Food Delivery Time Prediction using Machine Learning Algorithms

In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
```

In [2]:

```
import warnings
warnings.filterwarnings('ignore')
```

In [3]:

```
df = pd.read_csv("food_delivery.csv", encoding='latin1')
```

In [4]:

```
df.head()
```

Out[4]:

	ID	Delivery_person_ID	Delivery_person_Age	Delivery_person_Ratings	Restaurant_latitude	Restaurant_longitude	Delivery_location_la
0	4607	INDORES13DEL02	37	4.9	22.745049	75.892471	22.7
1	B379	BANGRES18DEL02	34	4.5	12.913041	77.683237	13.(
2	5D6D	BANGRES19DEL01	23	4.4	12.914264	77.678400	12.9
3	7A6A	COIMBRES13DEL02	38	4.7	11.003669	76.976494	11.(
4	70A2	CHENRES12DEL01	32	4.6	12.972793	80.249982	13.(

In [5]:

```
df.tail()
```

Out[5]:

	ID	Delivery_person_ID	Delivery_person_Age	Delivery_person_Ratings	Restaurant_latitude	Restaurant_longitude	Delivery_loca
45588	7C09	JAPRES04DEL01	30	4.8	26.902328	75.794257	
45589	D641	AGRRES16DEL01	21	4.6	0.000000	0.000000	
45590	4F8D	CHENRES08DEL03	30	4.9	13.022394	80.242439	
45591	5EEE	COIMBRES11DEL01	20	4.7	11.001753	76.986241	
45592	5FB2	RANCHIRES09DEL02	23	4.9	23.351058	85.325731	

In [6]:

```
df.shape
```

Out[6]:

```
(45593, 11)
```

In [7]:

```
df.columns
```

Out[7]:

```
Index(['ID', 'Delivery_person_ID', 'Delivery_person_Age',
       'Delivery_person_Ratings', 'Restaurant_latitude',
       'Restaurant_longitude', 'Delivery_location_latitude',
       'Delivery_location_longitude', 'Type_of_order', 'Type_of_vehicle',
       'Time_taken(min)'],
      dtype='object')
```

In [8]:

```
df.duplicated().sum()
```

Out[8]:

```
0
```

In [9]:

```
df.isnull().sum()
```

Out[9]:

```
ID                             0
Delivery_person_ID             0
Delivery_person_Age            0
Delivery_person_Ratings        0
Restaurant_latitude            0
Restaurant_longitude           0
Delivery_location_latitude     0
Delivery_location_longitude    0
Type_of_order                  0
Type_of_vehicle                0
Time_taken(min)                0
dtype: int64
```

In [10]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 45593 entries, 0 to 45592
Data columns (total 11 columns):
 #   Column                       Non-Null Count  Dtype  
---  ------                       --------------  -----  
 0   ID                           45593 non-null  object 
 1   Delivery_person_ID           45593 non-null  object 
 2   Delivery_person_Age          45593 non-null  int64  
 3   Delivery_person_Ratings      45593 non-null  float64
 4   Restaurant_latitude          45593 non-null  float64
 5   Restaurant_longitude         45593 non-null  float64
 6   Delivery_location_latitude   45593 non-null  float64
 7   Delivery_location_longitude  45593 non-null  float64
 8   Type_of_order                45593 non-null  object 
 9   Type_of_vehicle              45593 non-null  object 
 10  Time_taken(min)              45593 non-null  int64  
dtypes: float64(5), int64(2), object(4)
memory usage: 3.8+ MB
```

In [11]:

```
df.describe()
```

Out[11]:

	Delivery_person_Age	Delivery_person_Ratings	Restaurant_latitude	Restaurant_longitude	Delivery_location_latitude	Delivery_locatio
count	45593.000000	45593.000000	45593.000000	45593.000000	45593.000000	45
mean	29.544075	4.632367	17.017729	70.231332	17.465186	
std	5.696793	0.327708	8.185109	22.883647	7.335122	
min	15.000000	1.000000	-30.905562	-88.366217	0.010000	
25%	25.000000	4.600000	12.933284	73.170000	12.988453	
50%	29.000000	4.700000	18.546947	75.898497	18.633934	
75%	34.000000	4.800000	22.728163	78.044095	22.785049	
max	50.000000	6.000000	30.914057	88.433452	31.054057	

In [12]:

```
df.nunique()
```

Out[12]:

```
ID                           45451
Delivery_person_ID            1320
Delivery_person_Age             22
Delivery_person_Ratings         28
Restaurant_latitude            657
Restaurant_longitude           518
Delivery_location_latitude    4373
Delivery_location_longitude   4373
Type_of_order                    4
Type_of_vehicle                  4
Time_taken(min)                 45
dtype: int64
```

In [13]:

```
object_columns = df.select_dtypes(include='object').columns
print("Object Columns:")
print(object_columns)
print()

numerical_columns = df.select_dtypes(include=['int64', 'float64']).columns
print("Numerical Columns:")
print(numerical_columns)
```

```
Object Columns:
Index(['ID', 'Delivery_person_ID', 'Type_of_order', 'Type_of_vehicle'], dtype='object')

Numerical Columns:
Index(['Delivery_person_Age', 'Delivery_person_Ratings', 'Restaurant_latitude',
       'Restaurant_longitude', 'Delivery_location_latitude',
       'Delivery_location_longitude', 'Time_taken(min)'],
      dtype='object')
```

In [14]:

```
df['Type_of_order'].unique()
```

Out[14]:

```
array(['Snack ', 'Drinks ', 'Buffet ', 'Meal '], dtype=object)
```

In [15]:

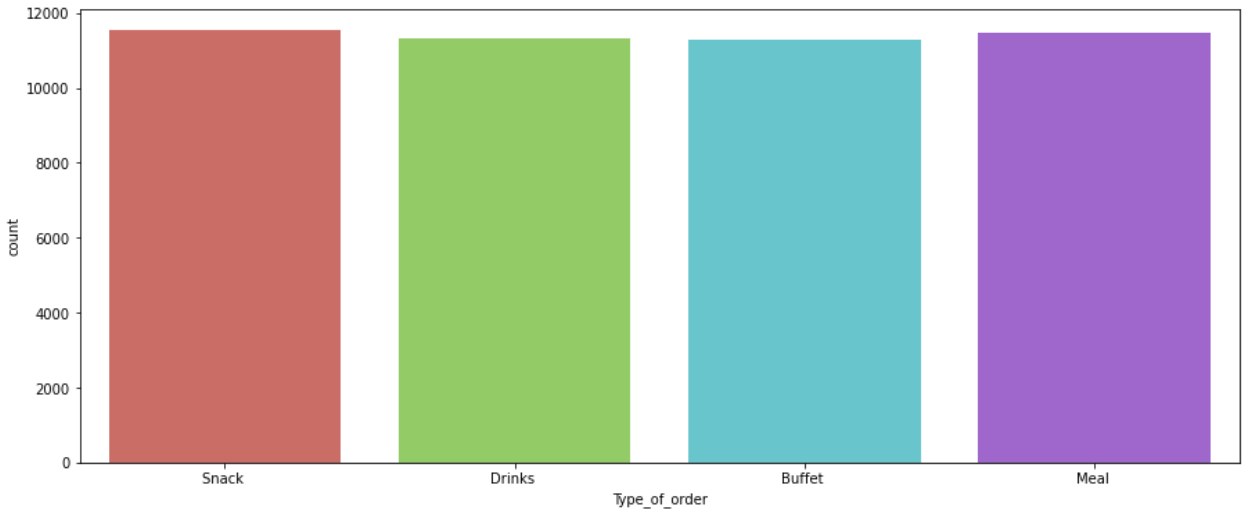
```
df['Type_of_order'].value_counts()
```

Out[15]:

```
Snack      11533
Meal       11458
Drinks     11322
Buffet     11280
Name: Type_of_order, dtype: int64
```

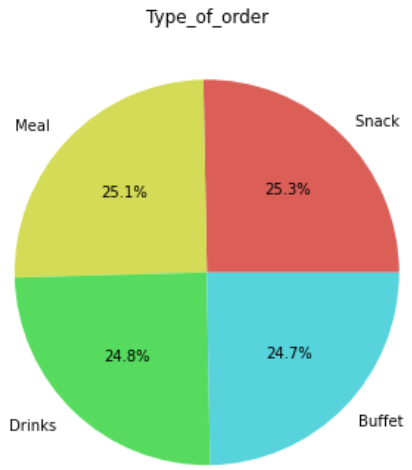
In [16]:

```
plt.figure(figsize=(15,6))
sns.countplot(df['Type_of_order'], data = df, palette = 'hls')
plt.xticks(rotation = 0)
plt.show()
```



