In [185…

```
import warnings
warnings.filterwarnings('ignore')
import pandas as pd
import numpy as np
import seaborn as sns
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error, r2_score
import plotly.express as px
from IPython.display import IFrame
import us
```

In [186…

```
df=pd.read_excel('Datasets/Enhanced_pizza_sell_data_2024-25.xlsx')
#url="https://github.com/Patilanuj/Python_Projects/blob/bc56f8c0e3f810c4ed3dd6b8
#df=pd.read_excel(url,engine='openpyxl')
df.head()
```

Out[186…

	Order ID	Restaurant Name	Location	Order Time	Delivery Time	Delivery Duration (min)	Pizza Size	Pizza Type	Toppi Co
0	ORD001	Domino's	New York, NY	2024-01-05 18:30:00	2024-01-05 18:45:00	15	Medium	Veg	
1	ORD002	Papa John's	Los Angeles, CA	2024-02-14 20:00:00	2024-02-14 20:25:00	25	Large	Non-Veg	
2	ORD003	Little Caesars	Chicago, IL	2024-03-21 12:15:00	2024-03-21 12:35:00	20	Small	Vegan	
3	ORD004	Pizza Hut	Miami, FL	2024-04-10 19:45:00	2024-04-10 20:10:00	25	XL	Cheese Burst	
4	ORD005	Marco's Pizza	Dallas, TX	2024-05-05 13:00:00	2024-05-05 13:20:00	20	Medium	Non-Veg	

5 rows × 25 columns

Hourly crowd

In [187…

```
cities=df['Restaurant Name'].value_counts()
print(cities)
```

```
Restaurant Name
Domino's           212
Papa John's        204
Little Caesars     199
Marco's Pizza      195
Pizza Hut          194
Name: count, dtype: int64
```

In [188…

```
print('Dataframe Shape:', df.shape)


print('\nDataframe info:')
df.info()

print('\nSummary Statistics of Dataframe:')
df.describe()
```

```
Dataframe Shape: (1004, 25)

Dataframe info:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1004 entries, 0 to 1003
Data columns (total 25 columns):
 #   Column                       Non-Null Count  Dtype
---  ------                       --------------  -----
 0   Order ID                     1004 non-null   object
 1   Restaurant Name              1004 non-null   object
 2   Location                     1004 non-null   object
 3   Order Time                   1004 non-null   datetime64[ns]
 4   Delivery Time                1004 non-null   datetime64[ns]
 5   Delivery Duration (min)      1004 non-null   int64
 6   Pizza Size                   1004 non-null   object
 7   Pizza Type                   1004 non-null   object
 8   Toppings Count               1004 non-null   int64
 9   Distance (km)                1004 non-null   float64
 10  Traffic Level                1004 non-null   object
 11  Payment Method               1004 non-null   object
 12  Is Peak Hour                 1004 non-null   bool
 13  Is Weekend                   1004 non-null   bool
 14  Delivery Efficiency (min/km) 1004 non-null   float64
 15  Topping Density              1004 non-null   float64
 16  Order Month                  1004 non-null   object
 17  Payment Category             1004 non-null   object
 18  Estimated Duration (min)     1004 non-null   float64
 19  Delay (min)                  1004 non-null   float64
 20  Is Delayed                   1004 non-null   bool
 21  Pizza Complexity             1004 non-null   int64
 22  Traffic Impact               1004 non-null   int64
 23  Order Hour                   1004 non-null   int64
 24  Restaurant Avg Time          1004 non-null   float64
dtypes: bool(3), datetime64[ns](2), float64(6), int64(5), object(9)
memory usage: 175.6+ KB

Summary Statistics of Dataframe:
```

Out[188…

	Order Time	Delivery Time	Delivery Duration (min)	Toppings Count	Distance (km)	
count	1004	1004	1004.000000	1004.000000	1004.000000	1(
mean	2025-03-27 00:33:24.980079872	2025-03-27 01:02:54.501992192	29.492032	3.362550	4.945618	
min	2024-01-05 18:30:00	2024-01-05 18:45:00	15.000000	1.000000	2.000000	
25%	2024-08-31 13:33:45	2024-08-31 14:05:00	25.000000	3.000000	3.500000	
50%	2025-03-01 07:30:00	2025-03-01 08:12:30	30.000000	3.000000	4.500000	
75%	2025-11-07 00:48:45	2025-11-07 01:18:45	30.000000	4.000000	6.000000	
max	2026-07-07 20:00:00	2026-07-07 20:30:00	50.000000	5.000000	10.000000	
std	NaN	NaN	7.753103	1.135853	1.951463	

