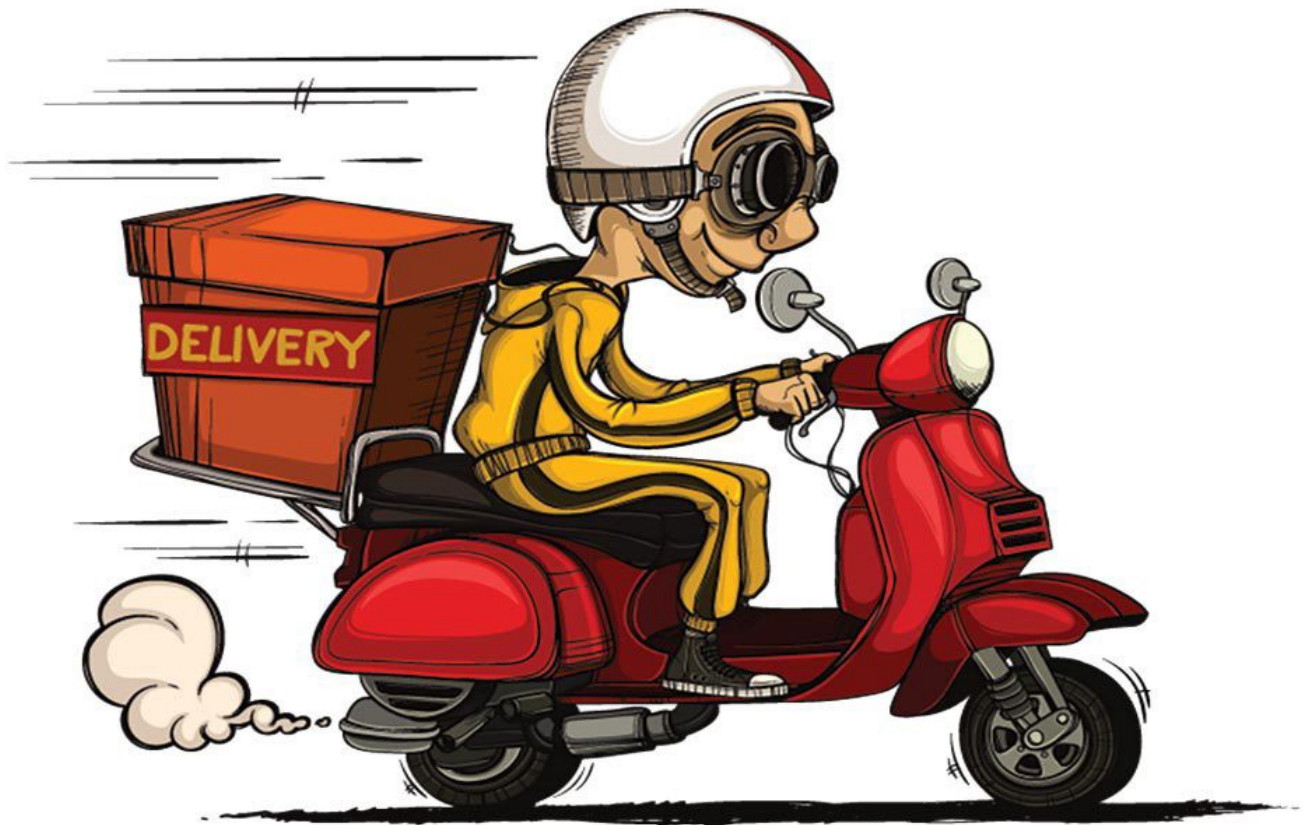


Food Delivery Time Prediction using Machine Learning Algorithms



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_latitude
0	4607	INDORES13DEL02	37	4.9	22.745049	75.892471	22.7
1	B379	BANGRES18DEL02	34	4.5	12.913041	77.683237	13.0
2	5D6D	BANGRES19DEL01	23	4.4	12.914264	77.678400	12.9
3	7A6A	COIMBRES13DEL02	38	4.7	11.003669	76.976494	11.0
4	70A2	CHENRES12DEL01	32	4.6	12.972793	80.249982	13.0

