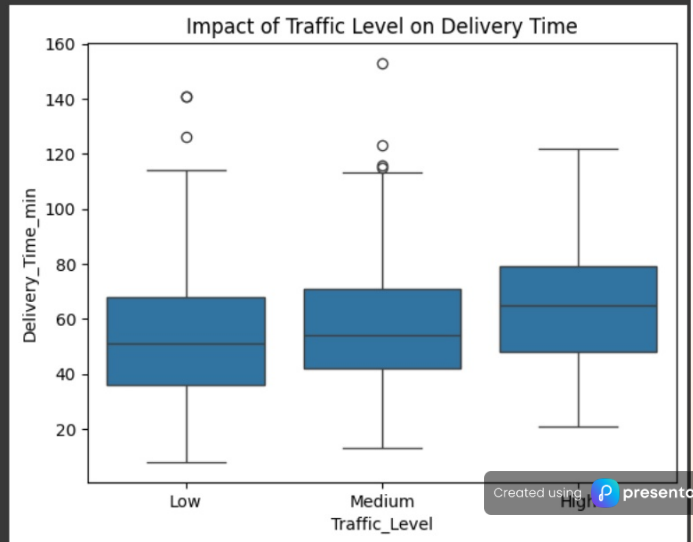
- Weather has an inverse relationship with delivery time.
- When traffic level is high it affects the delivery time.

```
sns.boxplot(x='Weather', y='Delivery_Time_min', data=df)
plt.title("Impact of Weather on Delivery Time")
```

```
Text(0.5, 1.0, 'Impact of Weather on Delivery Time')
```



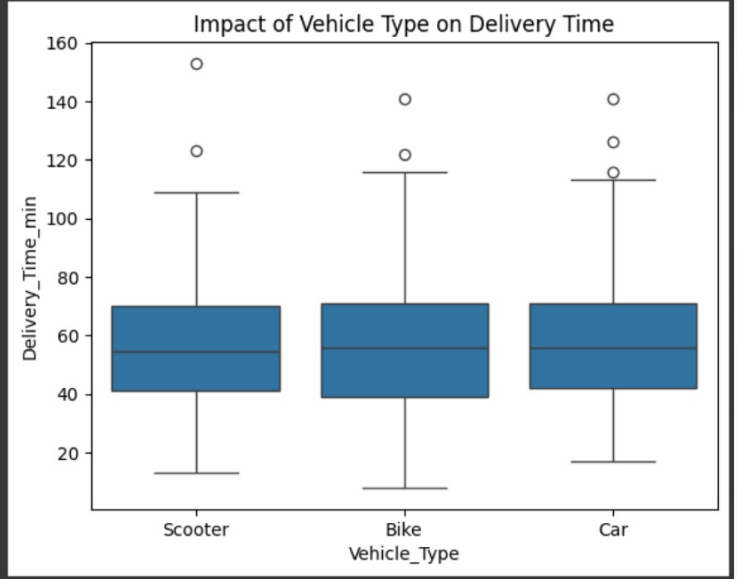

```
[53] sns.boxplot(x='Traffic_Level', y='Delivery_Time_min', data=df)
     plt.title("Impact of Traffic Level on Delivery Time")
     plt.show()
```



Bivarient

- Scooter is faster in delivery.

```
sns.boxplot(x='Vehicle_Type', y='Delivery_Time_min', data=df)
plt.title("Impact of Vehicle Type on Delivery Time")
plt.show()
```



machine learning

- Recover libraries
- Converting categorical variables to numbers
- Identifying independent variables and target variable

```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
```

```
df['Weather'] = df['Weather'].astype('category').cat.codes
df['Traffic_Level'] = df['Traffic_Level'].astype('category').cat.codes
df['Vehicle_Type'] = df['Vehicle_Type'].astype('category').cat.codes

X = df[['Weather', 'Traffic_Level', 'Vehicle_Type', 'Distance_km']]  #
y = df['Delivery_Time_min']  # المتغير المستهدف
```

machine learning

- Splitting the data into a training and test set
- Creating a linear regression model
- Training the model
- Predicting values for the test set
- Evaluating performance
- Displaying results
-Displaying coefficients

```
# تقسيم البيانات إلى مجموعة تدريب واختبار
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# إنشاء نموذج الانحدار الخطي
model = LinearRegression()

# تدريب النموذج
model.fit(X_train, y_train)

# توقع القيم لمجموعة الاختبار
y_pred = model.predict(X_test)

# تقييم الأداء
mse = mean_squared_error(y_test, y_pred)  # متوسط مربع الخطأ
r2 = r2_score(y_test, y_pred)  # معامل التحديد

# عرض النتائج
print("Mean Squared Error (MSE):", mse)
print("R-squared (R2):", r2)

# عرض المعاملات (Coefficients)
coefficients = pd.DataFrame({'Feature': X.columns, 'Coefficient': model.coef_})
print(coefficients)
```

machine learning

- The model is relatively good, explaining 66.44% of the variance in delivery times.
- Distance_km is the variable that most directly affects delivery time.
- Weather has a medium effect.

```
Mean Squared Error (MSE): 150.4112197528693
R-squared (R2): 0.6644306832428608
          Feature  Coefficient
0         Weather     1.276292
1  Traffic_Level    -1.633788
2   Vehicle_Type    -0.550671
3    Distance_km     2.992732
```

The End

Dataset From Kaggle