In [189…

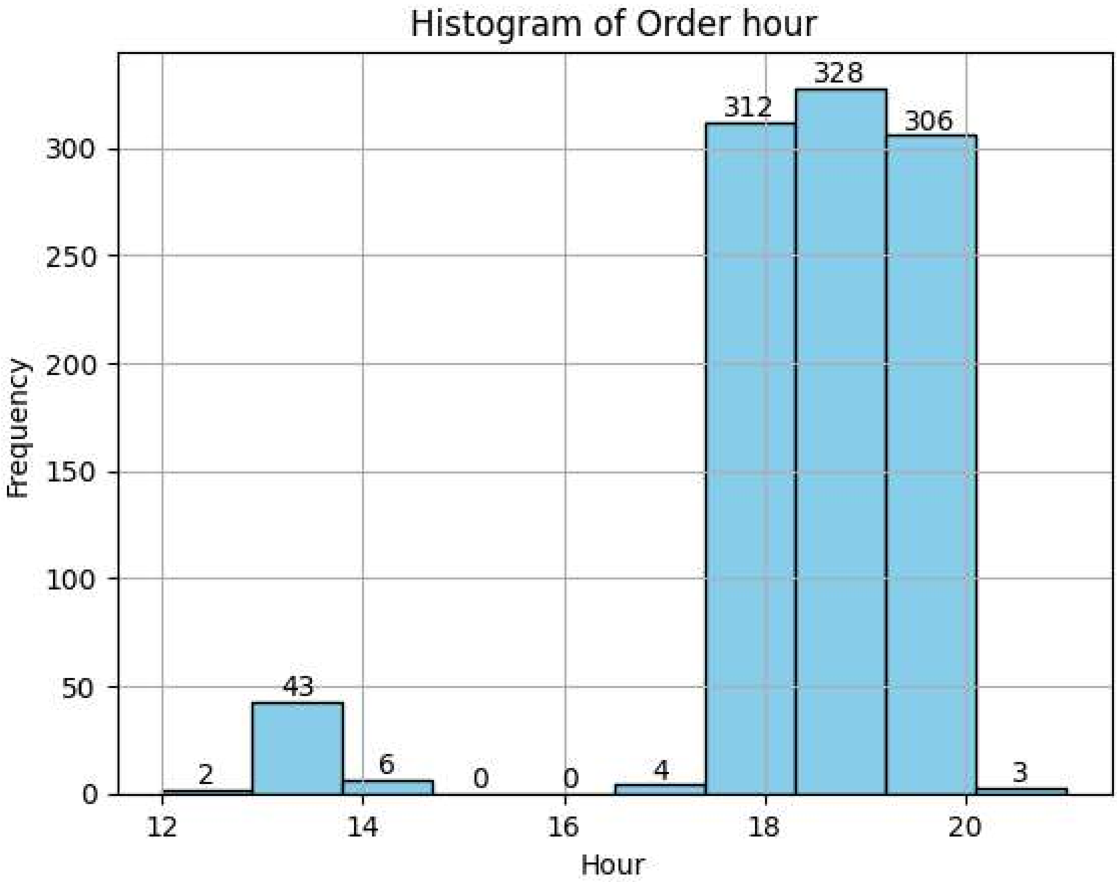
```
df['Order Time'].dtype
```

Out[189…

```
dtype('<M8[ns]')
```

In [190…

```
import matplotlib.pyplot as plt
# Plot histogram of the 'Age' column
values, bins, bars= plt.hist(df['Order Hour'], color='skyblue', edgecolor='black
plt.title('Histogram of Order hour')
plt.xlabel('Hour')
plt.ylabel('Frequency')
plt.grid(True)
plt.bar_label(bars)
plt.show()

distinct_counts = df['Order Hour'].value_counts()
print(distinct_counts)
```



```
Order  Hour
19     328
18     312
20     306
13      43
14       6
17       4
21       3
12       2
Name: count, dtype: int64
```

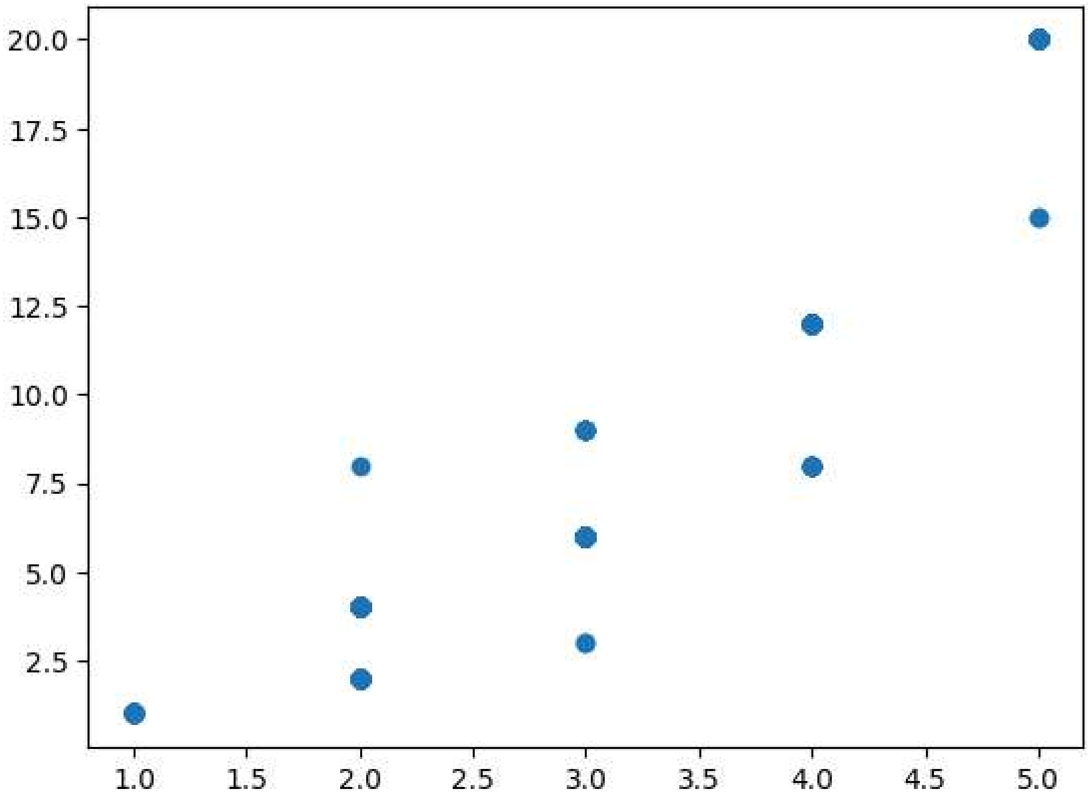
Relation of Toppings count and Pizza Complexity