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

In [12]:

```
df.nunique()
```

Out[12]:

```
ID                                     45451
Delivery_person_ID                   13200
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]:

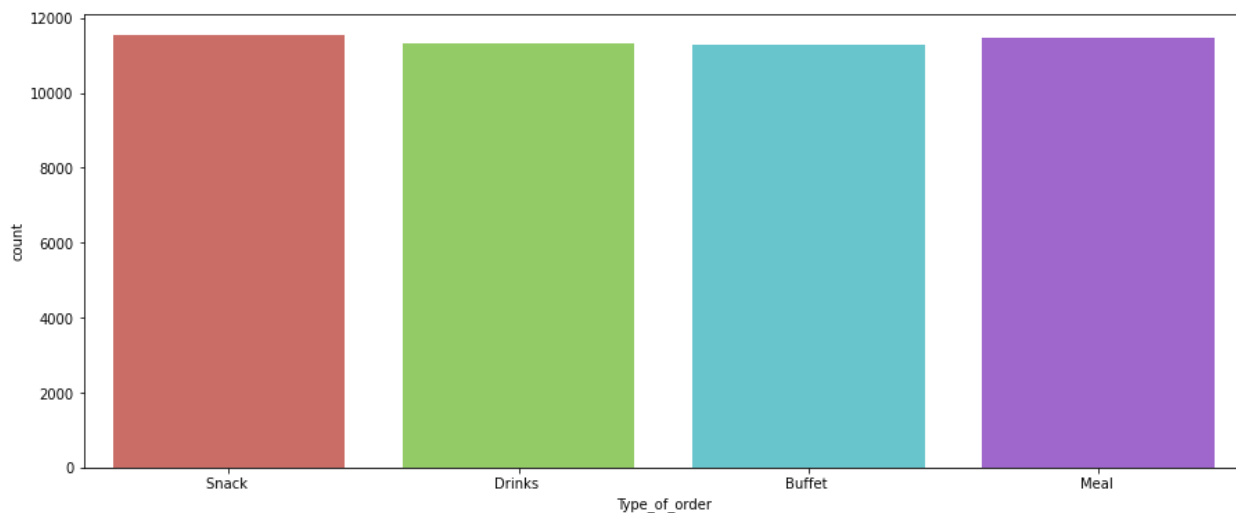
```
df['Type_of_order'].value_counts()
```

Out[15]:

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

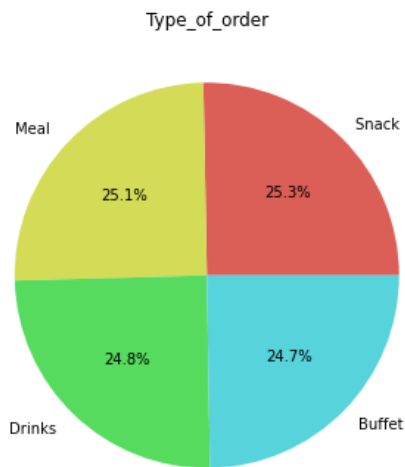
In [16]:

```
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()
```

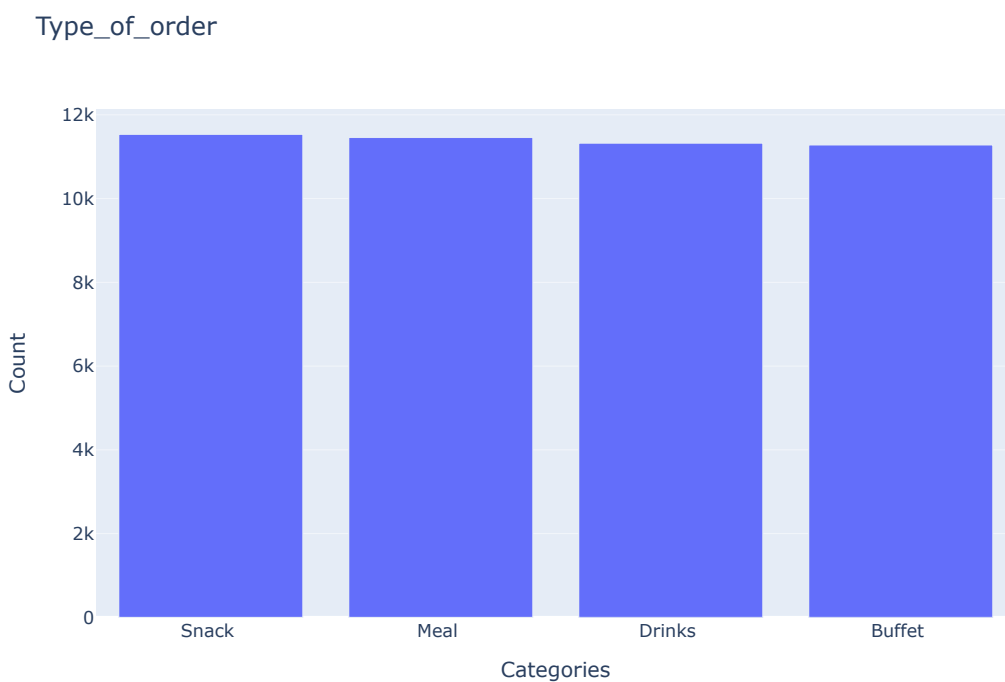


In [18]:

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

In [19]:

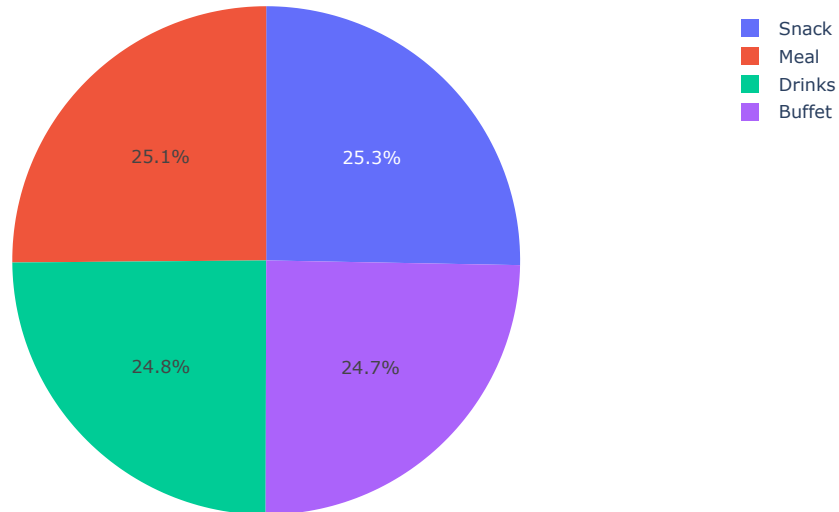
```
fig = go.Figure(data=[go.Bar(x=df['Type_of_order'].value_counts().index, y=df['Type_of_order'].value_counts())])
fig.update_layout(
    title= 'Type_of_order',
    xaxis_title="Categories",
    yaxis_title="Count"
)
fig.show()
```



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()
```

Type_of_order



In [21]:

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

Out[21]:

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

In [22]:

