

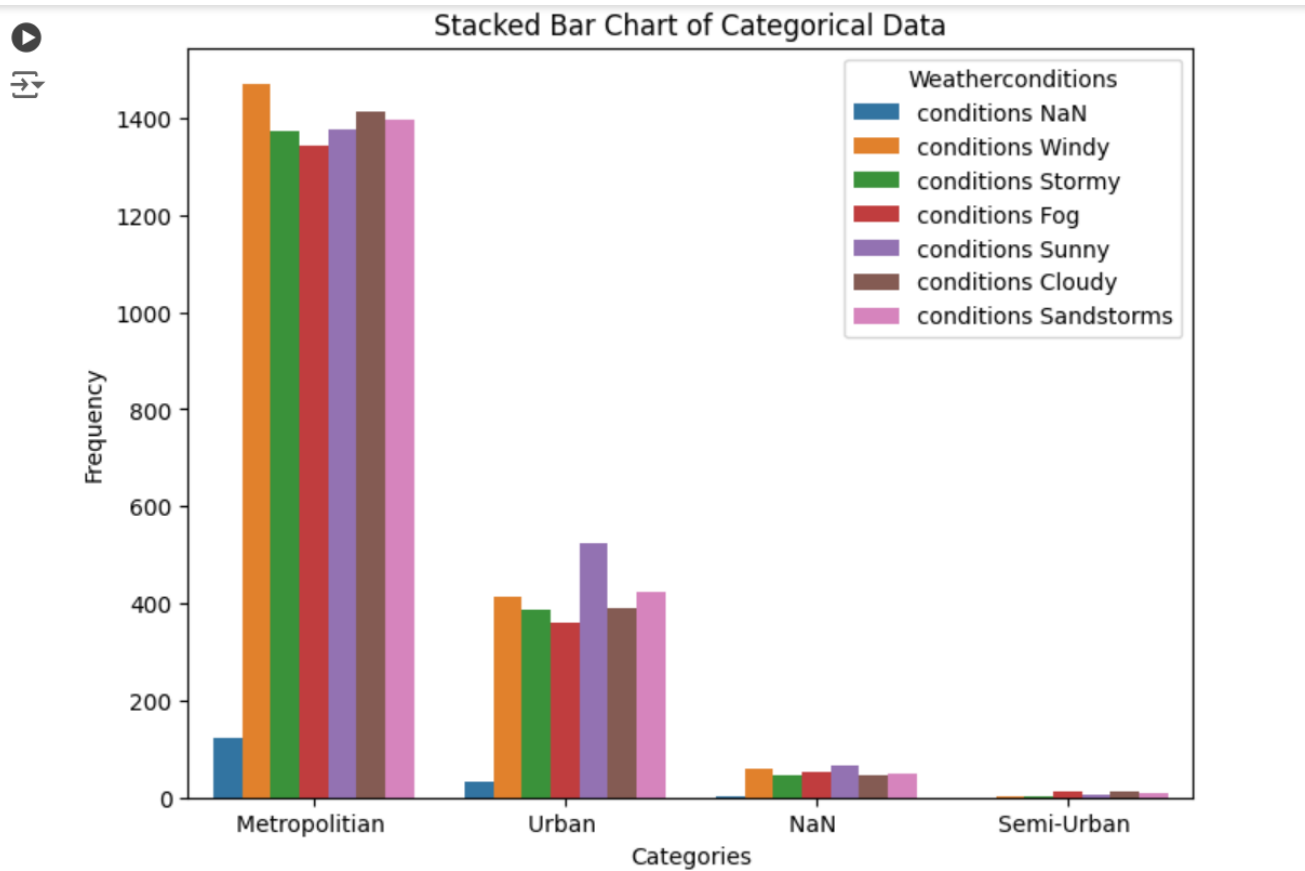
### **Data Collection and Preprocessing Phase**

|               |   |
|---------------|---|
| Date          | 07 JULY 2024                                    |
| Team ID       | 739721  |
| Project Title | Optimising Food Delivery Using Machine Learning |
| Maximum Marks | 6 Marks   |