In [191…

```
x=df['Toppings Count']
y=df['Pizza Complexity']
plt.scatter(x,y)
```

Out[191…

```
<matplotlib.collections.PathCollection at 0x1e8e3985a90>
```



In [192…

```
df['Traffic Impact'].value_counts()
```

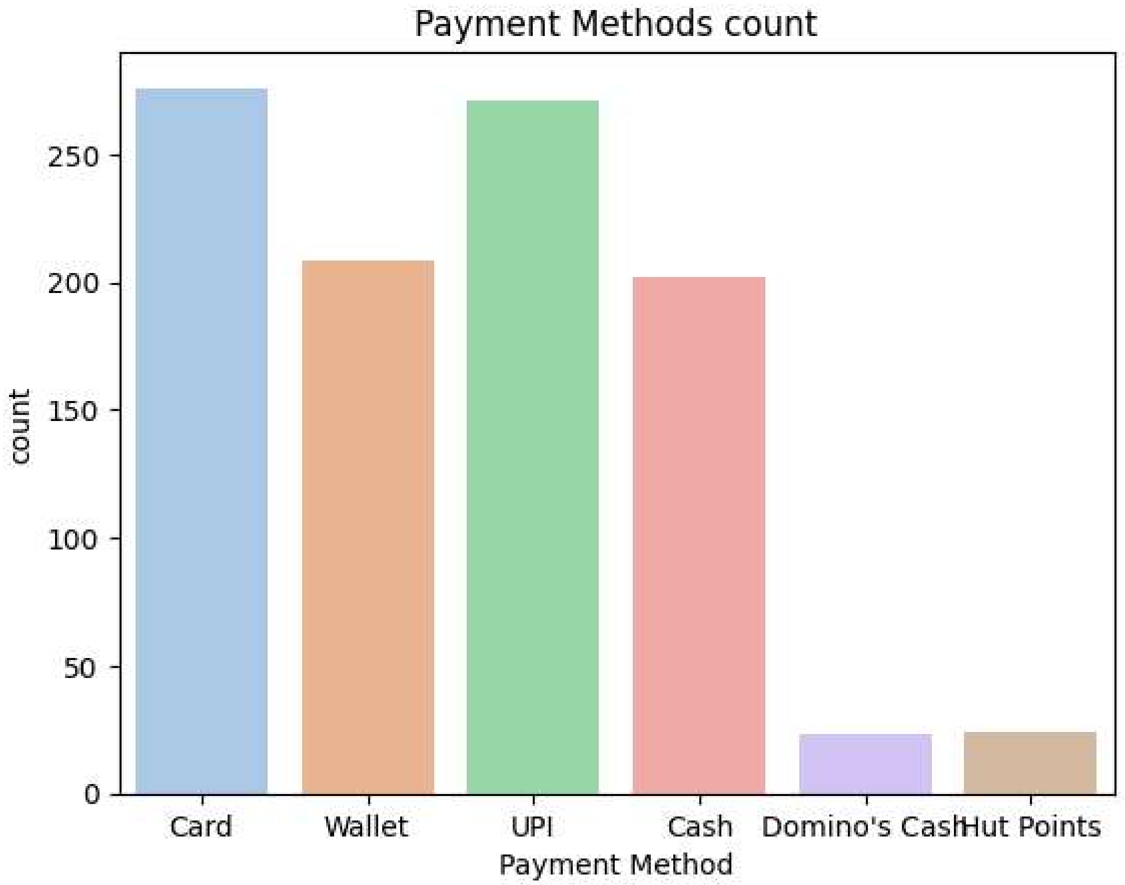
Out[192…

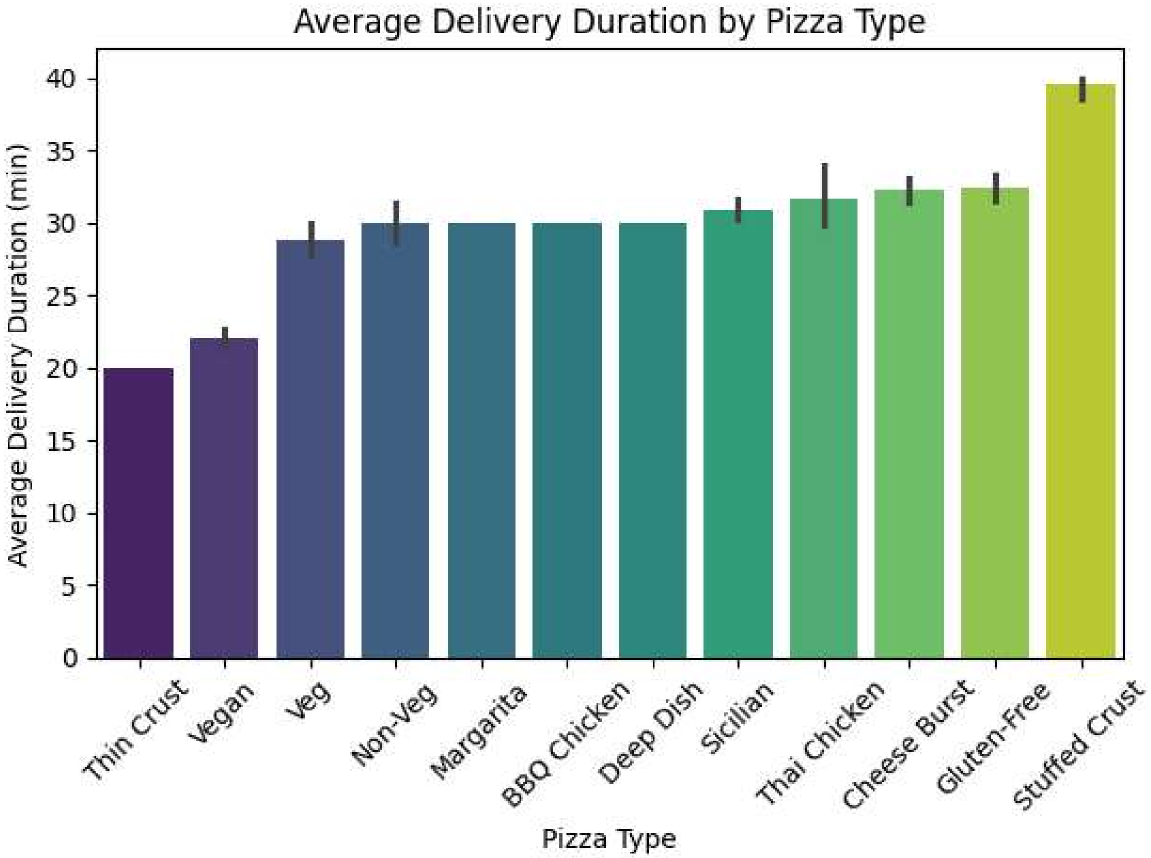
```
Traffic Impact
2    398
3    328
1    278
Name: count, dtype: int64
```