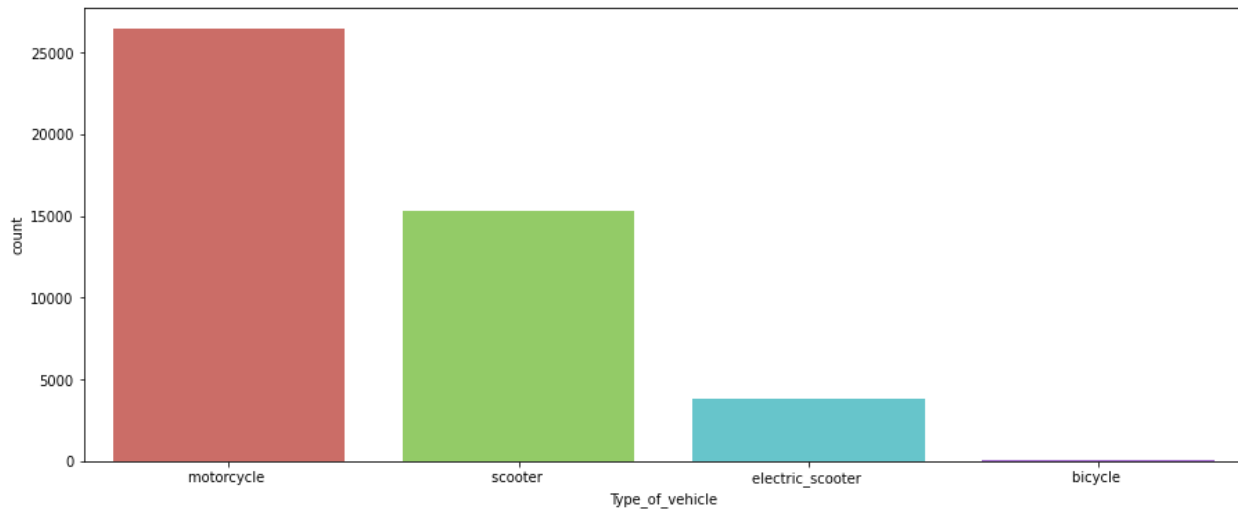
```
df['Type_of_vehicle'].value_counts()
```

Out[22]:

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

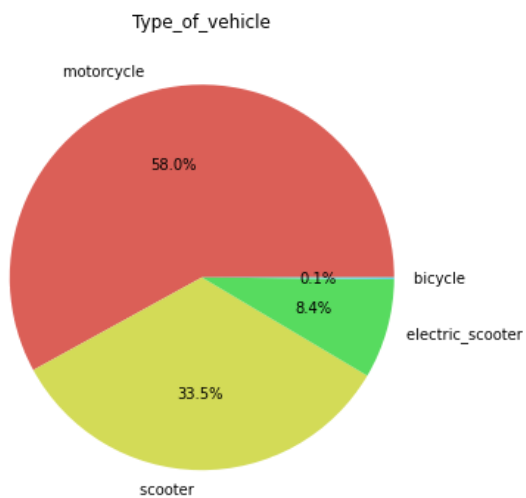
In [23]:

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



In [24]:

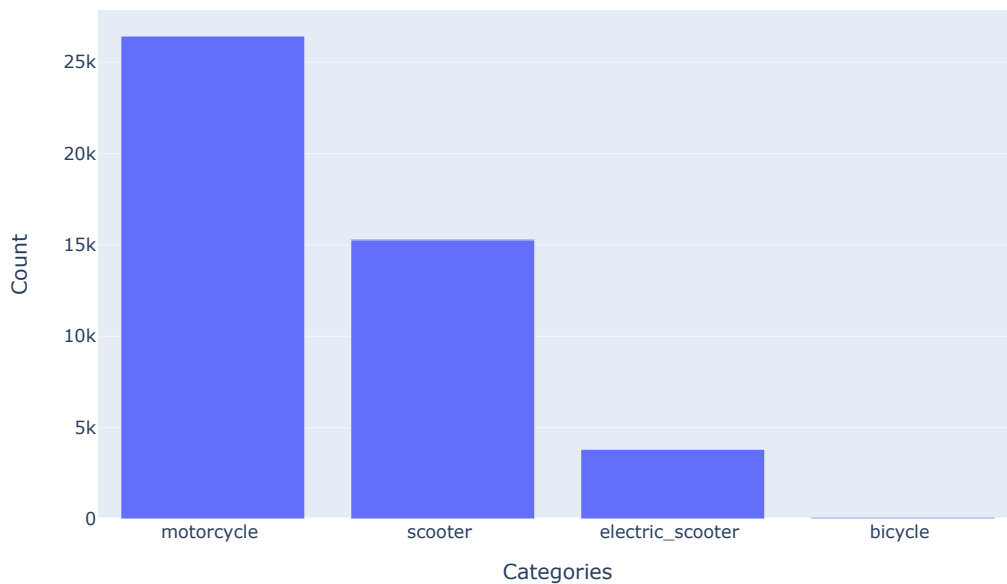
```
plt.figure(figsize=(15, 6))
counts = df['Type_of_vehicle'].value_counts()
plt.pie(counts, labels=counts.index, autopct='%1.1f%%', colors=sns.color_palette('hls'))
plt.title('Type_of_vehicle')
plt.show()
```