### **Data Exploration and Preprocessing Report**

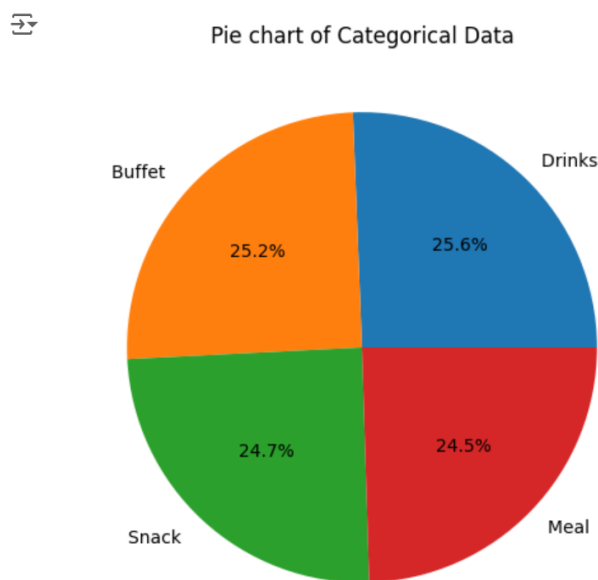
Identifies data sources, assesses quality issues like missing values and duplicates, and implements resolution plans to ensure accurate and reliable analysis