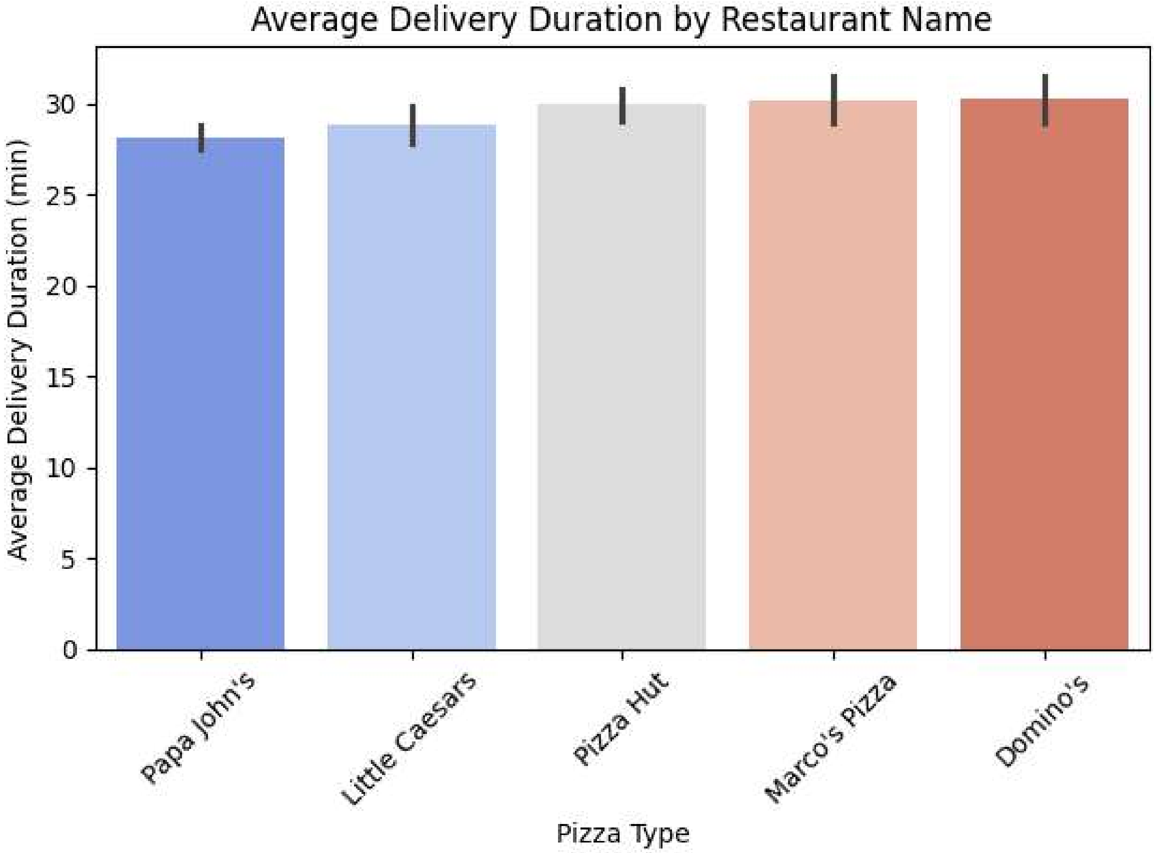
EDA

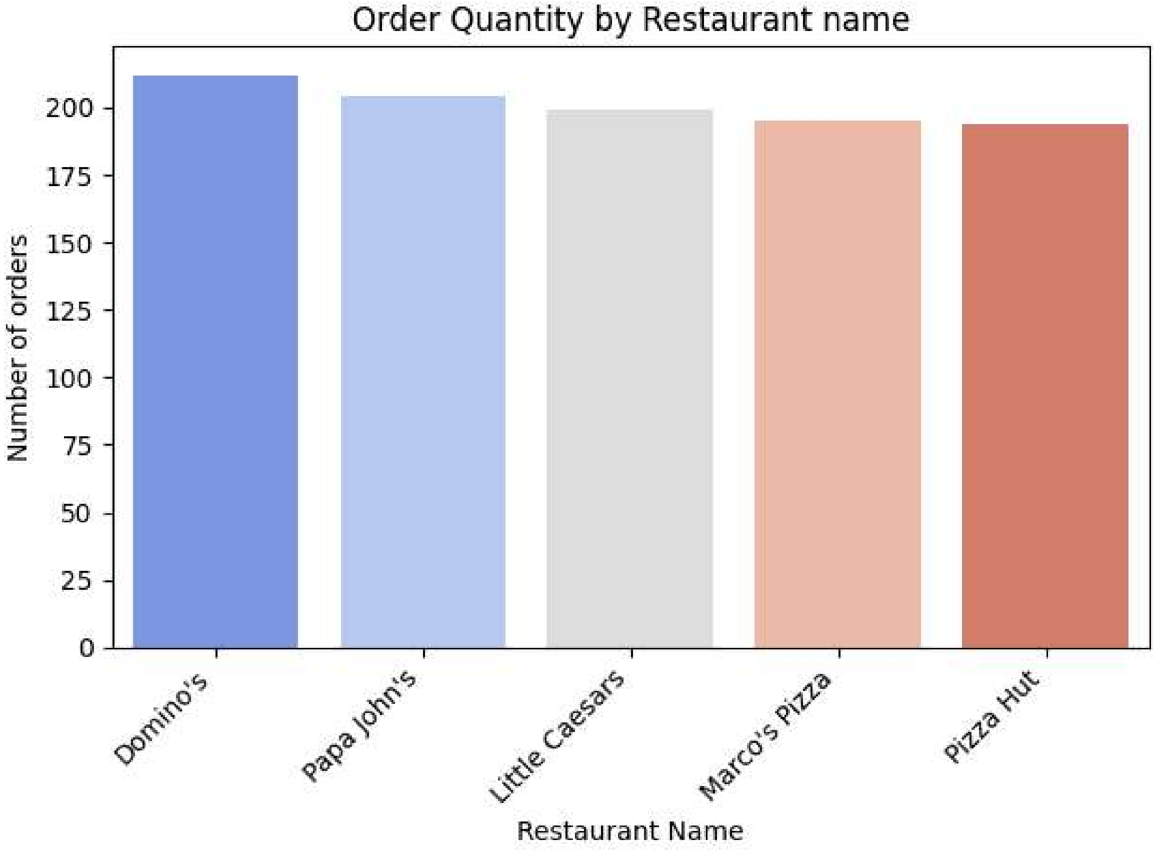
In [193…

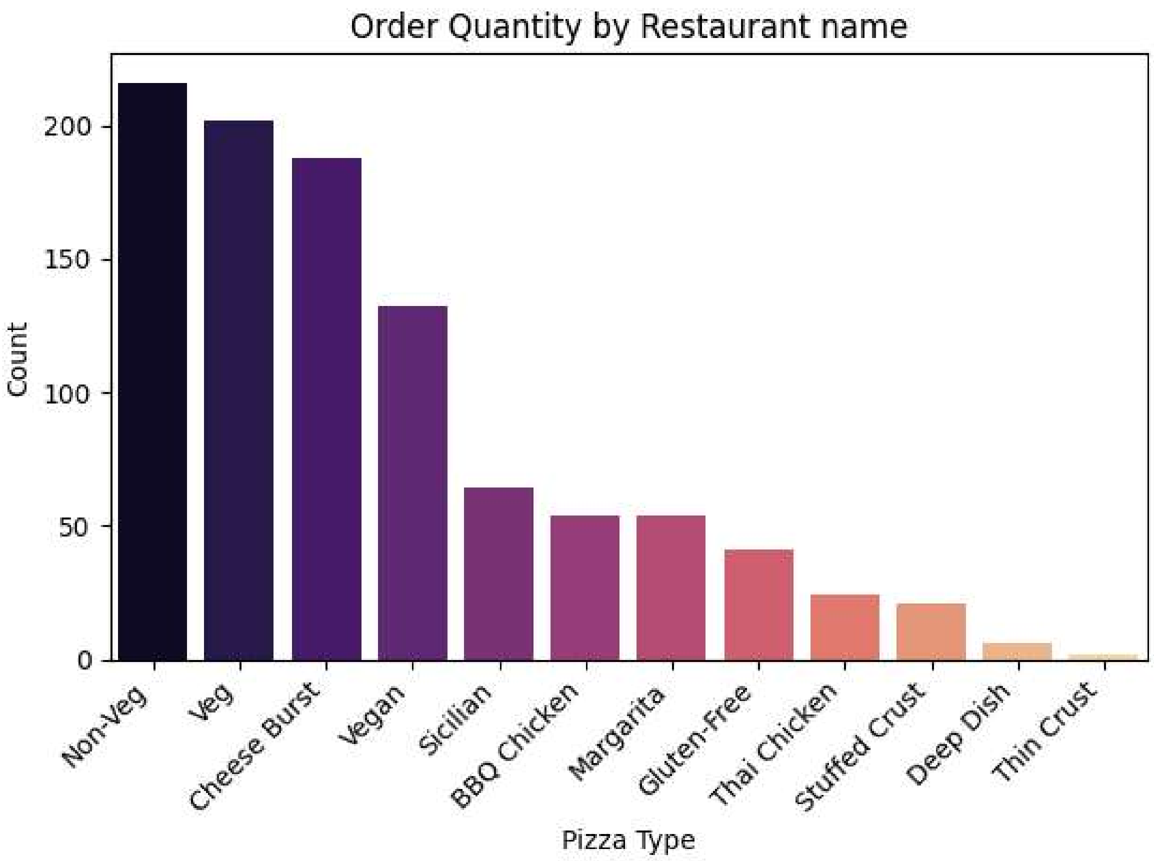
```
#Payment method and their count
#abs_values=df['Payment Method'].value_counts()
sns.countplot(x=df['Payment Method'], palette='pastel')
plt.title('Payment Methods count')
plt.show()

#Pizza type and time it took to deliver
order = df.groupby('Pizza Type')['Delivery Duration (min)'].mean().sort_values()
sns.barplot(x='Pizza Type', y='Delivery Duration (min)', data=df, order=order, p
plt.title('Average Delivery Duration by Pizza Type')
plt.xlabel('Pizza Type')
plt.ylabel('Average Delivery Duration (min)')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()

Restaurant_name = df.groupby('Restaurant Name')['Delivery Duration (min)'].mean(
sns.barplot(x='Restaurant Name', y='Delivery Duration (min)', data=df, order=Res
plt.title('Average Delivery Duration by Restaurant Name')
plt.xlabel('Pizza Type')
plt.ylabel('Average Delivery Duration (min)')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()


"""counts = df['Restaurant Name'].value_counts(ascending=False).values
ax=sns.countplot(x=df['Restaurant Name'], palette='pastel')
plt.title('Order Quantity by Restaurant name')
plt.xlabel('Restaurant Name')
ax.bar_label(container=ax.containers[0], labels=counts)
plt.ylabel('Number of orders')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()"""

sns.countplot(x='Restaurant Name', data=df, palette='coolwarm', order=df['Restau
plt.title('Order Quantity by Restaurant name')
plt.xlabel('Restaurant Name')
plt.ylabel('Number of orders')
#ax.bar_label(ax.containers[0], fmt='%d')
plt.xticks(rotation=45, ha='right') # ha='right' aligns rotated labels nicely
plt.tight_layout()
plt.show()


sns.countplot(x='Pizza Type', data=df, palette='magma', order=df['Pizza Type'].v
plt.title('Order Quantity by Restaurant name')
plt.xlabel('Pizza Type')
plt.ylabel('Count')
#ax.bar_label(ax.containers[0], fmt='%d')
plt.xticks(rotation=45, ha='right') # ha='right' aligns rotated labels nicely
plt.tight_layout()
plt.show()
#yy=df['Restaurant Name'].value_counts()
#sns.barplot(x=df['Restaurant Name'],y=yy, order= yy, palette='coolwarm')
```