In [17]:

```
plt.figure(figsize=(15, 6))
counts = df['Type_of_order'].value_counts()
plt.pie(counts, labels=counts.index, autopct='%1.1f%%', colors=sns.color_palette('hls'))
plt.title('Type_of_order')
plt.show()
```



In [18]:

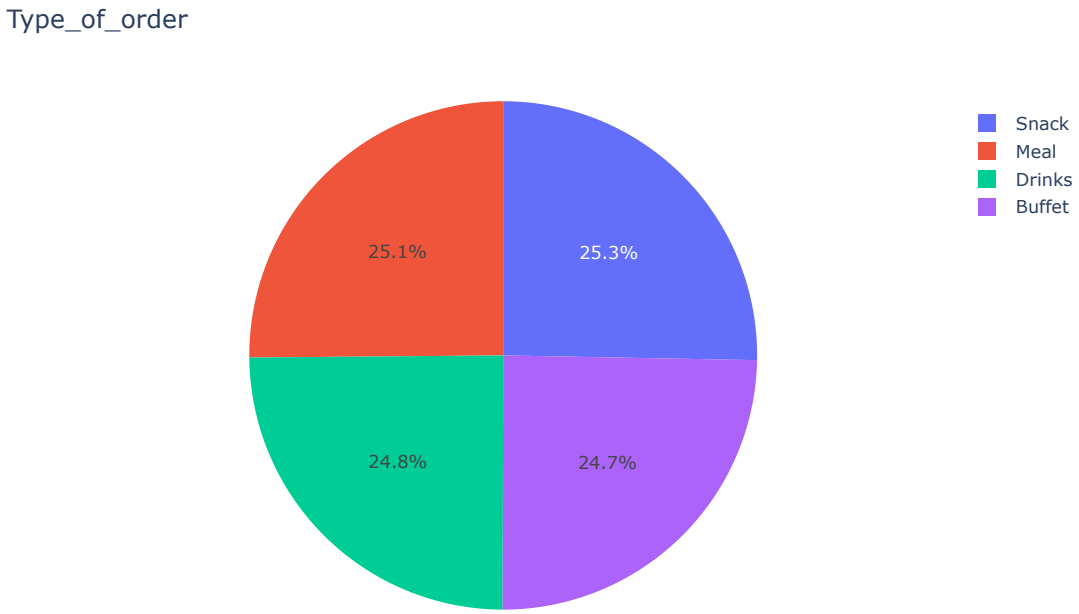
```
import plotly.graph_objects as go
```

In [19]:

```
fig = go.Figure(data=[go.Bar(x=df['Type_of_order'].value_counts().index, y=df['Type_of_order'].value_counts())])
fig.update_layout(
        title= 'Type_of_order',
        xaxis_title="Categories",
        yaxis_title="Count"
    )
fig.show()
```

In [20]:

```
counts = df['Type_of_order'].value_counts()
fig = go.Figure(data=[go.Pie(labels=counts.index, values=counts)])
fig.update_layout(title= 'Type_of_order')
fig.show()
```



In [21]:

```
df['Type_of_vehicle'].unique()
```

Out[21]:

```
array(['motorcycle ', 'scooter ', 'electric_scooter ', 'bicycle '],
      dtype=object)
```

In [22]:

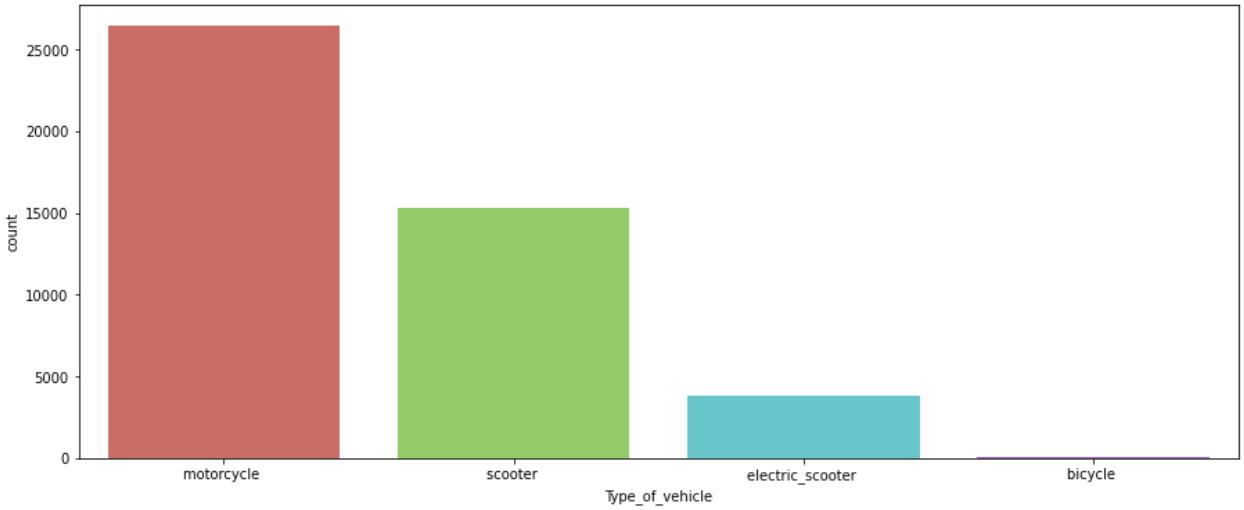
```
df['Type_of_vehicle'].value_counts()
```

Out[22]:

```
motorcycle           26435
scooter              15276
electric_scooter      3814
bicycle                 68
Name: Type_of_vehicle, dtype: int64
```

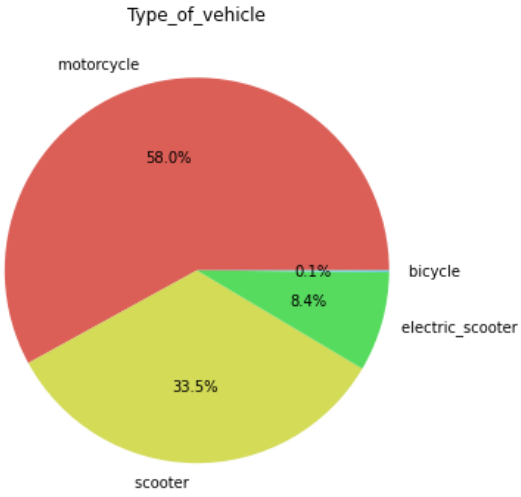
In [23]:

```
plt.figure(figsize=(15,6))
sns.countplot(df['Type_of_vehicle'], data = df, palette = 'hls')
plt.xticks(rotation = 0)
plt.show()
```



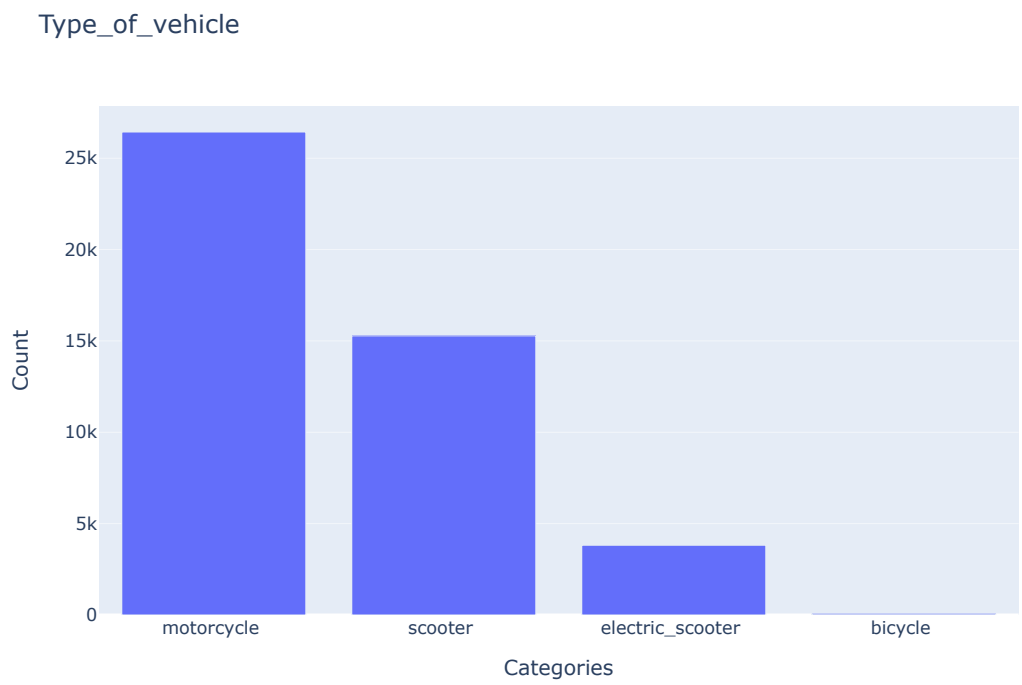
In [24]:

```
plt.figure(figsize=(15, 6))
counts = df['Type_of_vehicle'].value_counts()
plt.pie(counts, labels=counts.index, autopct='%1.1f%%', colors=sns.color_palette('hls'))
plt.title('Type_of_vehicle')
plt.show()
```