| Section             | Description  |                    |                     |                         |                     |                         |                            |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
|---------------------|--|--------------------|---------------------|-------------------------|---------------------|-------------------------|----------------------------|----------------------|----------------------------|-----|---|--------|----------------|----|-----|-----------|-----------|-----------|--|---|--------|----------------|----|-----|-----------|-----------|-----------|--|---|--------|----------------|----|-----|-----------|-----------|-----------|--|---|--------|-----------------|----|-----|-----------|-----------|-----------|--|---|--------|----------------|----|-----|-----------|-----------|-----------|--|--|----|--------------------|---------------------|-------------------------|---------------------|----------------------|----------------------------|-----|-------|--------|---------------|----|-----|-----------|-----------|-----------|--|-------|--------|---------------|----|-----|----------|----------|----------|--|-------|--------|----------------|----|-----|-----------|-----------|-----------|--|-------|--------|-----------------|----|-----|-----------|-----------|-----------|--|-------|--------|------------------|----|-----|-----------|-----------|-----------|--|
| Data Overview       | <div><pre>[ ] train_data.head()</pre><table><thead><tr><th></th><th>ID</th><th>Delivery_person_ID</th><th>Delivery_person_Age</th><th>Delivery_person_Ratings</th><th>Restaurant_latitude</th><th>Restaurant_longitude</th><th>Delivery_location_latitude</th><th>Del</th></tr></thead><tbody><tr><td>0</td><td>0x4607</td><td>INDORES13DEL02</td><td>37</td><td>4.9</td><td>22.745049</td><td>75.892471</td><td>22.765049</td><td></td></tr><tr><td>1</td><td>0xb379</td><td>BANGRES18DEL02</td><td>34</td><td>4.5</td><td>12.913041</td><td>77.683237</td><td>13.043041</td><td></td></tr><tr><td>2</td><td>0x5d6d</td><td>BANGRES19DEL01</td><td>23</td><td>4.4</td><td>12.914264</td><td>77.678400</td><td>12.924264</td><td></td></tr><tr><td>3</td><td>0x7a6a</td><td>COIMBRES13DEL02</td><td>38</td><td>4.7</td><td>11.003669</td><td>76.976494</td><td>11.053669</td><td></td></tr><tr><td>4</td><td>0x70a2</td><td>CHENRES12DEL01</td><td>32</td><td>4.6</td><td>12.972793</td><td>80.249962</td><td>13.012793</td><td></td></tr></tbody></table><pre>[ ] train_data.tail()</pre><table><thead><tr><th></th><th>ID</th><th>Delivery_person_ID</th><th>Delivery_person_Age</th><th>Delivery_person_Ratings</th><th>Restaurant_latitude</th><th>Restaurant_longitude</th><th>Delivery_location_latitude</th><th>Del</th></tr></thead><tbody><tr><td>45588</td><td>0x7cd9</td><td>JAPRES04DEL01</td><td>30</td><td>4.8</td><td>26.902328</td><td>75.794257</td><td>26.912328</td><td></td></tr><tr><td>45589</td><td>0xd641</td><td>AGRRES16DEL01</td><td>21</td><td>4.6</td><td>0.000000</td><td>0.000000</td><td>0.070000</td><td></td></tr><tr><td>45590</td><td>0x4f8d</td><td>CHENRES08DEL03</td><td>30</td><td>4.9</td><td>13.022394</td><td>80.242489</td><td>13.052394</td><td></td></tr><tr><td>45591</td><td>0x5eee</td><td>COIMBRES11DEL01</td><td>20</td><td>4.7</td><td>11.001753</td><td>76.986241</td><td>11.041753</td><td></td></tr><tr><td>45592</td><td>0x5fb2</td><td>RANCHIRES09DEL02</td><td>23</td><td>4.9</td><td>23.351058</td><td>85.325731</td><td>23.431058</td><td></td></tr></tbody></table></div> <p>Basic statistics, dimensions, and structure of the data.</p> |                    | ID                  | Delivery_person_ID      | Delivery_person_Age | Delivery_person_Ratings | Restaurant_latitude        | Restaurant_longitude | Delivery_location_latitude | Del | 0 | 0x4607 | INDORES13DEL02 | 37 | 4.9 | 22.745049 | 75.892471 | 22.765049 |  | 1 | 0xb379 | BANGRES18DEL02 | 34 | 4.5 | 12.913041 | 77.683237 | 13.043041 |  | 2 | 0x5d6d | BANGRES19DEL01 | 23 | 4.4 | 12.914264 | 77.678400 | 12.924264 |  | 3 | 0x7a6a | COIMBRES13DEL02 | 38 | 4.7 | 11.003669 | 76.976494 | 11.053669 |  | 4 | 0x70a2 | CHENRES12DEL01 | 32 | 4.6 | 12.972793 | 80.249962 | 13.012793 |  |  | ID | Delivery_person_ID | Delivery_person_Age | Delivery_person_Ratings | Restaurant_latitude | Restaurant_longitude | Delivery_location_latitude | Del | 45588 | 0x7cd9 | JAPRES04DEL01 | 30 | 4.8 | 26.902328 | 75.794257 | 26.912328 |  | 45589 | 0xd641 | AGRRES16DEL01 | 21 | 4.6 | 0.000000 | 0.000000 | 0.070000 |  | 45590 | 0x4f8d | CHENRES08DEL03 | 30 | 4.9 | 13.022394 | 80.242489 | 13.052394 |  | 45591 | 0x5eee | COIMBRES11DEL01 | 20 | 4.7 | 11.001753 | 76.986241 | 11.041753 |  | 45592 | 0x5fb2 | RANCHIRES09DEL02 | 23 | 4.9 | 23.351058 | 85.325731 | 23.431058 |  |
|                     | ID   | Delivery_person_ID | Delivery_person_Age | Delivery_person_Ratings | Restaurant_latitude | Restaurant_longitude    | Delivery_location_latitude | Del                  |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| 0                   | 0x4607   | INDORES13DEL02     | 37                  | 4.9                     | 22.745049           | 75.892471               | 22.765049                  |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| 1                   | 0xb379   | BANGRES18DEL02     | 34                  | 4.5                     | 12.913041           | 77.683237               | 13.043041                  |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| 2                   | 0x5d6d   | BANGRES19DEL01     | 23                  | 4.4                     | 12.914264           | 77.678400               | 12.924264                  |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| 3                   | 0x7a6a   | COIMBRES13DEL02    | 38                  | 4.7                     | 11.003669           | 76.976494               | 11.053669                  |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| 4                   | 0x70a2   | CHENRES12DEL01     | 32                  | 4.6                     | 12.972793           | 80.249962               | 13.012793                  |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
|                     | ID   | Delivery_person_ID | Delivery_person_Age | Delivery_person_Ratings | Restaurant_latitude | Restaurant_longitude    | Delivery_location_latitude | Del                  |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| 45588               | 0x7cd9   | JAPRES04DEL01      | 30                  | 4.8                     | 26.902328           | 75.794257               | 26.912328                  |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| 45589               | 0xd641   | AGRRES16DEL01      | 21                  | 4.6                     | 0.000000            | 0.000000                | 0.070000                   |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| 45590               | 0x4f8d   | CHENRES08DEL03     | 30                  | 4.9                     | 13.022394           | 80.242489               | 13.052394                  |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| 45591               | 0x5eee   | COIMBRES11DEL01    | 20                  | 4.7                     | 11.001753           | 76.986241               | 11.041753                  |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| 45592               | 0x5fb2   | RANCHIRES09DEL02   | 23                  | 4.9                     | 23.351058           | 85.325731               | 23.431058                  |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| Univariate Analysis | <p>Exploration of individual variables (mean, median, mode, etc.).</p> <div><pre>[ ]</pre><pre>[ ]</pre></div>   |                    |                     |                         |                     |                         |                            |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |
| Bivariate Analysis  | <p>Relationships between two variables (correlation, scatter plots).</p>   |                    |                     |                         |                     |                         |                            |                      |                            |     |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |   |        |                 |    |     |           |           |           |  |   |        |                |    |     |           |           |           |  |  |    |                    |                     |                         |                     |                      |                            |     |       |        |               |    |     |           |           |           |  |       |        |               |    |     |          |          |          |  |       |        |                |    |     |           |           |           |  |       |        |                 |    |     |           |           |           |  |       |        |                  |    |     |           |           |           |  |



Multivariate  
Analysis

Patterns and relationships involving multiple variables.