Payment Methods count
count
0
50
100
150
200
250
Card
Wallet
UPI
Cash
Domino's Cash
Hut Points
Payment Method


Average Delivery Duration by Pizza Type
Average Delivery Duration (min)
0
5
10
15
20
25
30
35
40
Thin Crust
Vegan
Veg
Non-Veg
Margarita
BBQ Chicken
Deep Dish
Sicilian
Thai Chicken
Cheese Burst
Gluten-Free
Stuffed Crust
Pizza Type


Average Delivery Duration by Restaurant Name
Average Delivery Duration (min)
0
5
10
15
20
25
30
Papa John's
Little Caesars
Pizza Hut
Marco's Pizza
Domino's
Pizza Type


Order Quantity by Restaurant name
Number of orders
0
25
50
75
100
125
150
175
200
Domino's
Papa John's
Little Caesars
Marco's Pizza
Pizza Hut
Restaurant Name



In [194…

```
df.head()
```

Out[194…

	Order ID	Restaurant Name	Location	Order Time	Delivery Time	Delivery Duration (min)	Pizza Size	Pizza Type	Toppi Cou
0	ORD001	Domino's	New York, NY	2024-01-05 18:30:00	2024-01-05 18:45:00	15	Medium	Veg	
1	ORD002	Papa John's	Los Angeles, CA	2024-02-14 20:00:00	2024-02-14 20:25:00	25	Large	Non-Veg	
2	ORD003	Little Caesars	Chicago, IL	2024-03-21 12:15:00	2024-03-21 12:35:00	20	Small	Vegan	
3	ORD004	Pizza Hut	Miami, FL	2024-04-10 19:45:00	2024-04-10 20:10:00	25	XL	Cheese Burst	
4	ORD005	Marco's Pizza	Dallas, TX	2024-05-05 13:00:00	2024-05-05 13:20:00	20	Medium	Non-Veg	

5 rows × 25 columns

In [195…

```
df['Traffic Impact'].value_counts()
```

Out[195…

```
Traffic Impact
2    398
3    328
1    278
Name: count, dtype: int64
```

In [196…

```
one_hot_data=df.loc[:, df.columns.drop(['Order ID', 'Payment Method', 'Traffic L
```

In [197…

```
one_hot_data.head()
```

Out[197…

	Distance (km)	Is Weekend	Delivery Efficiency (min/km)	Delay (min)	Traffic Impact	Order Hour
0	2.5	False	6.000000	9.0	2	18
1	5.0	False	5.000000	13.0	3	20
2	3.0	False	6.666667	12.8	1	12
3	4.5	False	5.555556	14.2	2	19
4	2.0	True	10.000000	15.2	3	13