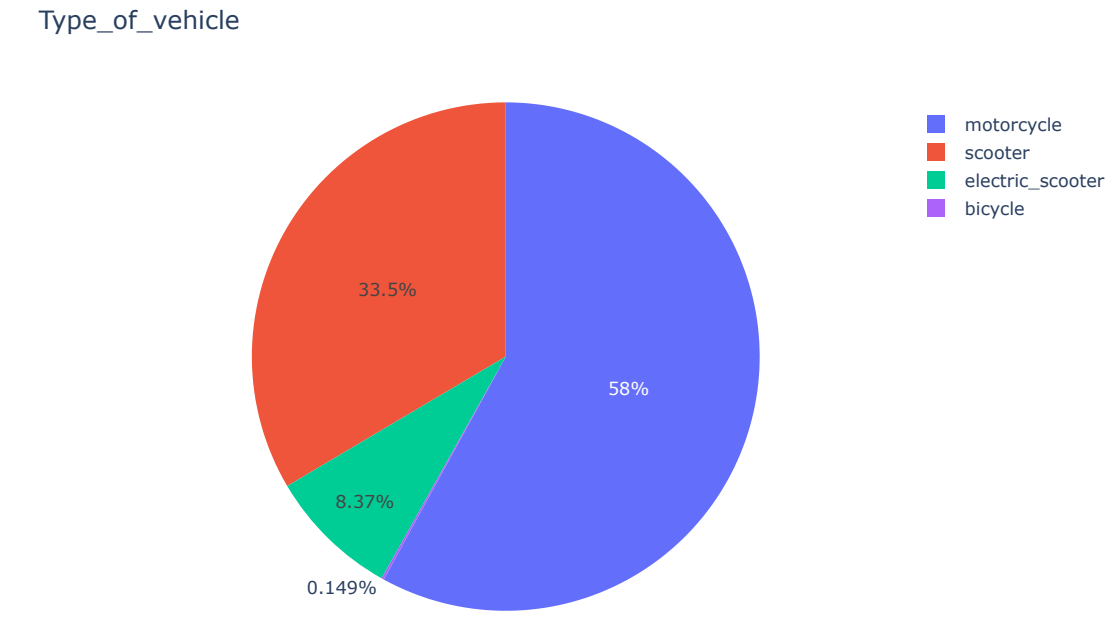
In [25]:

```
fig = go.Figure(data=[go.Bar(x=df['Type_of_vehicle'].value_counts().index, y=df['Type_of_vehicle'].value_counts())])
fig.update_layout(
        title= 'Type_of_vehicle',
        xaxis_title="Categories",
        yaxis_title="Count"
    )
fig.show()
```



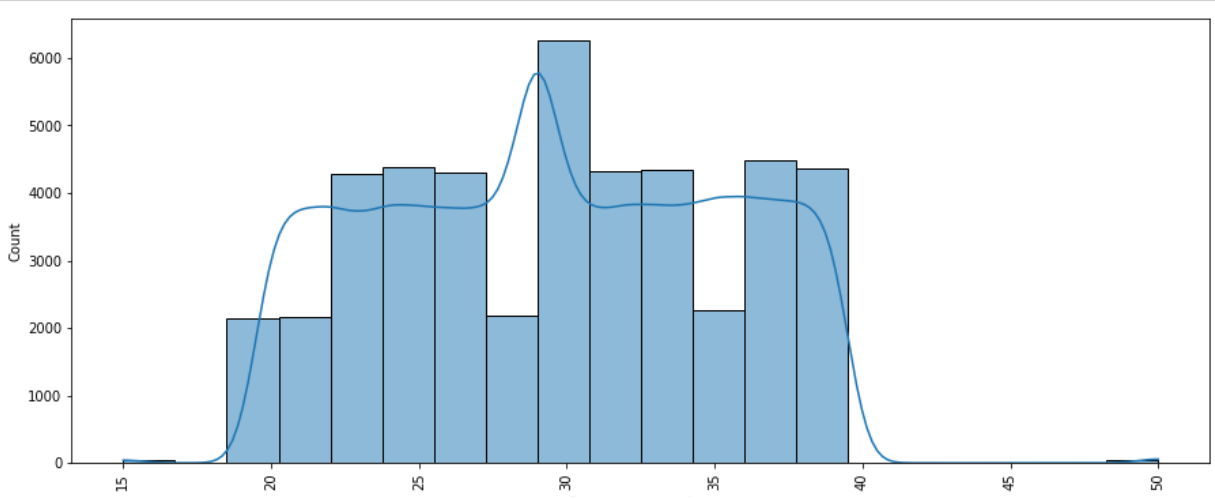
In [26]:

```
counts = df['Type_of_vehicle'].value_counts()
fig = go.Figure(data=[go.Pie(labels=counts.index, values=counts)])
fig.update_layout(title= 'Type_of_vehicle')
fig.show()
```



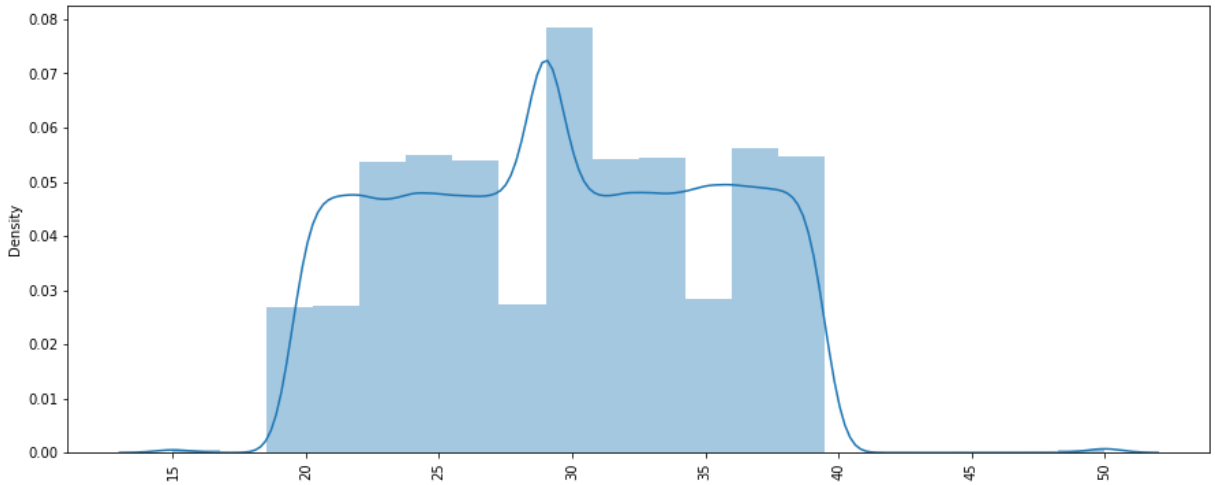
In [27]:

```
for i in numerical_columns:
    plt.figure(figsize=(15,6))
    sns.histplot(df[i], kde = True, bins = 20, palette = 'hls')
    plt.xticks(rotation = 90)
    plt.show()
```



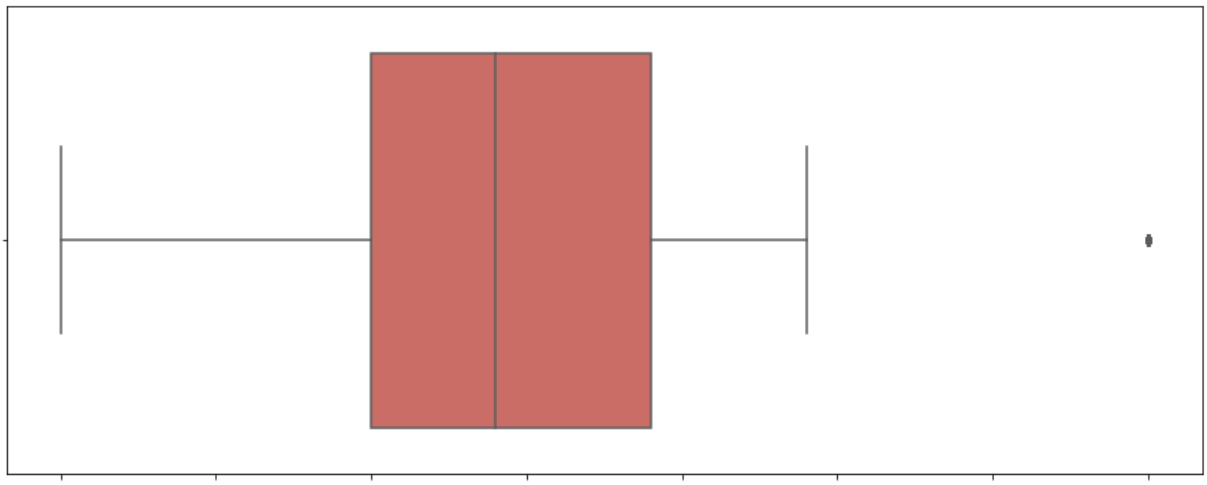
In [28]:

```
for i in numerical_columns:
    plt.figure(figsize=(15,6))
    sns.distplot(df[i], kde = True, bins = 20)
    plt.xticks(rotation = 90)
    plt.show()
```



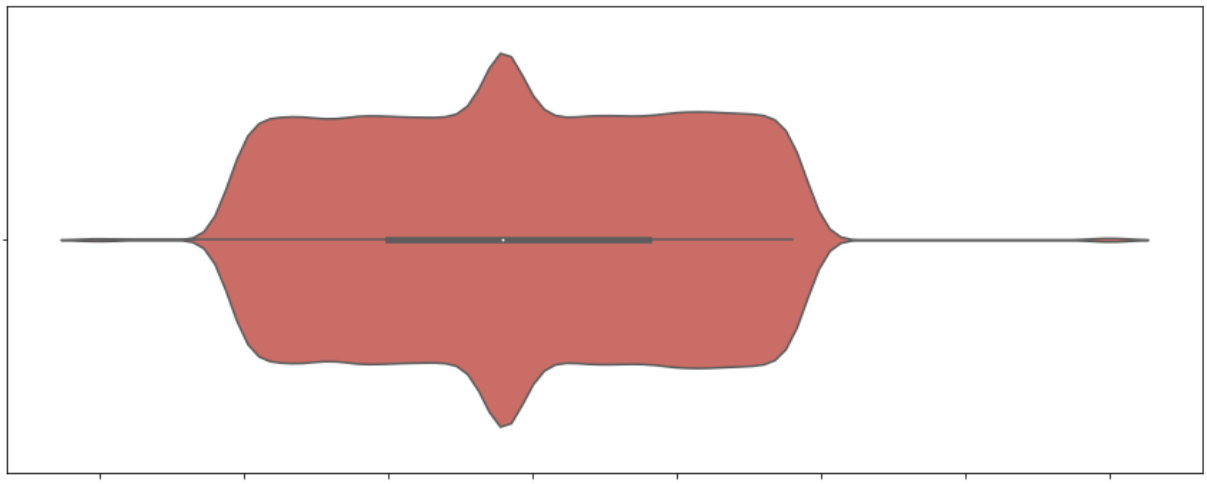
In [29]:

```
for i in numerical_columns:
    plt.figure(figsize=(15,6))
    sns.boxplot(df[i], data = df, palette = 'hls')
    plt.xticks(rotation = 90)
    plt.show()
```



In [30]:

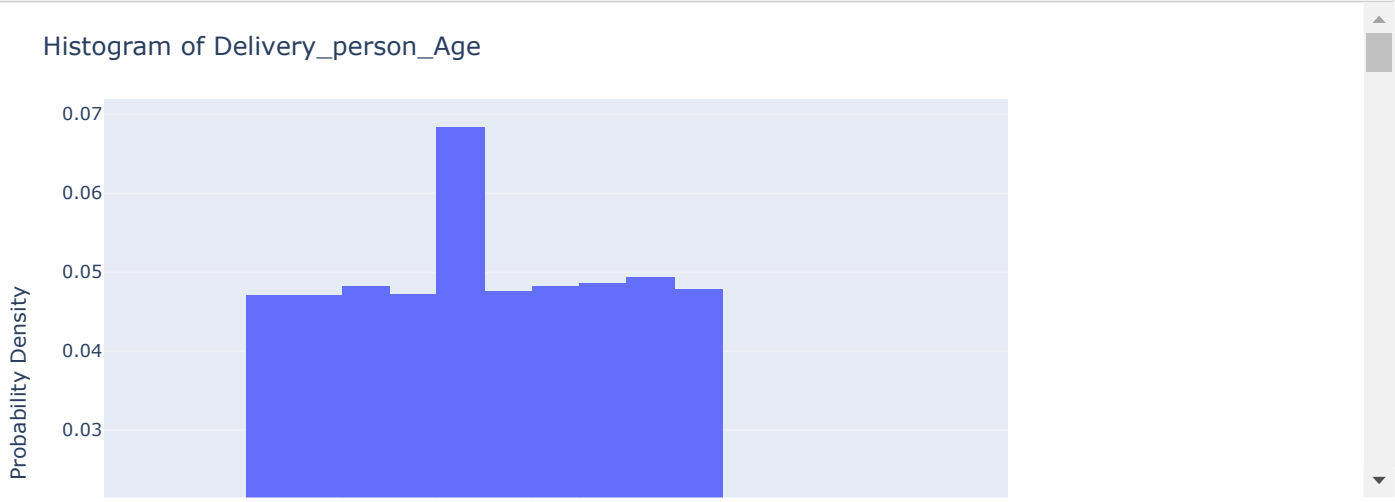
```
for i in numerical_columns:
    plt.figure(figsize=(15,6))
    sns.violinplot(df[i], data = df, palette = 'hls')
    plt.xticks(rotation = 90)
    plt.show()
```



In [31]:

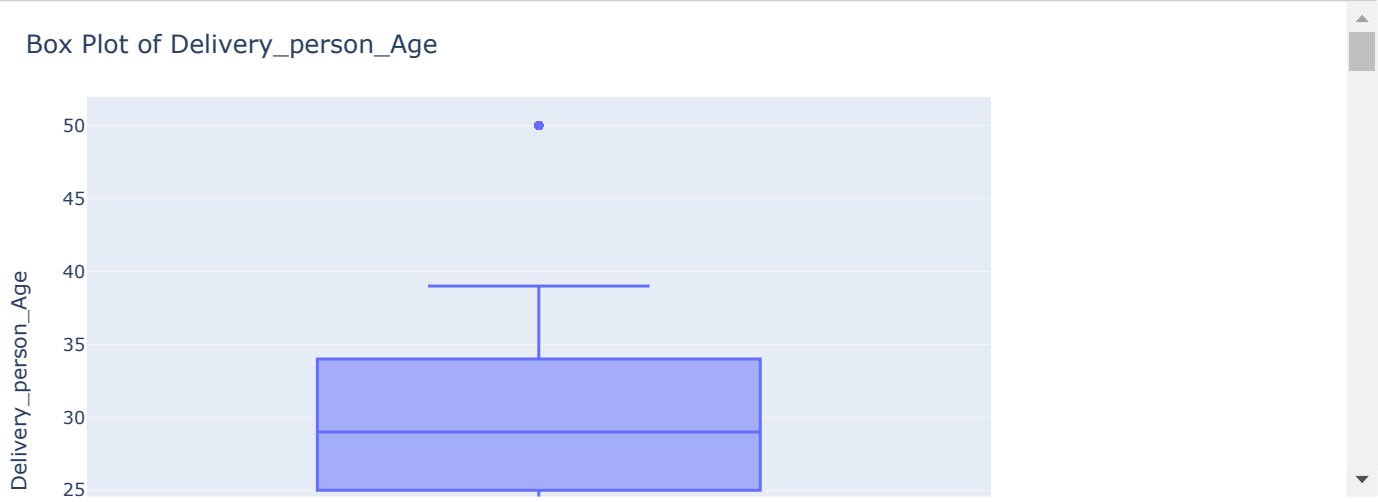
```
import plotly.express as px

for column in numerical_columns:
    fig = px.histogram(df, x=column, nbins=20, histnorm='probability density')
    fig.update_layout(title=f"Histogram of {column}", xaxis_title=column, yaxis_title="Probability Density")
    fig.show()
```