Outliers and Anomalies

Identification and treatment of outliers.

```
import math
def haversine(lat1, lon1, lat2, lon2):
    lat1 = math.radians(lat1)
    lon1 = math.radians(lon1)
    lat2 = math.radians(lat2)
    lon2 = math.radians(lon2)

    radius = 6371.0

    dlon = lon2 - lon1
    dlat = lat2 - lat1
    a = math.sin(dlat/2)**2 + math.cos(lat1) * math.cos(lat2) * math.sin(dlon/2)**2
    c = 2 * math.atan2(math.sqrt(a), math.sqrt(1-a))
    distance = radius * c

    return distance

test_data['distance'] = test_data.apply(lambda row: haversine(row['Restaurant_latitude'], row['R

[ ] for column in test_data.columns:
    if test_data[column].dtype != 'O':
        sns.displot(test_data[column])
        plt.title(f'Distribution of {column}')
        plt.show()
```

Data Preprocessing Code Screenshots

Loading Data

Code to load the dataset into the preferred environment (e.g., Python, R).

[ ] x\_train

|       | Delivery_person_Ratings | Restaurant_latitude | Restaurant_longitude | Delivery_location_latitude | Delivery_location_longitude | Time_Orderd | Weathr |
|-------|-------------------------|---------------------|----------------------|----------------------------|-----------------------------|-------------|--------|
| 29044 | 24                      | 4.723145            | 73.167753            | 22.318096                  | 73.177753                   | 36          |        |
| 41736 | 18                      | 3.512546            | 76.616792            | 12.367978                  | 76.646792                   | 160         |        |
| 17874 | 22                      | 4.770911            | 75.886362            | 22.831593                  | 75.956362                   | 101         |        |
| 42093 | 16                      | 4.723381            | 73.169083            | 22.350329                  | 73.209083                   | 51          |        |
| 22952 | 24                      | 0.000000            | 0.000000             | 0.110000                   | 0.110000                    | 132         |        |
| ...   | ...                     | ...                 | ...                  | ...                        | ...                         | ...         | ...    |
| 11284 | 25                      | 3.310868            | 76.971082            | 11.071850                  | 77.081082                   | 100         |        |
| 44732 | 25                      | 5.185672            | 75.802083            | 26.981191                  | 75.892083                   | 141         |        |
| 38158 | 25                      | 4.350584            | 72.832585            | 18.967584                  | 72.872585                   | 70          |        |
| 860   | 25                      | 3.617518            | 80.220672            | 13.136439                  | 80.270672                   | 100         |        |
| 15795 | 22                      | 4.172574            | 78.437225            | 17.470371                  | 78.497225                   | 117         |        |

36474 rows x 11 columns



|                       |   |
|-----------------------|---|
| Handling Missing Data | <p>Code for identifying and handling missing values.</p> <pre> ▶ Delivery_person_Ratings      0 ↔ Restaurant_latitude          431 ↔ Restaurant_longitude         0 Delivery_location_latitude     0 Delivery_location_longitude    0 Time_Orderd                   0 Weatherconditions              0 Road_traffic_density           0 Type_of_order                  0 Festival                       0 City                           0 dtype: int64 </pre> <pre>[ ] X['Restaurant_latitude'].fillna(X['Restaurant_latitude'].mean(),inplace=True)</pre> <pre>[ ] X.isnull().sum()</pre> <pre> ↔ Delivery_person_Ratings      0 Restaurant_latitude            0 Restaurant_longitude           0 Delivery_location_latitude     0 Delivery_location_longitude    0 Time_Orderd                   0 Weatherconditions              0 Road_traffic_density           0 Type_of_order                  0 Festival                       0 City                           0 dtype: int64 </pre> |
| Data Transformation   | Code for transforming variables (scaling, normalization).   |
| Feature Engineering   | Code for creating new features or modifying existing ones.  |

```
[ ] #Get feature importances

importances = rf.feature_importances_

#Create a DataFrame for visualization

feature_importances = pd.DataFrame({'feature': X.columns, 'importance': importances})
```

```
[ ] feature_importances
```

|   | feature                     | importance |
|---|-----------------------------|------------|
| 0 | Delivery_person_Ratings     | 0.229907   |
| 1 | Restaurant_latitude         | 0.062626   |
| 2 | Restaurant_longitude        | 0.060808   |
| 3 | Delivery_location_latitude  | 0.090019   |
| 4 | Delivery_location_longitude | 0.088612   |
| 5 | Time_Orderd                 | 0.117300   |
| 6 | Weatherconditions           | 0.125084   |
| 7 | Road_traffic_density        | 0.129196   |
| 8 | Type_of_order               | 0.027626   |
| 9 | Festival                    | 0.046998   |