Linear regression to check effectiveness of features on order delay

In [198…

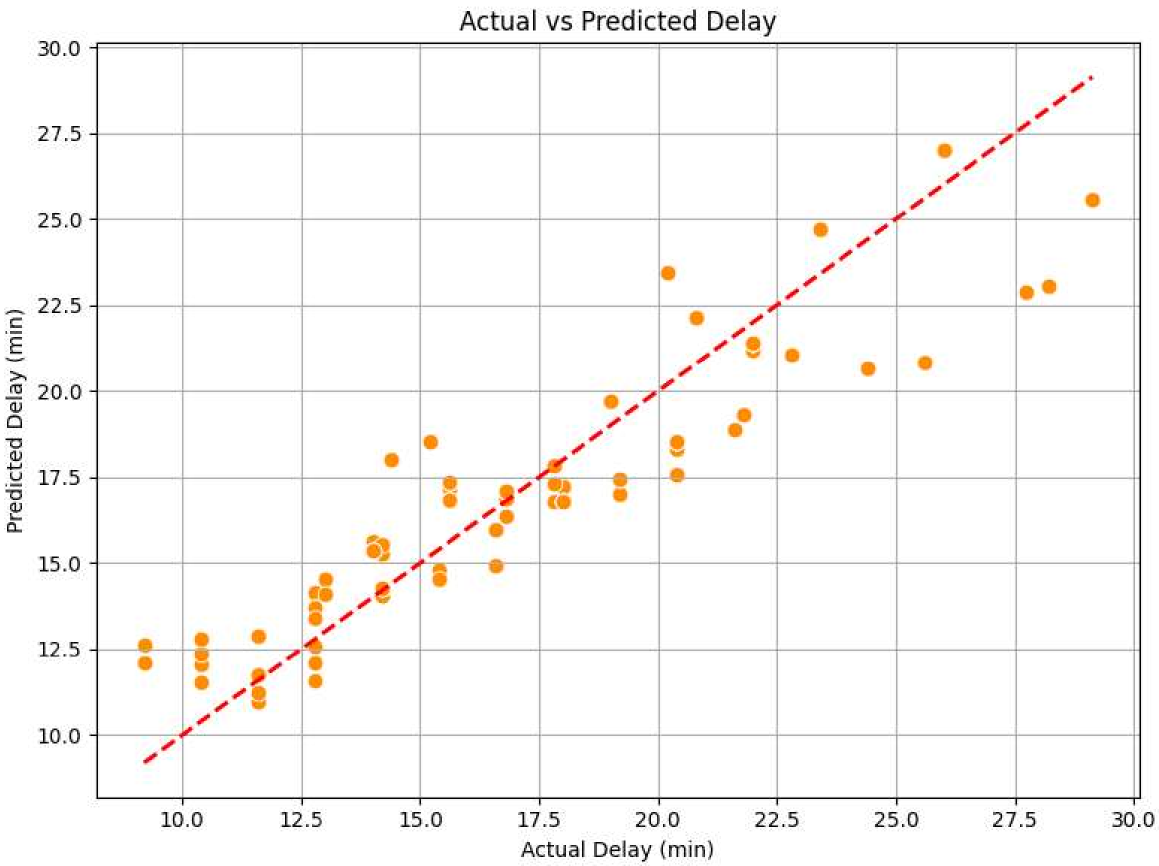
```
# Features and target
X = one_hot_data[['Distance (km)', 'Delivery Efficiency (min/km)', 'Traffic Impa
y = one_hot_data['Delay (min)']

# Split data into train and test sets (optional but recommended)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_

# Create and train the model
model = LinearRegression()
model.fit(X_train, y_train)

# Predict
y_pred = model.predict(X_test)

# Evaluation
print("Coefficients:", model.coef_)
print("Intercept:", model.intercept_)
print("Mean Squared Error (MSE):", mean_squared_error(y_test, y_pred))
print("R-squared (R²):", r2_score(y_test, y_pred))
```

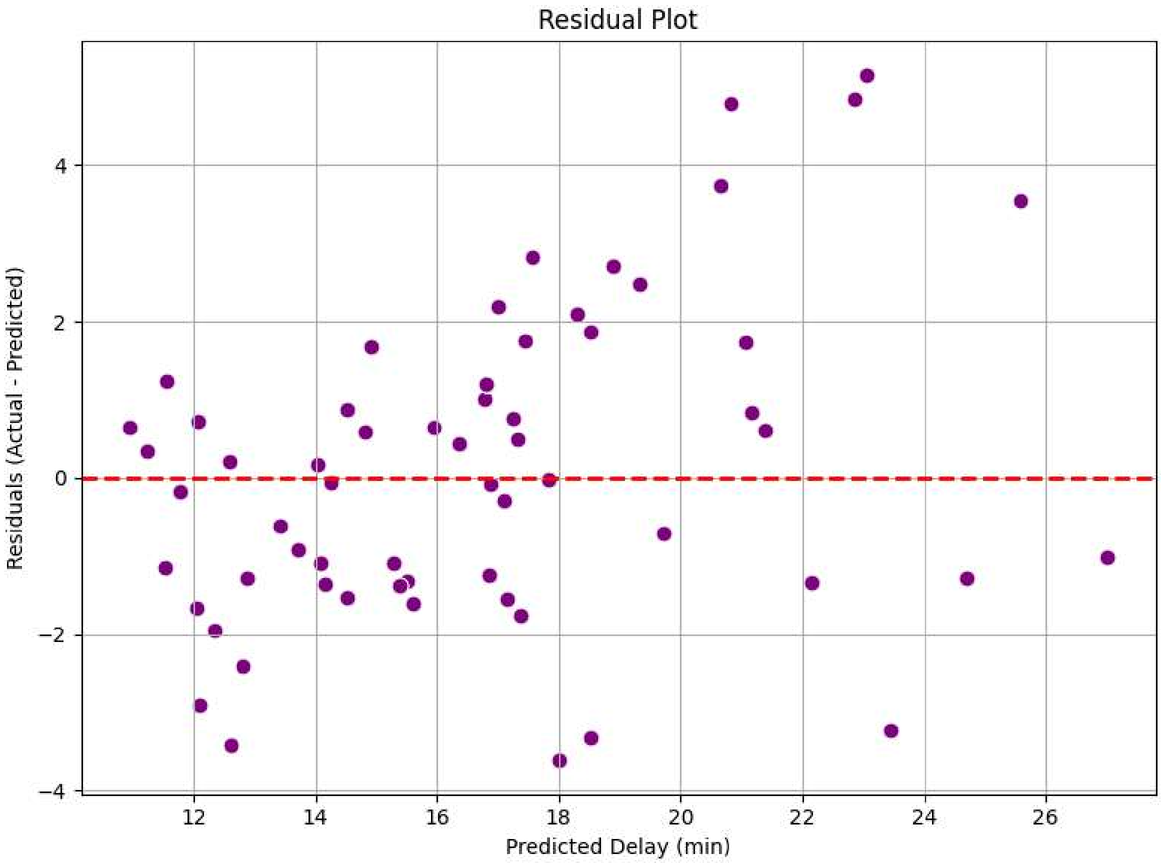
```
Coefficients: [ 2.54076955  2.20445525 -0.51799644  0.22199371]
Intercept: -12.087190990925937
Mean Squared Error (MSE): 3.398943279107687
R-squared (R²): 0.8094841070251694
```