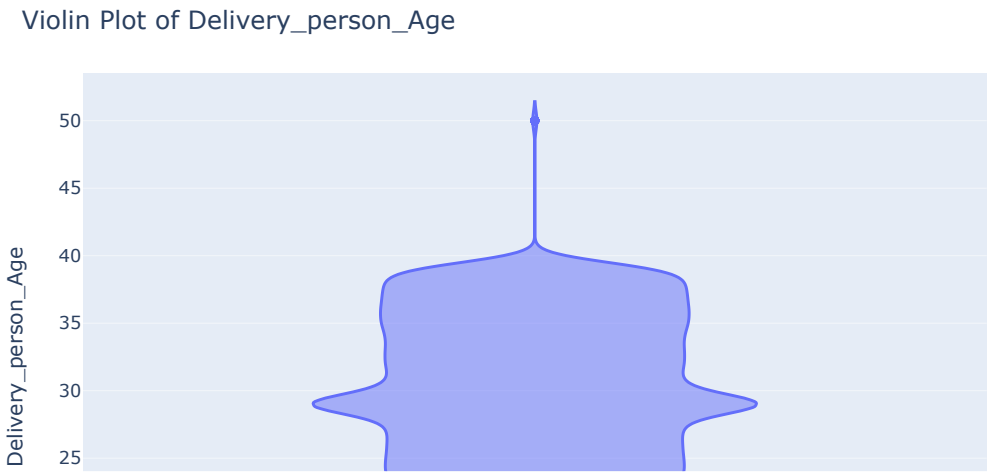
In [32]:

```
for column in numerical_columns:
    fig = px.box(df, y=column)
    fig.update_layout(title=f"Box Plot of {column}", yaxis_title=column)
    fig.show()
```



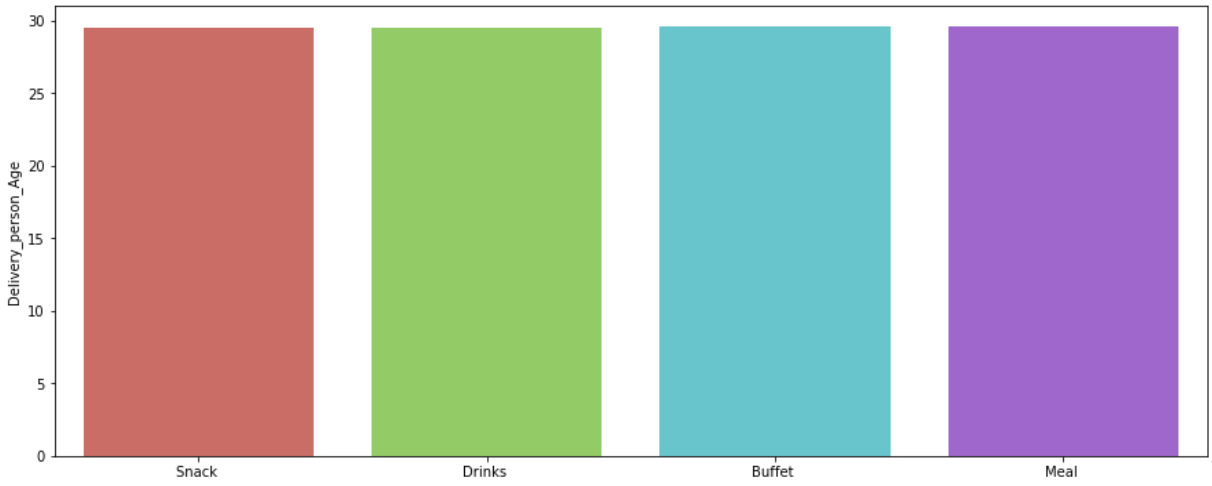
In [33]:

```
for column in numerical_columns:
    fig = px.violin(df, y=column)
    fig.update_layout(title=f"Violin Plot of {column}", yaxis_title=column)
    fig.show()
```



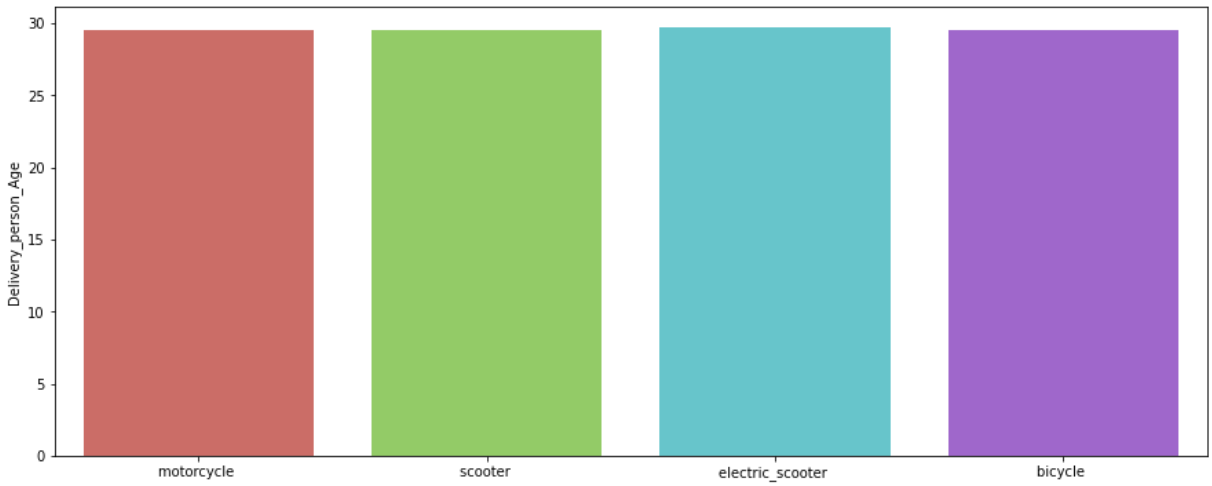
In [34]:

```
for i in numerical_columns:
    plt.figure(figsize=(15,6))
    sns.barplot(x = df['Type_of_order'], y = df[i], data = df, ci = None, palette = 'hls')
    plt.show()
```



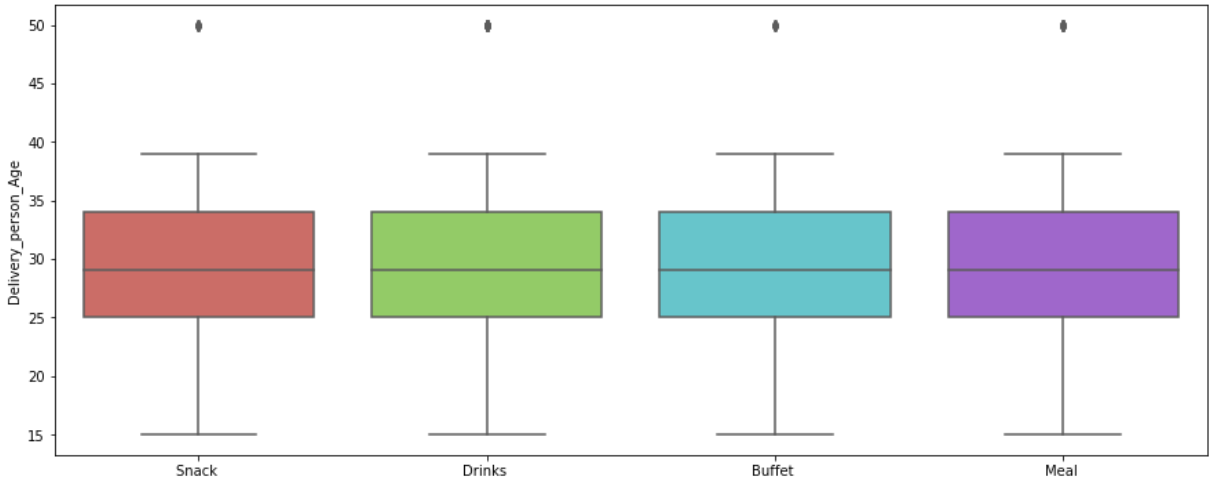
In [35]:

```
for i in numerical_columns:
    plt.figure(figsize=(15,6))
    sns.barplot(x = df['Type_of_vehicle'], y = df[i], data = df, ci = None, palette = 'hls')
    plt.show()
```



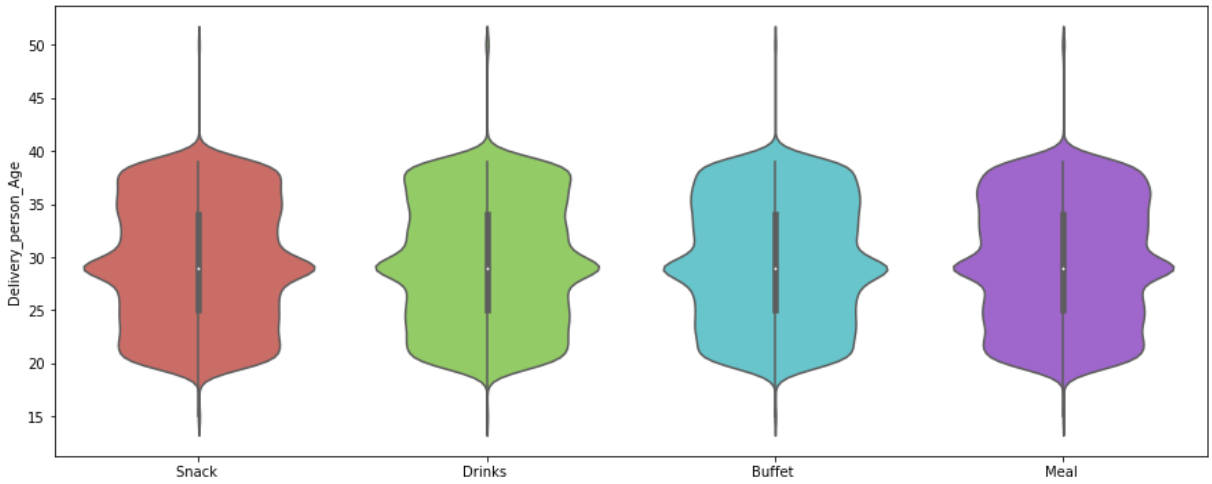
In [36]:

```
for i in numerical_columns:
    plt.figure(figsize=(15,6))
    sns.boxplot(x = df['Type_of_order'], y = df[i], data = df, palette = 'hls')
    plt.show()
```



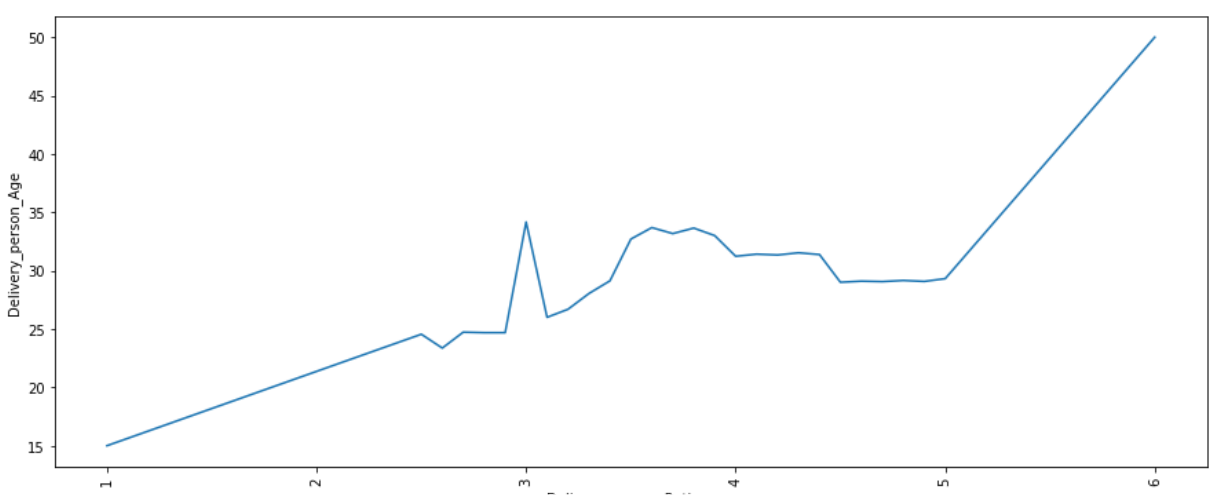
In [37]:

```
for i in numerical_columns:
    plt.figure(figsize=(15,6))
    sns.violinplot(x = df['Type_of_order'], y = df[i], data = df, palette = 'hls')
    plt.show()
```



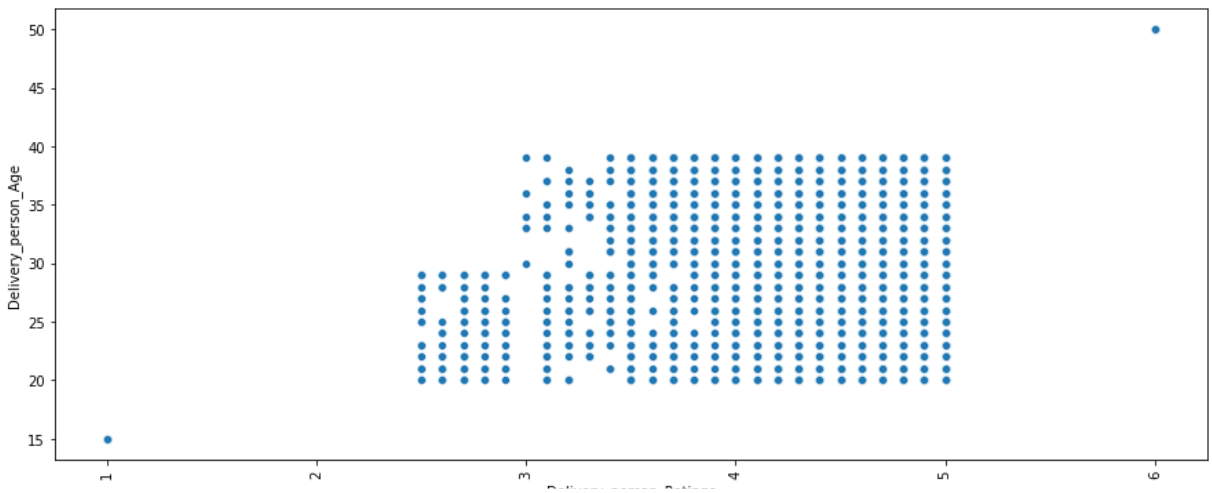
In [38]:

```
for i in numerical_columns:
    for j in numerical_columns:
        if i != j:
            plt.figure(figsize=(15,6))
            sns.lineplot(x = df[j], y = df[i], data = df, ci = None, palette = 'hls')
            plt.xticks(rotation = 90)
            plt.show()
```



In [39]:

```
for i in numerical_columns:
    for j in numerical_columns:
        if i != j:
            plt.figure(figsize=(15,6))
            sns.scatterplot(x = df[j], y = df[i], data = df, ci = None, palette = 'hls')
            plt.xticks(rotation = 90)
            plt.show()
```



In [40]:

```
df_corr = df.corr()
```

In [41]:

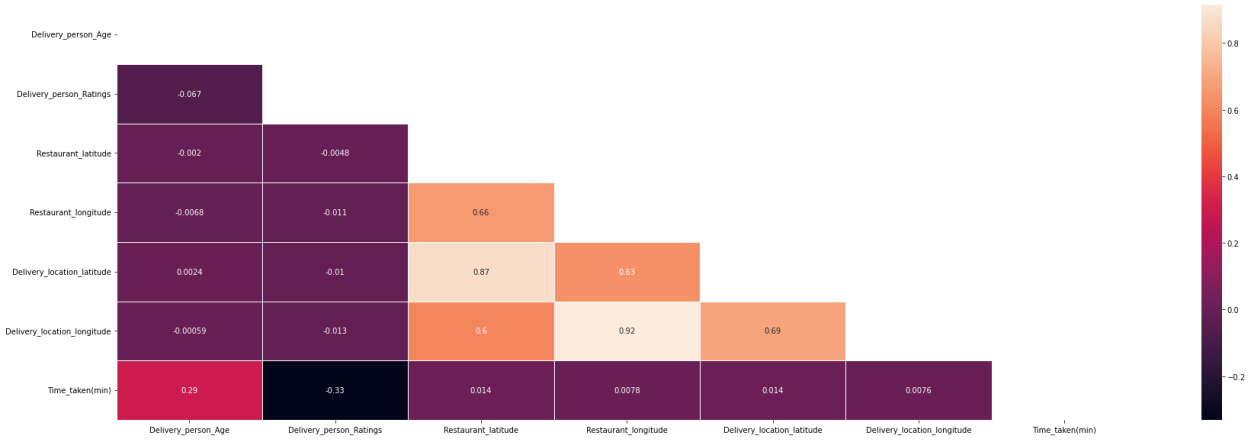
```
df_corr
```

Out[41]:

	Delivery_person_Age	Delivery_person_Ratings	Restaurant_latitude	Restaurant_longitude	Delivery_location_latit
Delivery_person_Age	1.000000	-0.067449	-0.001955	-0.006796	0.002
Delivery_person_Ratings	-0.067449	1.000000	-0.004846	-0.011147	-0.010
Restaurant_latitude	-0.001955	-0.004846	1.000000	0.661784	0.866
Restaurant_longitude	-0.006796	-0.011147	0.661784	1.000000	0.632
Delivery_location_latitude	0.002359	-0.010198	0.866378	0.632293	1.000
Delivery_location_longitude	-0.000593	-0.013350	0.602713	0.915026	0.690
Time_taken(min)	0.292708	-0.331103	0.013981	0.007821	0.014

In [42]:

```
plt.figure(figsize=(30, 10))
matrix = np.triu(df_corr)
sns.heatmap(df_corr, annot=True, linewidth=.8, mask=matrix, cmap="rocket");
plt.show()
```

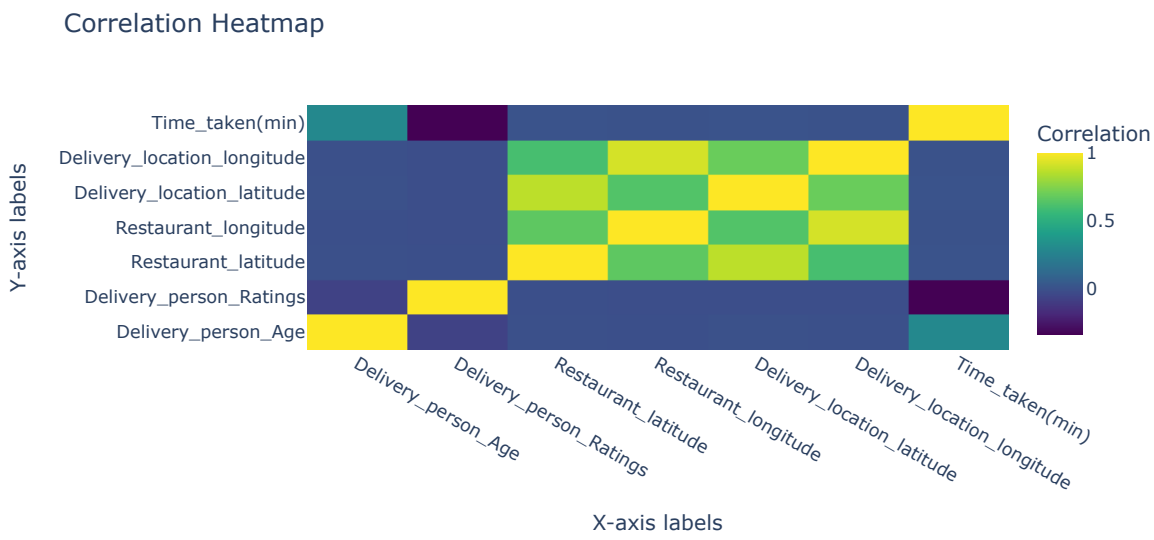


In [43]:

```
fig = go.Figure(data=go.Heatmap(
    z=df_corr.values,
    x=df_corr.columns,
    y=df_corr.index,
    colorscale='Viridis',  # Use a valid colorscale name
    colorbar=dict(title='Correlation')
))

fig.update_layout(
    title='Correlation Heatmap',
    xaxis=dict(title='X-axis labels'),
    yaxis=dict(title='Y-axis labels'),
    width=800,
    height=400,
    plot_bgcolor='white'
)

fig.show()
```



In [44]:

```
df
```

Out[44]:

	ID	Delivery_person_ID	Delivery_person_Age	Delivery_person_Ratings	Restaurant_latitude	Restaurant_longitude	Delivery_loca
0	4607	INDORES13DEL02	37	4.9	22.745049	75.892471	
1	B379	BANGRES18DEL02	34	4.5	12.913041	77.683237	
2	5D6D	BANGRES19DEL01	23	4.4	12.914264	77.678400	
3	7A6A	COIMBRES13DEL02	38	4.7	11.003669	76.976494	
4	70A2	CHENRES12DEL01	32	4.6	12.972793	80.249982	
...	...	...	...	...	...	...	...
45588	7C09	JAPRES04DEL01	30	4.8	26.902328	75.794257	
45589	D641	AGRRES16DEL01	21	4.6	0.000000	0.000000	
45590	4F8D	CHENRES08DEL03	30	4.9	13.022394	80.242439	
45591	5EEE	COIMBRES11DEL01	20	4.7	11.001753	76.986241	
45592	5FB2	RANCHIRES09DEL02	23	4.9	23.351058	85.325731	

45593 rows × 11 columns

In [45]:

```
# Extracting Time Components
df['hour_of_day'] = pd.to_datetime(df['Time_taken(min)'], unit='m').dt.hour
df['day_of_week'] = pd.to_datetime(df['Time_taken(min)'], unit='m').dt.dayofweek
df['month_of_year'] = pd.to_datetime(df['Time_taken(min)'], unit='m').dt.month
```

In [46]:

```
import math
```

In [47]:

```
# Function to calculate distance between two sets of latitude and longitude coordinates
def calculate_distance(lat1, lon1, lat2, lon2):
    R = 6371  # Earth's radius in kilometers

    # Convert latitude and longitude from degrees to radians
    lat1_rad = math.radians(lat1)
    lon1_rad = math.radians(lon1)
    lat2_rad = math.radians(lat2)
    lon2_rad = math.radians(lon2)

    # Haversine formula to calculate distance
    dlat = lat2_rad - lat1_rad
    dlon = lon2_rad - lon1_rad
    a = math.sin(dlat/2) ** 2 + math.cos(lat1_rad) * math.cos(lat2_rad) * math.sin(dlon/2) ** 2
    c = 2 * math.atan2(math.sqrt(a), math.sqrt(1-a))
    distance = R * c

    return distance

# Calculate distance and create the distance feature
df['distance'] = df.apply(lambda row: calculate_distance(row['Restaurant_latitude'], row['Restaurant_longitude'],
                                                         row['Delivery_location_latitude'], row['Delivery_location_longitude'
```

In [48]:

```
# Categorizing Age
age_bins = [0, 30, 50, float('inf')]
age_labels = ['young', 'middle-aged', 'senior']
df['age_category'] = pd.cut(df['Delivery_person_Age'], bins=age_bins, labels=age_labels)
```

In [49]:

```
# Aggregating Ratings
df['avg_ratings'] = df.groupby('Delivery_person_ID')['Delivery_person_Ratings'].transform('mean')
```

In [50]:

```
# Binary Encoding
df = pd.get_dummies(df, columns=['Type_of_order', 'Type_of_vehicle'])
```

In [51]:

```
# Interaction Features
df['time_ratings_interaction'] = df['Time_taken(min)'] * df['Delivery_person_Ratings']
```

In [52]:

```
df
```

Out[52]:

	ID	Delivery_person_ID	Delivery_person_Age	Delivery_person_Ratings	Restaurant_latitude	Restaurant_longitude	Delivery_loca
0	4607	INDORES13DEL02	37	4.9	22.745049	75.892471	
1	B379	BANGRES18DEL02	34	4.5	12.913041	77.683237	
2	5D6D	BANGRES19DEL01	23	4.4	12.914264	77.678400	
3	7A6A	COIMBRES13DEL02	38	4.7	11.003669	76.976494	
4	70A2	CHENRES12DEL01	32	4.6	12.972793	80.249982	
...	...	...	...	...	...	...	
45588	7C09	JAPRES04DEL01	30	4.8	26.902328	75.794257	
45589	D641	AGRRES16DEL01	21	4.6	0.000000	0.000000	
45590	4F8D	CHENRES08DEL03	30	4.9	13.022394	80.242439	
45591	5EEE	COIMBRES11DEL01	20	4.7	11.001753	76.986241	
45592	5FB2	RANCHIRES09DEL02	23	4.9	23.351058	85.325731	

45593 rows × 24 columns

In [53]:

```
columns_to_drop = ['ID', 'Delivery_person_ID', 'Restaurant_latitude', 'Restaurant_longitude',
                   'Delivery_location_latitude', 'Delivery_location_longitude']
```

In [54]:

```
# Drop the columns from the dataset
df = df.drop(columns=columns_to_drop)
```

In [55]:

```
df
```

Out[55]:

	Delivery_person_Age	Delivery_person_Ratings	Time_taken(min)	hour_of_day	day_of_week	month_of_year	distance	age_categoı
0	37	4.9	24	0	3	1	3.025149	middle-age
1	34	4.5	33	0	3	1	20.183530	middle-age
2	23	4.4	26	0	3	1	1.552758	your
3	38	4.7	21	0	3	1	7.790401	middle-age
4	32	4.6	30	0	3	1	6.210138	middle-age
...	...	...	...	...	...	...	...	
45588	30	4.8	32	0	3	1	1.489846	your
45589	21	4.6	36	0	3	1	11.007735	your
45590	30	4.9	16	0	3	1	4.657195	your
45591	20	4.7	26	0	3	1	6.232393	your
45592	23	4.9	36	0	3	1	12.074396	your

45593 rows × 18 columns

In [56]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 45593 entries, 0 to 45592
Data columns (total 18 columns):
 #   Column                            Non-Null Count  Dtype
---  ------                            --------------  -----
 0   Delivery_person_Age               45593 non-null  int64
 1   Delivery_person_Ratings           45593 non-null  float64
 2   Time_taken(min)                   45593 non-null  int64
 3   hour_of_day                       45593 non-null  int64
 4   day_of_week                       45593 non-null  int64
 5   month_of_year                     45593 non-null  int64
 6   distance                          45593 non-null  float64
 7   age_category                      45593 non-null  category
 8   avg_ratings                       45593 non-null  float64
 9   Type_of_order_Buffet              45593 non-null  uint8
 10  Type_of_order_Drinks              45593 non-null  uint8
 11  Type_of_order_Meal                45593 non-null  uint8
 12  Type_of_order_Snack               45593 non-null  uint8
 13  Type_of_vehicle_bicycle           45593 non-null  uint8
 14  Type_of_vehicle_electric_scooter  45593 non-null  uint8
 15  Type_of_vehicle_motorcycle        45593 non-null  uint8
 16  Type_of_vehicle_scooter           45593 non-null  uint8
 17  time_ratings_interaction          45593 non-null  float64
dtypes: category(1), float64(4), int64(5), uint8(8)
memory usage: 3.5 MB
```

In [57]:

```
df.columns
```

Out[57]:

```
Index(['Delivery_person_Age', 'Delivery_person_Ratings', 'Time_taken(min)',
       'hour_of_day', 'day_of_week', 'month_of_year', 'distance',
       'age_category', 'avg_ratings', 'Type_of_order_Buffet ',
       'Type_of_order_Drinks ', 'Type_of_order_Meal ', 'Type_of_order_Snack ',
       'Type_of_vehicle_bicycle ', 'Type_of_vehicle_electric_scooter ',
       'Type_of_vehicle_motorcycle ', 'Type_of_vehicle_scooter ',
       'time_ratings_interaction'],
      dtype='object')
```

In [58]:

```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
```

In [59]:

```
features_to_scale = ['Delivery_person_Age', 'Delivery_person_Ratings', 'time_ratings_interaction']
features_not_to_scale = ['Time_taken(min)', 'hour_of_day', 'day_of_week', 'month_of_year', 'distance',
                         'age_category', 'avg_ratings', 'Type_of_order_Buffet ', 'Type_of_order_Drinks ',
                         'Type_of_order_Meal ', 'Type_of_order_Snack ', 'Type_of_vehicle_bicycle ',
                         'Type_of_vehicle_electric_scooter ', 'Type_of_vehicle_motorcycle ',
                         'Type_of_vehicle_scooter ']
target = 'Time_taken(min)'
```

In [60]:

```
# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(df[features_to_scale + features_not_to_scale], df[target], test_size=0.2
```

In [61]:

```
# Perform feature scaling for the appropriate features
scaler = StandardScaler()
X_train_scaled = X_train.copy()
X_test_scaled = X_test.copy()
X_train_scaled[features_to_scale] = scaler.fit_transform(X_train_scaled[features_to_scale])
X_test_scaled[features_to_scale] = scaler.transform(X_test_scaled[features_to_scale])
```

In [62]:

```
# Perform one-hot encoding for the 'age_category' feature
ct = ColumnTransformer(
    [('one_hot_encoder', OneHotEncoder(), ['age_category'])],
    remainder='passthrough'
)
X_train_scaled = ct.fit_transform(X_train_scaled)
X_test_scaled = ct.transform(X_test_scaled)
```

In [63]:

```
# Create and train the linear regression model
model_lr = LinearRegression()
model_lr.fit(X_train_scaled, y_train)
```

Out[63]:

▾ LinearRegression

LinearRegression()

In [64]:

```
# Make predictions on the test set
y_pred = model_lr.predict(X_test_scaled)
```

In [65]:

```
# Evaluate the model using root mean squared error (RMSE)
rmse = mean_squared_error(y_test, y_pred, squared=False)
print('Root Mean Squared Error:', rmse)
```

```
Root Mean Squared Error: 7.209843718310522e-14
```

In [66]:

```
from sklearn.metrics import r2_score
```

In [67]:

```
# Calculate R-squared score
r2_lr = r2_score(y_test, y_pred)
print('R-squared Score:', r2_lr)

# Calculate Mean Squared Error (MSE)
mse = mean_squared_error(y_test, y_pred)
print('Mean Squared Error:', mse)
```

```
R-squared Score: 1.0
Mean Squared Error: 5.19818464424617e-27
```

In [68]:

```
from sklearn.tree import DecisionTreeRegressor
from xgboost import XGBRegressor
```

In [69]:

```
# Create and train the Decision Tree Regressor
dt_regressor = DecisionTreeRegressor(random_state=42)
dt_regressor.fit(X_train_scaled, y_train)
```

Out[69]:

```
DecisionTreeRegressor(random_state=42)
```

In [71]:

```
# Make predictions on the test set using Decision Tree Regressor
y_pred_dt = dt_regressor.predict(X_test_scaled)
```

In [72]:

```
# Calculate R-squared score for Decision Tree Regressor
r2_dt = r2_score(y_test, y_pred_dt)
print('Decision Tree Regressor - R-squared Score:', r2_dt)
```

```
Decision Tree Regressor - R-squared Score: 1.0
```

In [73]:

```
# Calculate Mean Squared Error (MSE) for Decision Tree Regressor
mse_dt = mean_squared_error(y_test, y_pred_dt)
print('Decision Tree Regressor - Mean Squared Error:', mse_dt)
```

```
Decision Tree Regressor - Mean Squared Error: 0.0
```

In [74]:

```
# Create and train the XGBoost Regressor
xgb_regressor = XGBRegressor(random_state=42)
xgb_regressor.fit(X_train_scaled, y_train)
```

Out[74]:

```
XGBRegressor(base_score=0.5, booster='gbtree', callbacks=None,
             colsample_bylevel=1, colsample_bynode=1, colsample_bytree=1,
             early_stopping_rounds=None, enable_categorical=False,
             eval_metric=None, gamma=0, gpu_id=-1, grow_policy='depthwise',
             importance_type=None, interaction_constraints='',
             learning_rate=0.300000012, max_bin=256, max_cat_to_onehot=4,
             max_delta_step=0, max_depth=6, max_leaves=0, min_child_weight=1,
             missing=nan, monotone_constraints='()', n_estimators=100, n_jobs=0,
             num_parallel_tree=1, predictor='auto', random_state=42,
             reg_alpha=0, reg_lambda=1, ...)
```

In [75]:

```
# Make predictions on the test set using XGBoost Regressor
y_pred_xgb = xgb_regressor.predict(X_test_scaled)
```

In [76]:

```
# Calculate R-squared score for XGBoost Regressor
r2_xgb = r2_score(y_test, y_pred_xgb)
print('XGBoost Regressor - R-squared Score:', r2_xgb)

# Calculate Mean Squared Error (MSE) for XGBoost Regressor
mse_xgb = mean_squared_error(y_test, y_pred_xgb)
print('XGBoost Regressor - Mean Squared Error:', mse_xgb)
```

```
XGBoost Regressor - R-squared Score: 0.999999999991573
XGBoost Regressor - Mean Squared Error: 7.388065861443196e-10
```