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()
```

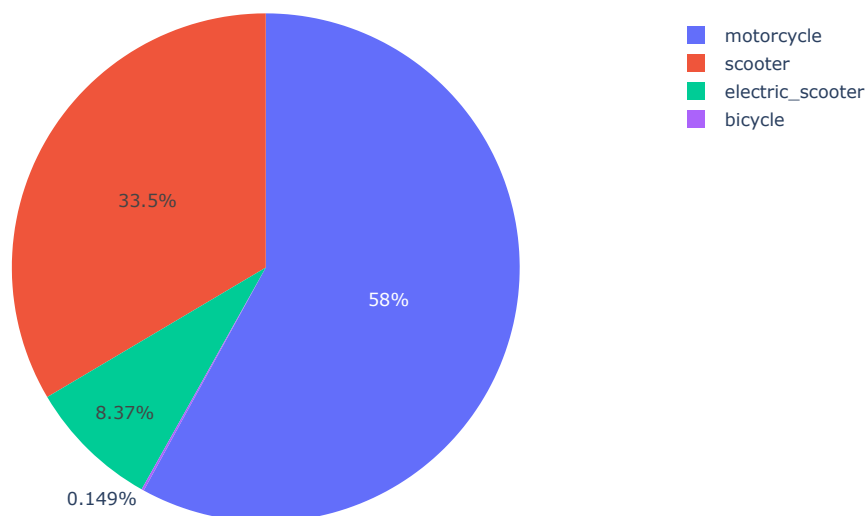
Type_of_vehicle



In [26]:

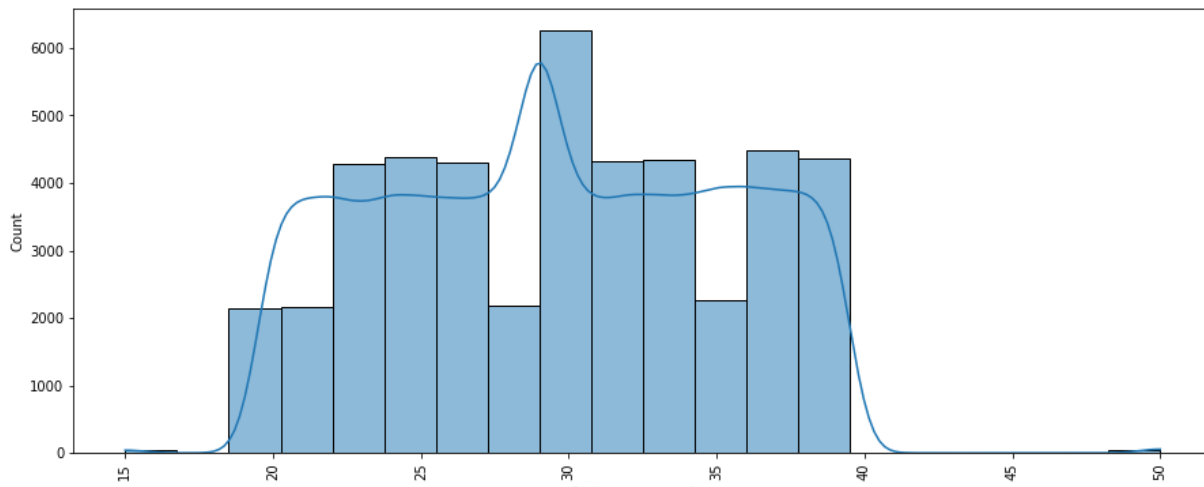
```
counts = df['Type_of_vehicle'].value_counts()
fig = go.Figure(data=[go.Pie(labels=counts.index, values=counts)])
fig.update_layout(title= 'Type_of_vehicle')
fig.show()
```

Type_of_vehicle



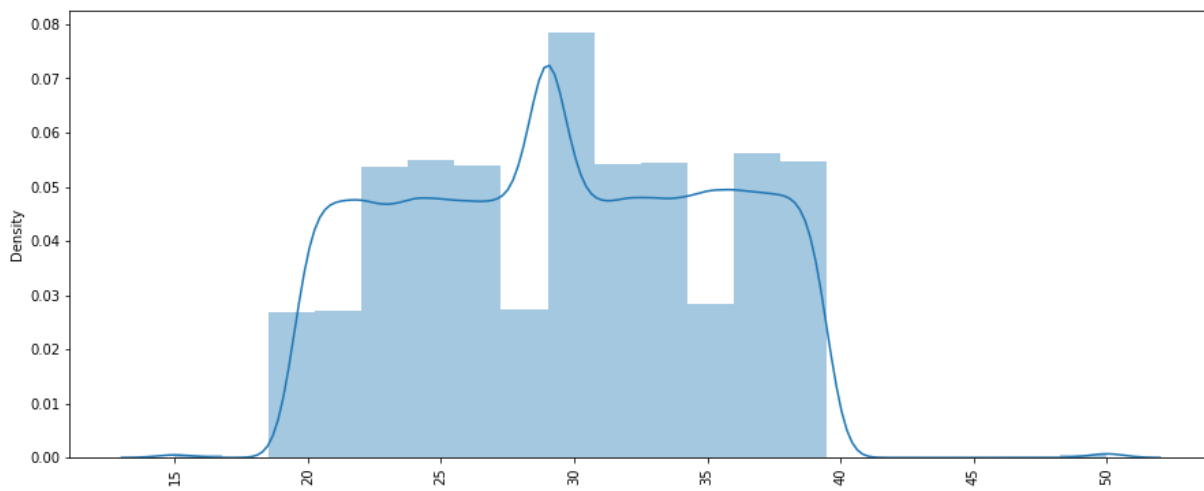
In [27]:

```
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()
```



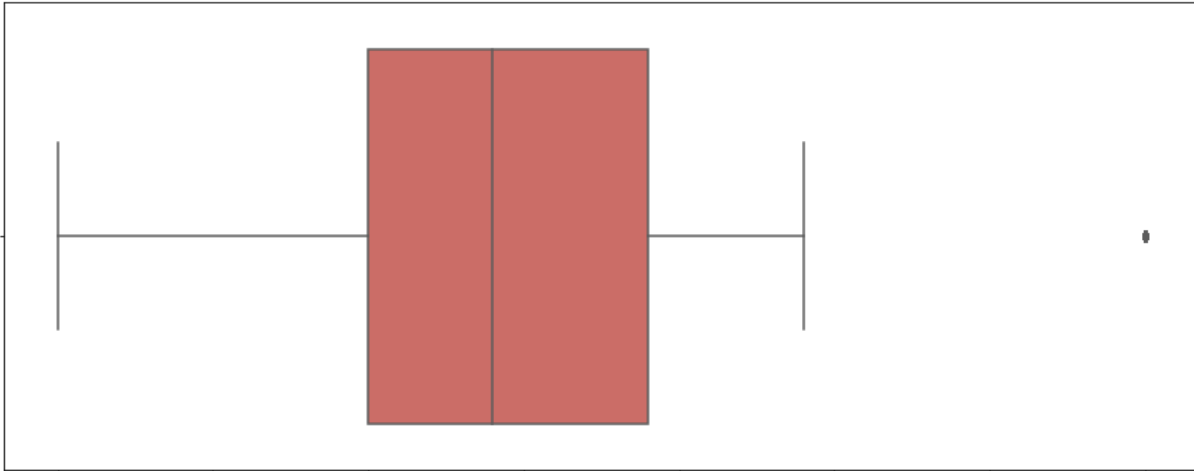
In [28]:

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



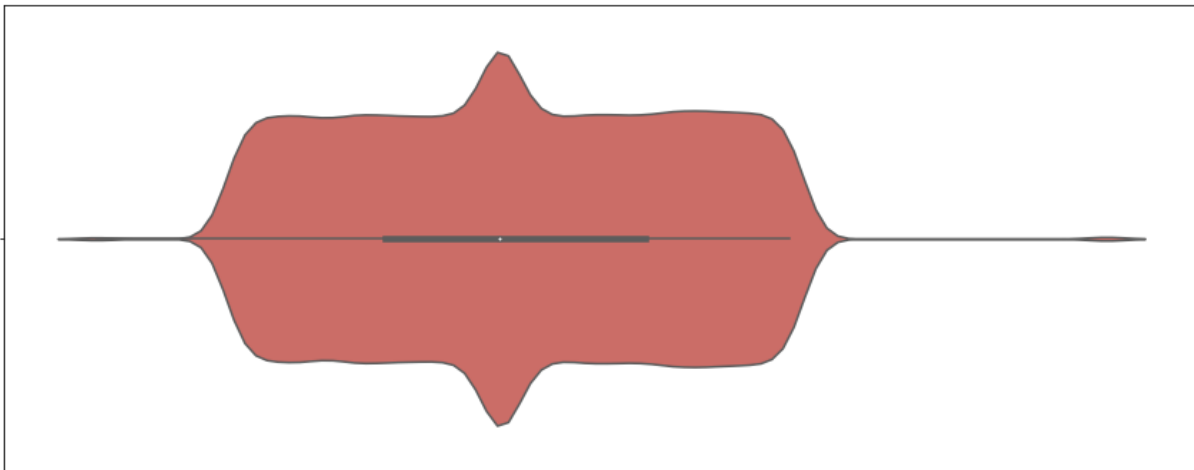
In [29]:

```
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()
```

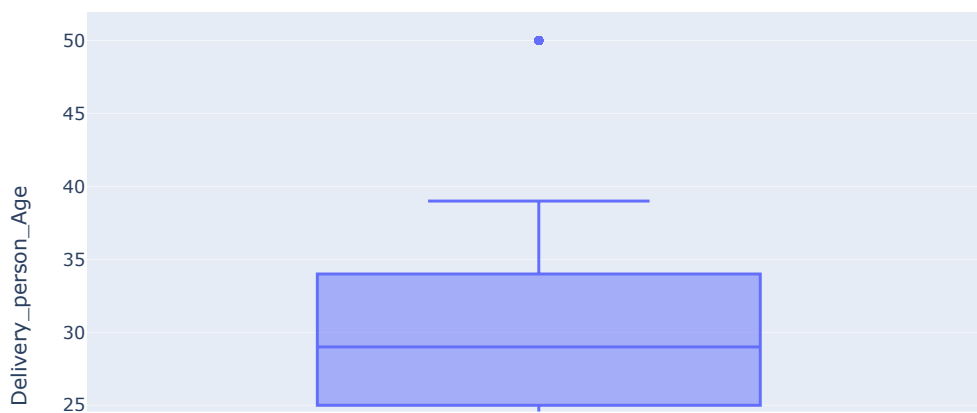
Histogram of Delivery_person_Age



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()
```

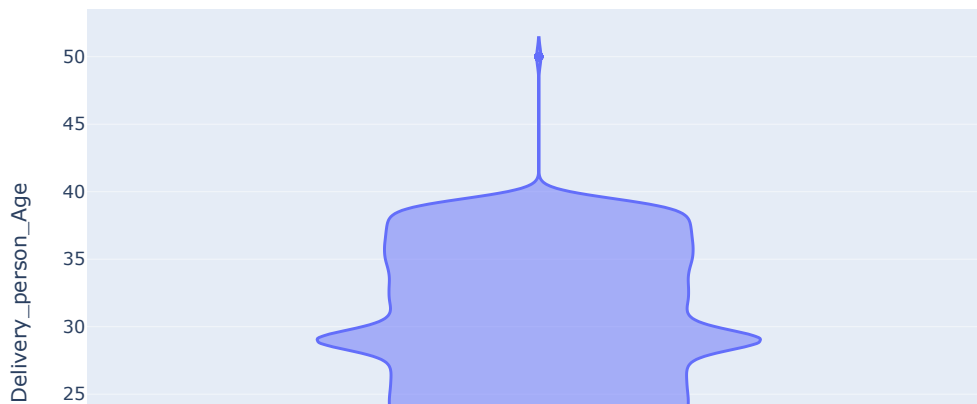
Box Plot of Delivery_person_Age



In [33]:

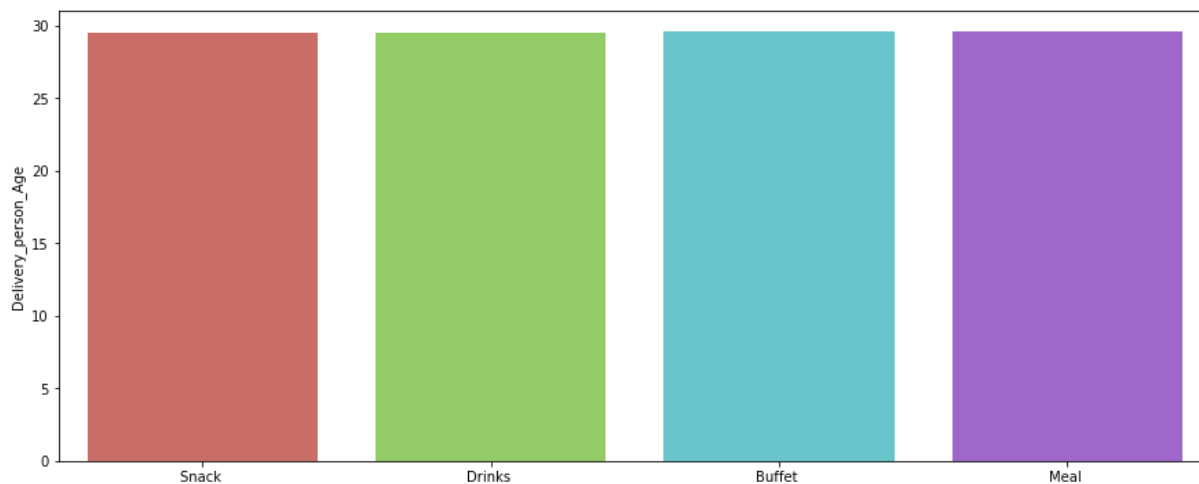
```
for column in numerical_columns:
    fig = px.violin(df, y=column)
    fig.update_layout(title=f"Violin Plot of {column}", yaxis_title=column)
    fig.show()
```

Violin Plot of Delivery_person_Age



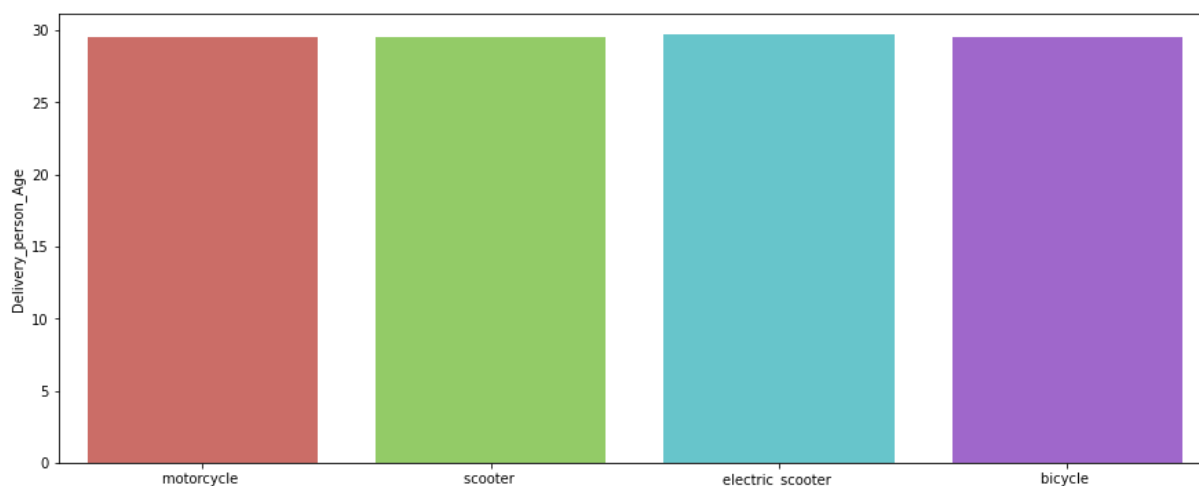
In [34]:

```
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()
```



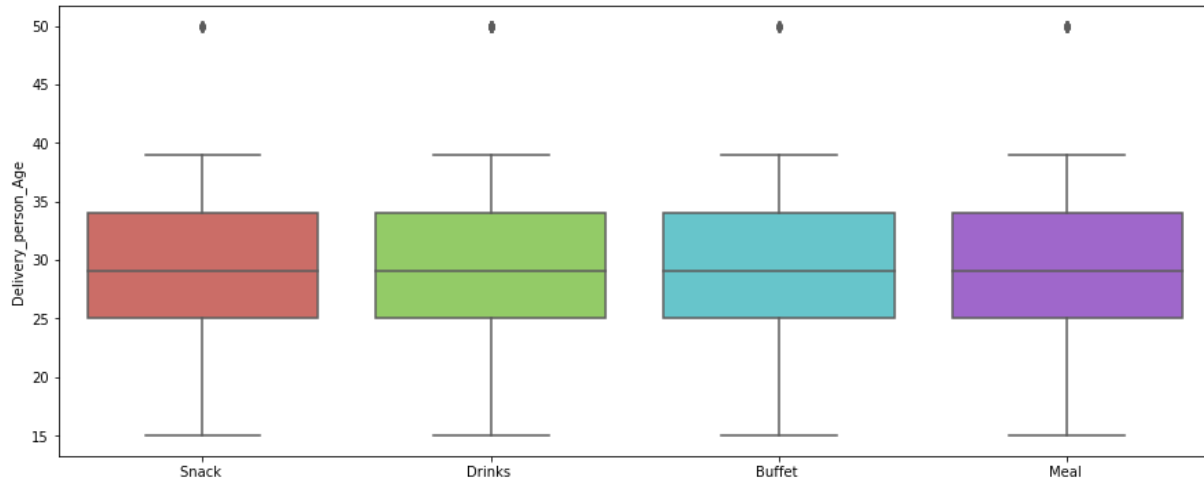
In [35]:

```
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()
```



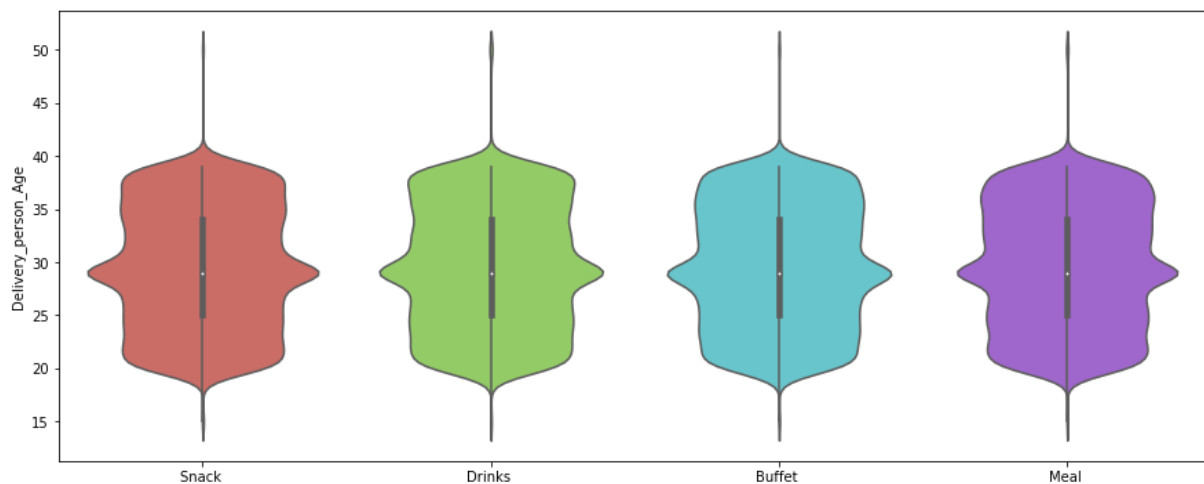
In [36]:

```
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()
```



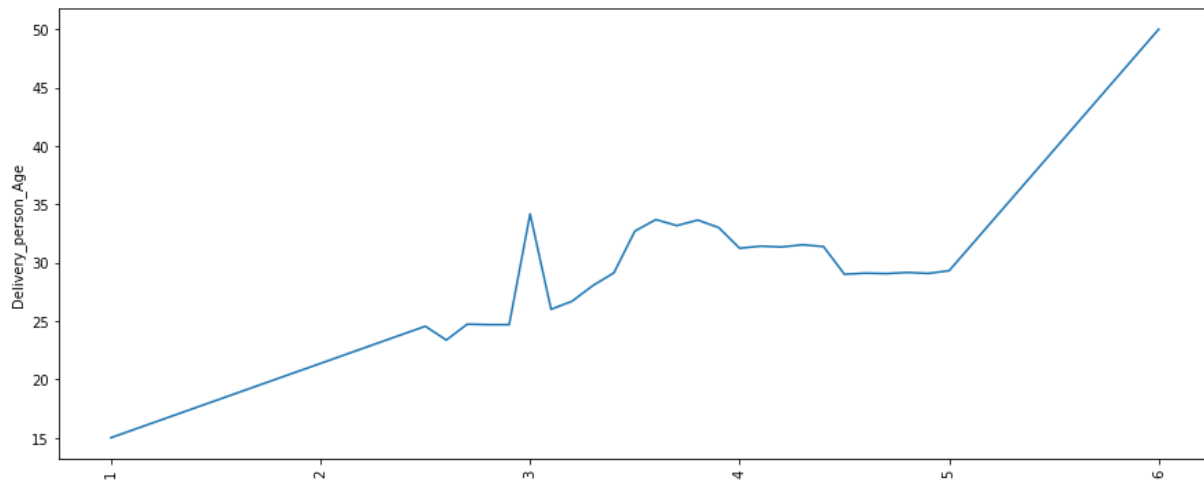
In [37]:

```
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()
```



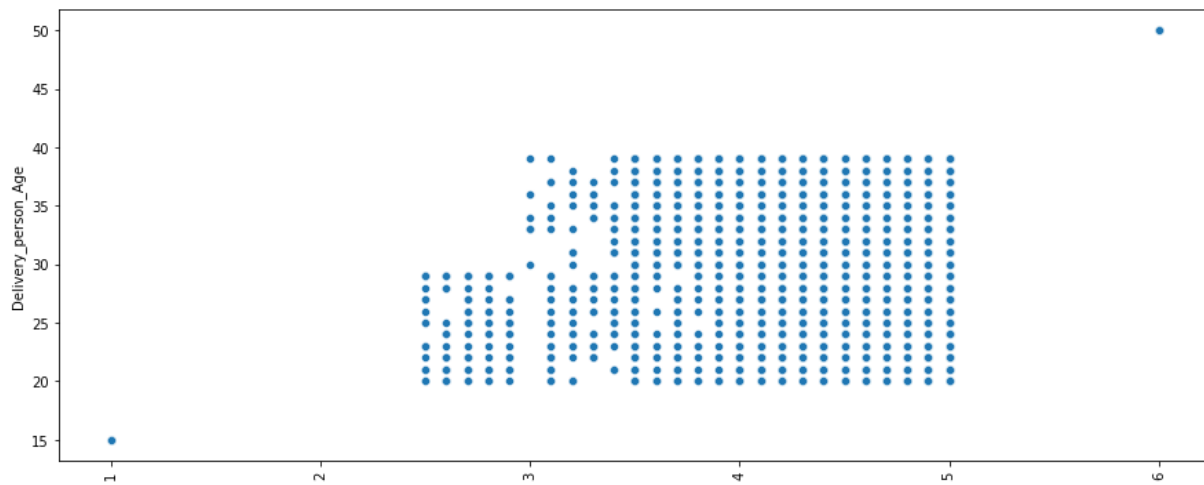
In [38]:

```
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()
```



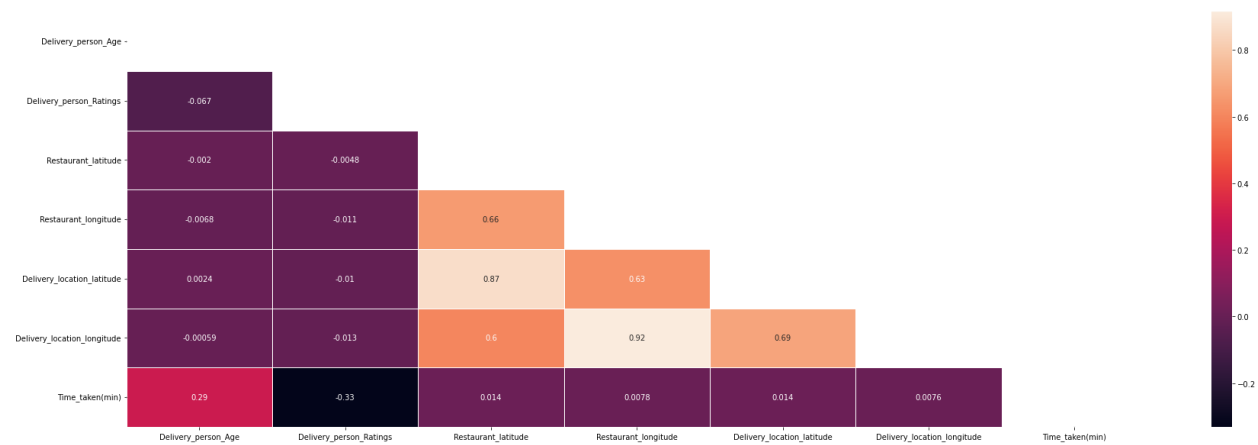
In [40]:

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

df_corr

	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_latit	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

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



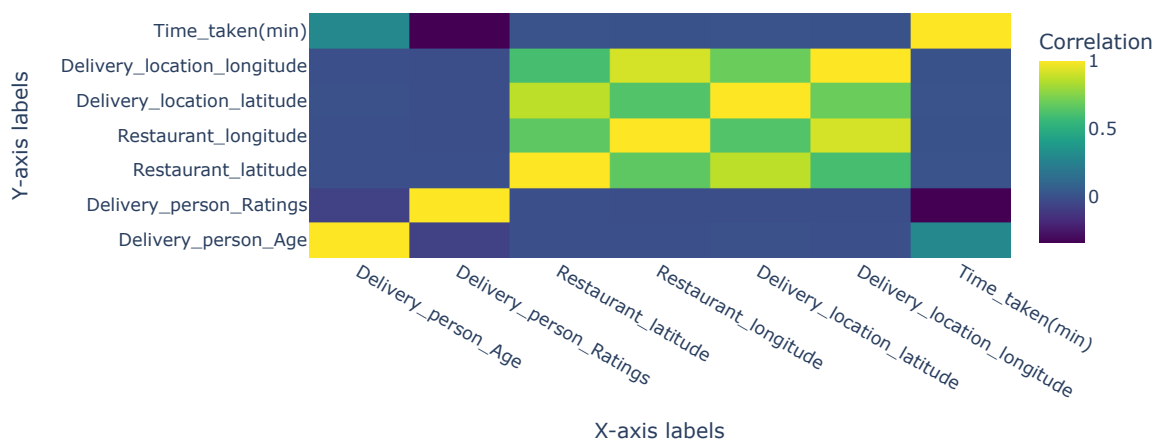
In [43]:

```
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()
```

Correlation Heatmap



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_categori
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
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 XGBRegressor
xgb_regressor = XGBRegressor(random_state=42)
xgb_regressor.fit(X_train_scaled, y_train)
```

Out[74]:

```
XGBRegressor
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 XGBRegressor
y_pred_xgb = xgb_regressor.predict(X_test_scaled)
```

In [76]:

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

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

XGBRegressor - R-squared Score: 0.9999999999991573
XGBRegressor - Mean Squared Error: 7.388065861443196e-10