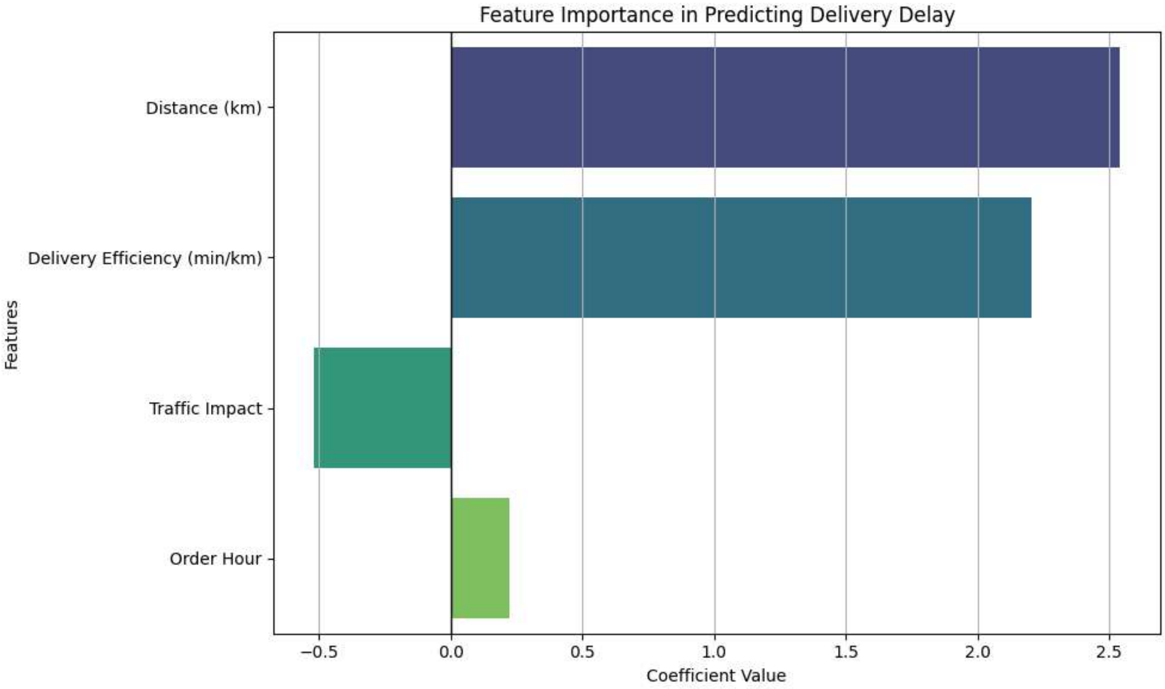
Plotting the outcomes of regression

In [199…

```
# 1. Plot: Actual vs Predicted values
plt.figure(figsize=(8, 6))
sns.scatterplot(x=y_test, y=y_pred, color='darkorange', s=60)
plt.plot([y_test.min(), y_test.max()], [y_test.min(), y_test.max()], 'r--', line
plt.xlabel("Actual Delay (min)")
plt.ylabel("Predicted Delay (min)")
plt.title("Actual vs Predicted Delay")
plt.grid(True)
plt.tight_layout()
plt.show()

# 2. Plot: Residuals (errors)
residuals = y_test - y_pred

plt.figure(figsize=(8, 6))
sns.scatterplot(x=y_pred, y=residuals, color='purple', s=60)
plt.axhline(0, color='red', linestyle='--', linewidth=2)
plt.xlabel("Predicted Delay (min)")
plt.ylabel("Residuals (Actual - Predicted)")
plt.title("Residual Plot")
plt.grid(True)
plt.tight_layout()
plt.show()

# 3. Plot: Coefficients for Feature Importance
feature_names = X.columns
coefficients = model.coef_

plt.figure(figsize=(10, 6))
sns.barplot(x=coefficients, y=feature_names, palette='viridis')
plt.xlabel("Coefficient Value")
plt.ylabel("Features")
plt.title("Feature Importance in Predicting Delivery Delay")
plt.axvline(0, color='black', linewidth=1)
plt.grid(True, axis='x')
plt.tight_layout()
plt.show()
```




Residual Plot
Residuals (Actual - Predicted)
4
2
0
−2
−4
12
14
16
18
20
22
24
26
Predicted Delay (min)


Feature Importance in Predicting Delivery Delay
Features
Distance (km)
Delivery Efficiency (min/km)
Traffic Impact
Order Hour
−0.5
0.0
0.5
1.0
1.5
2.0
2.5
Coefficient Value

In [ ]: