Delhivery - Business Case Study

Problem Statement

We have been given data on trips performed by parcels for Delhivery, which has attributes like trip_creation_time, routes, source and destination places, and open-source routing engine time. We need to clean, sanitize and manipulate data and get useful features and provide data to help them build forecasting models.

Importing required Python Libraries

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels
from scipy.special import comb
from scipy.stats import binom
from scipy.stats import norm,t
from scipy.stats import poisson, expon,geom, ttest_1samp,
ttest_ind,ttest_ind_from_stats,boxcox
from scipy.stats import shapiro, levene, kruskal, chi2,
chi2_contingency,pearsonr, spearmanr
from statsmodels.graphics.gofplots import qqplot
from sklearn.preprocessing import LabelEncoder, StandardScaler,
MinMaxScaler, OneHotEncoder
```

Loading our dataset

```
#Loading of csv file
df=pd.read_csv("delhivery_data.csv")
df
```

```
            data          trip_creation_time  \
0       training  2018-09-20 02:35:36.476840
1       training  2018-09-20 02:35:36.476840
2       training  2018-09-20 02:35:36.476840
3       training  2018-09-20 02:35:36.476840
4       training  2018-09-20 02:35:36.476840
...          ...                         ...
144862  training  2018-09-20 16:24:28.436231
144863  training  2018-09-20 16:24:28.436231
144864  training  2018-09-20 16:24:28.436231
144865  training  2018-09-20 16:24:28.436231
144866  training  2018-09-20 16:24:28.436231

                                    route_schedule_uuid
```

```
route_type  \
0       thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...    Carting

1       thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...    Carting

2       thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...    Carting

3       thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...    Carting

4       thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...    Carting

...                                                    ...         ...

144862  thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...    Carting

144863  thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...    Carting

144864  thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...    Carting

144865  thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...    Carting

144866  thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...    Carting


                      trip_uuid source_center
source_name  \
0       trip-153741093647649320  IND388121AAA  Anand_VUNagar_DC
(Gujarat)
1       trip-153741093647649320  IND388121AAA  Anand_VUNagar_DC
(Gujarat)
2       trip-153741093647649320  IND388121AAA  Anand_VUNagar_DC
(Gujarat)
3       trip-153741093647649320  IND388121AAA  Anand_VUNagar_DC
(Gujarat)
4       trip-153741093647649320  IND388121AAA  Anand_VUNagar_DC
(Gujarat)
...                         ...           ...
...
144862  trip-153746066843555182  IND131028AAB  Sonipat_Kundli_H
(Haryana)
144863  trip-153746066843555182  IND131028AAB  Sonipat_Kundli_H
(Haryana)
144864  trip-153746066843555182  IND131028AAB  Sonipat_Kundli_H
(Haryana)
144865  trip-153746066843555182  IND131028AAB  Sonipat_Kundli_H
(Haryana)
144866  trip-153746066843555182  IND131028AAB  Sonipat_Kundli_H
(Haryana)

       destination_center               destination_name  \
```

```
0            IND388620AAB  Khambhat_MotvdDPP_D (Gujarat)
1            IND388620AAB  Khambhat_MotvdDPP_D (Gujarat)
2            IND388620AAB  Khambhat_MotvdDPP_D (Gujarat)
3            IND388620AAB  Khambhat_MotvdDPP_D (Gujarat)
4            IND388620AAB  Khambhat_MotvdDPP_D (Gujarat)
...                   ...                            ...
144862       IND000000ACB  Gurgaon_Bilaspur_HB (Haryana)
144863       IND000000ACB  Gurgaon_Bilaspur_HB (Haryana)
144864       IND000000ACB  Gurgaon_Bilaspur_HB (Haryana)
144865       IND000000ACB  Gurgaon_Bilaspur_HB (Haryana)
144866       IND000000ACB  Gurgaon_Bilaspur_HB (Haryana)

                     od_start_time  ...            cutoff_timestamp  \
0       2018-09-20 03:21:32.418600  ...         2018-09-20 04:27:55
1       2018-09-20 03:21:32.418600  ...         2018-09-20 04:17:55
2       2018-09-20 03:21:32.418600  ...  2018-09-20 04:01:19.505586
3       2018-09-20 03:21:32.418600  ...         2018-09-20 03:39:57
4       2018-09-20 03:21:32.418600  ...         2018-09-20 03:33:55
...                            ...  ...                         ...
144862  2018-09-20 16:24:28.436231  ...         2018-09-20 21:57:20
144863  2018-09-20 16:24:28.436231  ...         2018-09-20 21:31:18
144864  2018-09-20 16:24:28.436231  ...         2018-09-20 21:11:18
144865  2018-09-20 16:24:28.436231  ...         2018-09-20 20:53:19
144866  2018-09-20 16:24:28.436231  ...  2018-09-20 16:24:28.436231

        actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                            10.435660         14.0       11.0
11.9653
1                            18.936842         24.0       20.0
21.7243
2                            27.637279         40.0       28.0
32.5395
3                            36.118028         62.0       40.0
45.5620
4                            39.386040         68.0       44.0
54.2181
...                                ...          ...        ...
...
144862                       45.258278         94.0       60.0
67.9280
144863                       54.092531        120.0       76.0
85.6829
144864                       66.163591        140.0       88.0
97.0933
144865                       73.680667        158.0       98.0
111.2709
144866                       70.039010        426.0       95.0
88.7319
```

```
          factor  segment_actual_time  segment_osrm_time  \
0       1.272727                 14.0               11.0
1       1.200000                 10.0                9.0
2       1.428571                 16.0                7.0
3       1.550000                 21.0               12.0
4       1.545455                  6.0                5.0
...          ...                  ...                ...
144862  1.566667                 12.0               12.0
144863  1.578947                 26.0               21.0
144864  1.590909                 20.0               34.0
144865  1.612245                 17.0               27.0
144866  4.484211                268.0                9.0

        segment_osrm_distance  segment_factor
0                     11.9653        1.272727
1                      9.7590        1.111111
2                     10.8152        2.285714
3                     13.0224        1.750000
4                      3.9153        1.200000
...                       ...             ...
144862                 8.1858        1.000000
144863                17.3725        1.238095
144864                20.7053        0.588235
144865                18.8885        0.629630
144866                 8.8088       29.777778

[144867 rows x 24 columns]
```

Observations on shape of data, data types of all the attributes, conversion of categorical attributes to 'category', missing value detection, statistical summary

```
df.shape #Shape of dataset
```

```
(144867, 24)
```

```
df.info() #datatype info of dataset
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 144867 entries, 0 to 144866
Data columns (total 24 columns):
 #   Column                          Non-Null Count   Dtype
---  ------                          --------------   -----
 0   data                            144867 non-null  object
```

```
 1   trip_creation_time               144867 non-null  object
 2   route_schedule_uuid              144867 non-null  object
 3   route_type                       144867 non-null  object
 4   trip_uuid                        144867 non-null  object
 5   source_center                    144867 non-null  object
 6   source_name                      144574 non-null  object
 7   destination_center               144867 non-null  object
 8   destination_name                 144606 non-null  object
 9   od_start_time                    144867 non-null  object
 10  od_end_time                      144867 non-null  object
 11  start_scan_to_end_scan           144867 non-null  float64
 12  is_cutoff                        144867 non-null  bool
 13  cutoff_factor                    144867 non-null  int64
 14  cutoff_timestamp                 144867 non-null  object
 15  actual_distance_to_destination   144867 non-null  float64
 16  actual_time                      144867 non-null  float64
 17  osrm_time                        144867 non-null  float64
 18  osrm_distance                    144867 non-null  float64
 19  factor                           144867 non-null  float64
 20  segment_actual_time              144867 non-null  float64
 21  segment_osrm_time                144867 non-null  float64
 22  segment_osrm_distance            144867 non-null  float64
 23  segment_factor                   144867 non-null  float64
dtypes: bool(1), float64(10), int64(1), object(12)
memory usage: 25.6+ MB
```

```
df.nunique() # number of unique values in columns
```

```
data                                   2
trip_creation_time                 14817
route_schedule_uuid                 1504
route_type                             2
trip_uuid                          14817
source_center                       1508
source_name                         1498
destination_center                  1481
destination_name                    1468
od_start_time                      26369
od_end_time                        26369
start_scan_to_end_scan              1915
is_cutoff                              2
cutoff_factor                        501
cutoff_timestamp                   93180
actual_distance_to_destination    144515
actual_time                         3182
osrm_time                           1531
osrm_distance                     138046
factor                             45641
segment_actual_time                  747
segment_osrm_time                    214
```

```
segment_osrm_distance             113799
segment_factor                      5675
dtype: int64
```

```
df.isna().sum() #missing values in columns
```

```
data                                  0
trip_creation_time                    0
route_schedule_uuid                   0
route_type                            0
trip_uuid                             0
source_center                         0
source_name                         293
destination_center                    0
destination_name                    261
od_start_time                         0
od_end_time                           0
start_scan_to_end_scan                0
is_cutoff                             0
cutoff_factor                         0
cutoff_timestamp                      0
actual_distance_to_destination        0
actual_time                           0
osrm_time                             0
osrm_distance                         0
factor                                0
segment_actual_time                   0
segment_osrm_time                     0
segment_osrm_distance                 0
segment_factor                        0
dtype: int64
```

```
df.describe() #Statistical summary of the dataset
```

```
       start_scan_to_end_scan  cutoff_factor
actual_distance_to_destination  \
count           144867.000000  144867.000000
144867.000000
mean               961.262986     232.926567
234.073372
std               1037.012769     344.755577
344.990009
min                 20.000000       9.000000
9.000045
25%                161.000000      22.000000
23.355874
50%                449.000000      66.000000
66.126571
75%               1634.000000     286.000000
286.708875
```

```
max               7898.000000    1927.000000
1927.447705

         actual_time      osrm_time  osrm_distance         factor  \
count  144867.000000  144867.000000  144867.000000  144867.000000
mean      416.927527     213.868272     284.771297       2.120107
std       598.103621     308.011085     421.119294       1.715421
min         9.000000       6.000000       9.008200       0.144000
25%        51.000000      27.000000      29.914700       1.604264
50%       132.000000      64.000000      78.525800       1.857143
75%       513.000000     257.000000     343.193250       2.213483
max      4532.000000    1686.000000    2326.199100      77.387097

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
count        144867.000000      144867.000000           144867.00000

mean             36.196111          18.507548               22.82902

std              53.571158          14.775960               17.86066

min            -244.000000           0.000000                0.00000

25%              20.000000          11.000000               12.07010

50%              29.000000          17.000000               23.51300

75%              40.000000          22.000000               27.81325

max            3051.000000        1611.000000             2191.40370


       segment_factor
count   144867.000000
mean         2.218368
std          4.847530
min        -23.444444
25%          1.347826
50%          1.684211
75%          2.250000
max        574.250000

df.describe(include=object)

            data          trip_creation_time  \
count     144867                      144867
unique         2                       14817
top     training  2018-09-28 05:23:15.359220
freq      104858                         101

                                  route_schedule_uuid
```

```
route_type  \
count                                                144867     144867

unique                                                 1504          2

top     thanos::sroute:4029a8a2-6c74-4b7e-a6d8-f9e069f...         FTL

freq                                                   1812      99660


                       trip_uuid source_center
source_name  \
count                     144867        144867
144574
unique                     14817          1508
1498
top     trip-153811219535896559  IND000000ACB  Gurgaon_Bilaspur_HB
(Haryana)
freq                         101         23347
23347

       destination_center               destination_name  \
count              144867                         144606
unique               1481                           1468
top          IND000000ACB  Gurgaon_Bilaspur_HB (Haryana)
freq                15192                          15192

                     od_start_time                  od_end_time  \
count                       144867                       144867
unique                       26369                        26369
top     2018-09-21 18:37:09.322207  2018-09-24 09:59:15.691618
freq                            81                           81

           cutoff_timestamp
count                144867
unique                93180
top     2018-09-24 05:19:20
freq                    40
```

```
#Checking for source center value for which source name is null
df[(df["source_name"].notnull()) &
(df["source_center"].isin(df[df["source_name"].isnull()]
["source_center"]))]
```

```
Empty DataFrame
Columns: [data, trip_creation_time, route_schedule_uuid, route_type,
trip_uuid, source_center, source_name, destination_center,
destination_name, od_start_time, od_end_time, start_scan_to_end_scan,
is_cutoff, cutoff_factor, cutoff_timestamp,
actual_distance_to_destination, actual_time, osrm_time, osrm_distance,
```

```
factor, segment_actual_time, segment_osrm_time, segment_osrm_distance,
segment_factor]
Index: []

[0 rows x 24 columns]
```

```
#Checking for destination center value for which destination name is
null
df[(df["destination_name"].notnull()) &
(df["destination_center"].isin(df[df["destination_name"].isnull()]
["destination_center"]))]
```

```
Empty DataFrame
Columns: [data, trip_creation_time, route_schedule_uuid, route_type,
trip_uuid, source_center, source_name, destination_center,
destination_name, od_start_time, od_end_time, start_scan_to_end_scan,
is_cutoff, cutoff_factor, cutoff_timestamp,
actual_distance_to_destination, actual_time, osrm_time, osrm_distance,
factor, segment_actual_time, segment_osrm_time, segment_osrm_distance,
segment_factor]
Index: []

[0 rows x 24 columns]
```

```
#Here we can observe that minimum value of segment_actual_time and
segment_factor is negative,
#which seems false values as time can not be negative, so we will drop
that data
df.drop(df[df["segment_actual_time"]<0].index, inplace=True)

df.describe()
```

```
       start_scan_to_end_scan  cutoff_factor
actual_distance_to_destination  \
count           144846.000000  144846.000000
144846.000000
mean               961.226537     232.911057
234.057171
std               1036.993595     344.740981
344.974984
min                 20.000000       9.000000
9.000045
25%                161.000000      22.000000
23.354927
50%                449.000000      66.000000
66.126234
75%               1634.000000     286.000000
286.706673
max               7898.000000    1927.000000
1927.447705
```

```
         actual_time      osrm_time  osrm_distance         factor  \
count  144846.000000  144846.000000  144846.000000  144846.000000
mean      416.908724     213.853002     284.750969       2.120190
std       598.085058     307.997702     421.101831       1.715508
min         9.000000       6.000000       9.008200       0.144000
25%        51.000000      27.000000      29.909925       1.604288
50%       132.000000      64.000000      78.524600       1.857143
75%       513.000000     257.000000     343.062075       2.213589
max      4532.000000    1686.000000    2326.199100      77.387097

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
count        144846.000000      144846.000000          144846.000000

mean             36.207427          18.507304              22.828528

std              53.561259          14.775870              17.860268

min               0.000000           0.000000               0.000000

25%              20.000000          11.000000              12.070100

50%              29.000000          17.000000              23.513000

75%              40.000000          22.000000              27.812975

max            3051.000000        1611.000000            2191.403700


       segment_factor
count   144846.000000
mean         2.219084
std          4.847144
min         -1.000000
25%          1.347826
50%          1.684211
75%          2.250000
max        574.250000
```

Dataset Information

data: It contains whether the data is testing or training type

trip_creation_time: It is the timestamp of trip_creation. It ranges from '2018-09-12 00:25:19.499696' to '2018-10-03 23:59:42.701692'

oute_schedule_uuid: it is unique_id for particular route schedule

route type: It contains whether the route is Full Truck Load or Carting type

trip_uuid: It is a unique id associated with a particular trip

source_center: It is the ID of the origin of the trip

source_name: Its the name of the origin of the trip

destination_center: It is the ID of the destination of the trip

destination_name: It is the name of the destination of the trip

od_start_time: It is the trip start time

od_end_time: It is the trip end time

Start_scan_to_end_scan: It gives the time taken to deliver from source to destination. It ranges from 20 to 7898.

is_cutoff: It is an unknown field, which is boolean

cutoff_factor: It is the rounded value of the actual_distance_to_destination, it ranges from 9 to 1927

cutoff_timestamp: It is an unknown field

actual_distance_to_destination: It is the distance between the source and destination warehouses, it ranges from 9.00 to 1927.44

actual_time: It contains the actual time taken to complete the delivery (cumulative), it ranges from 9 to 4532.

osrm_time: It is an open-source routing engine time calculator which computes the shortest path between points in a given map and gives the time (cumulative), it ranges from 6 to 1686

osrm_distance: It contains the distance to the destination based on osrm, it ranges from 9.00 to 2326.199

factor: It is a ratio of actual_time to osrm_time, it ranges from 0.144 to 77.38.

segment_actual_time: It is a segment time, a time taken by a subset of package delivery, It ranges from -244 to 3051

segment_osrm_time: It contains the orsm time taken by a subset of the package delivery. It ranges from 0 to 1611

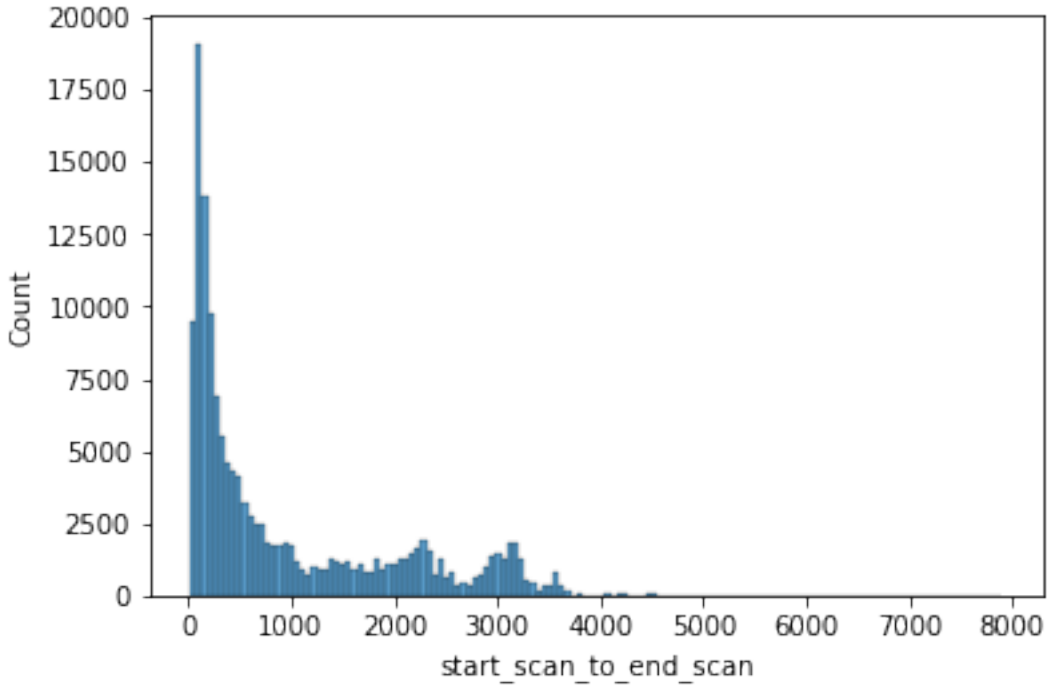
segment_osrm_distance: It contains OSRM distance, the distance covered by a subset of package delivery, it ranges from 0 to 2191.40

segment_factor: It is a ratio between segment_actual_time to segment_osrm_time, it ranges from -23.544 to 574.25

Univariate Analysis

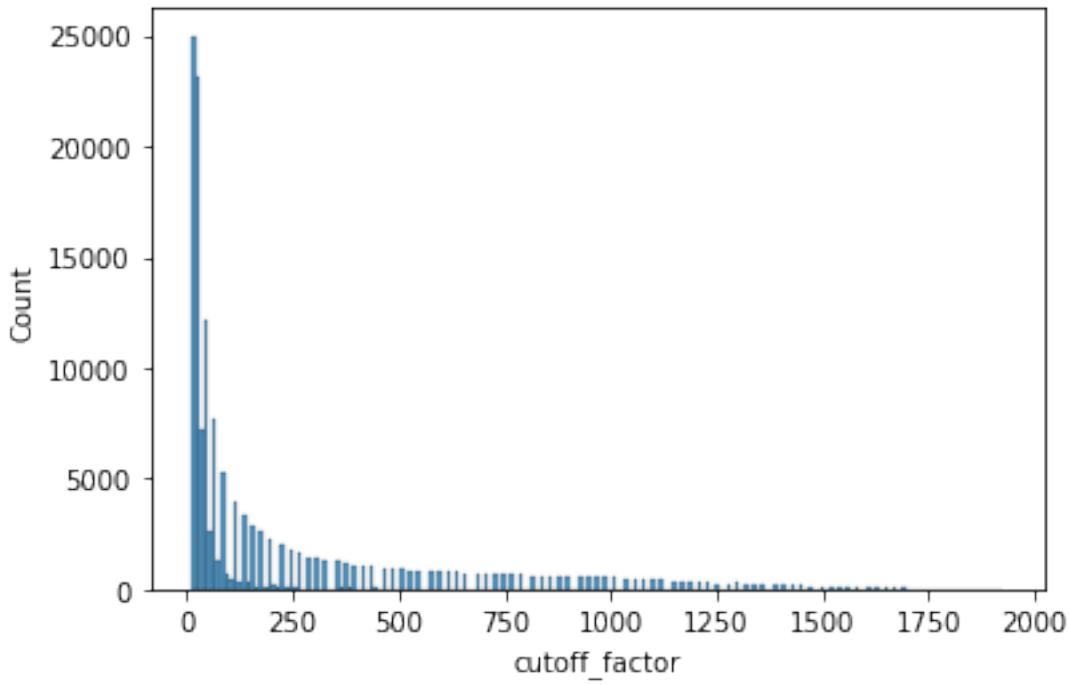
```
#Histplot for start_to_scan_to_end_scan attribute
sns.histplot(df["start_scan_to_end_scan"])
```

```
<AxesSubplot: xlabel='start_scan_to_end_scan', ylabel='Count'>
```



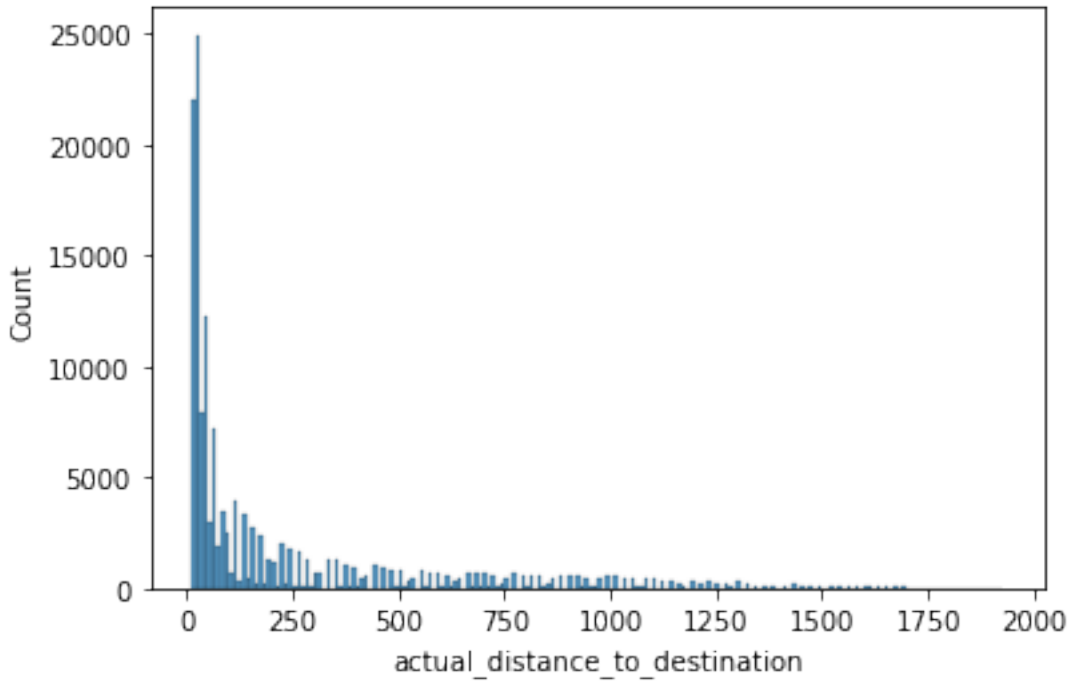

```
#Histplot for cutoff_factor attribute
sns.histplot(df["cutoff_factor"])
```

```
<AxesSubplot: xlabel='cutoff_factor', ylabel='Count'>
```



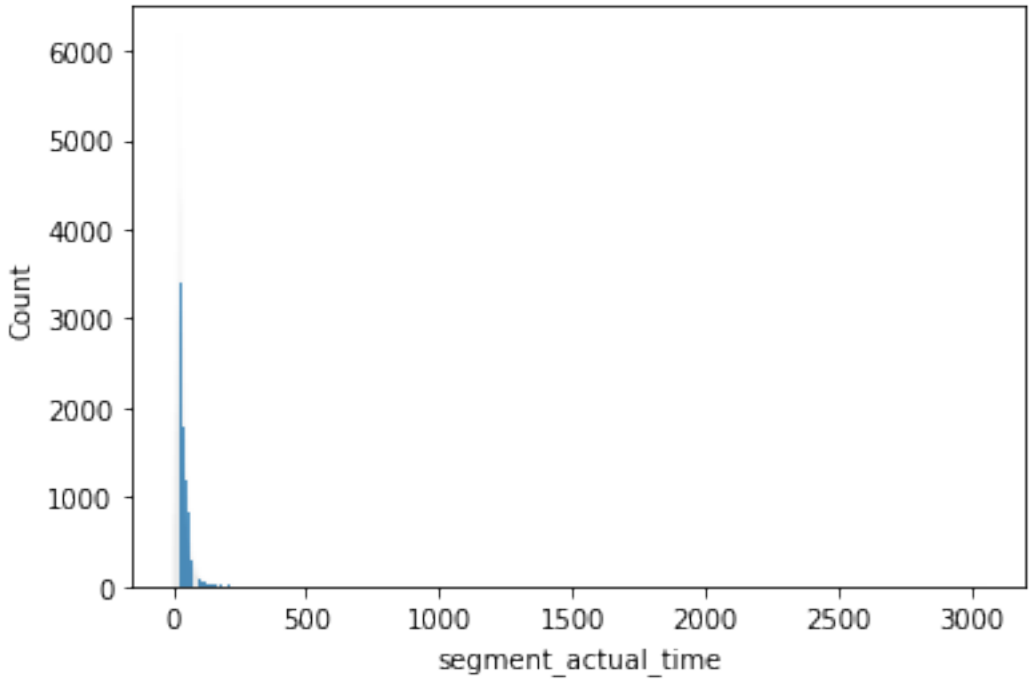

```
#Histplot for actual_distance_to_destination attribute
sns.histplot(df["actual_distance_to_destination"])
```

```
<AxesSubplot: xlabel='actual_distance_to_destination', ylabel='Count'>
```



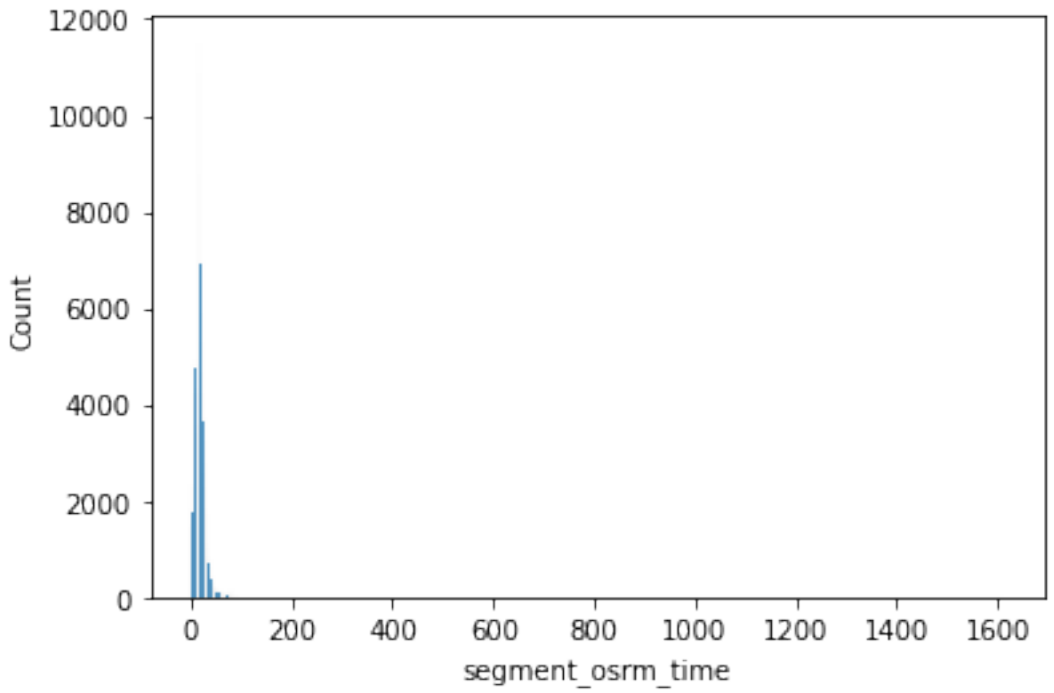
```
#Histplot for segment_actual_time attribute
sns.histplot(df["segment_actual_time"])
```

```
<AxesSubplot: xlabel='segment_actual_time', ylabel='Count'>
```



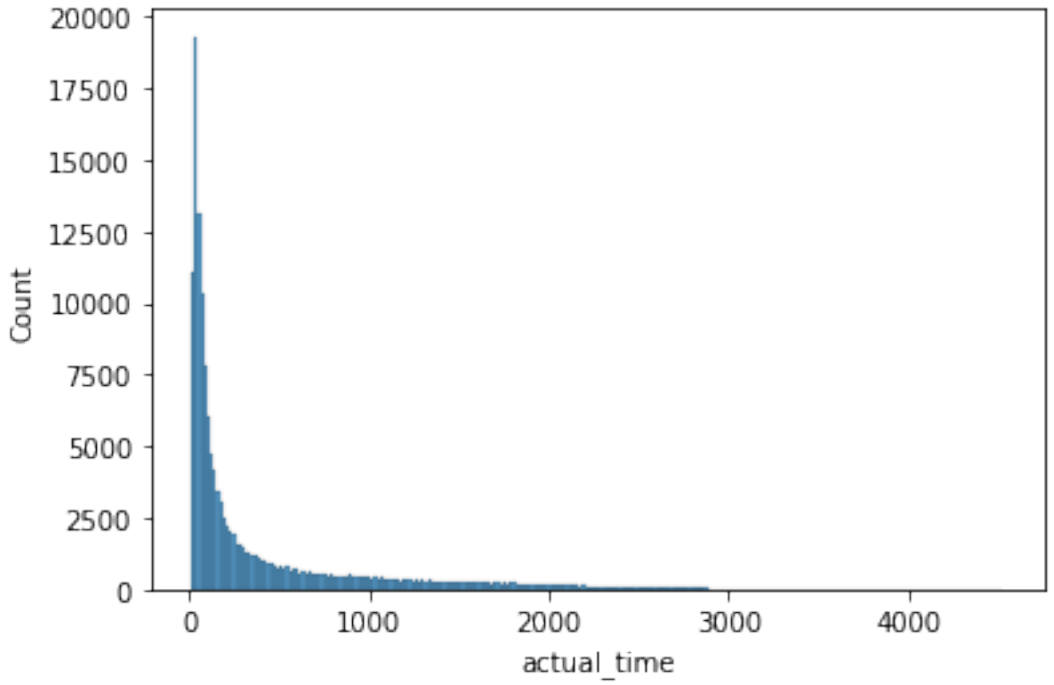

```
#Histplot for segment_osrm_time attribute
sns.histplot(df["segment_osrm_time"])
```

```
<AxesSubplot: xlabel='segment_osrm_time', ylabel='Count'>
```



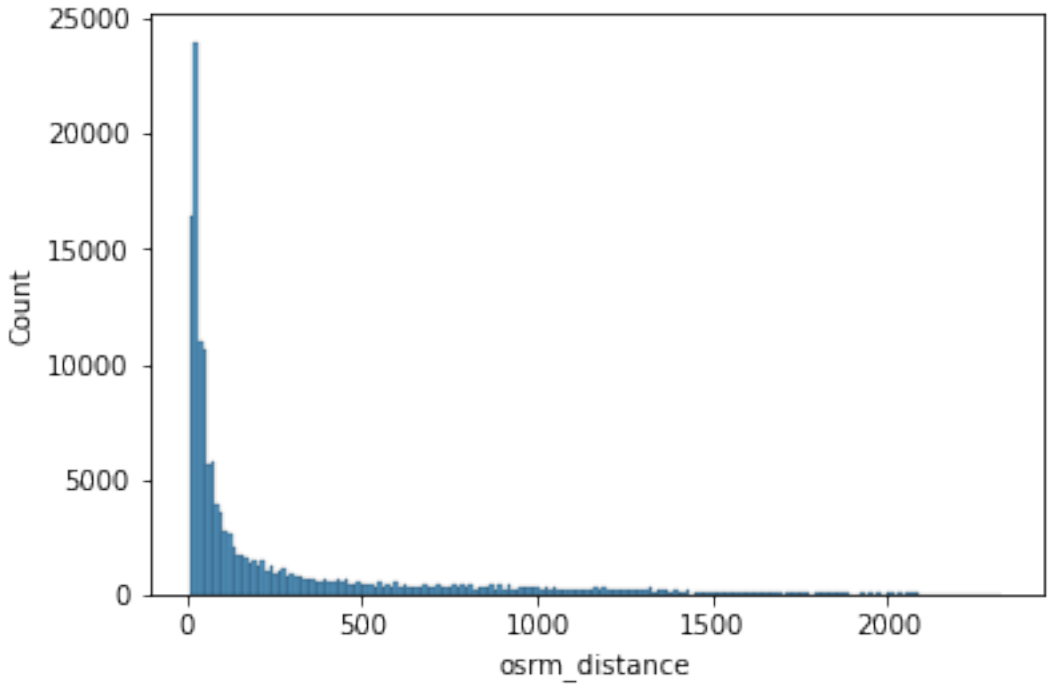

```
#Histplot for actual_time attribute
sns.histplot(df["actual_time"])
```

```
<AxesSubplot: xlabel='actual_time', ylabel='Count'>
```



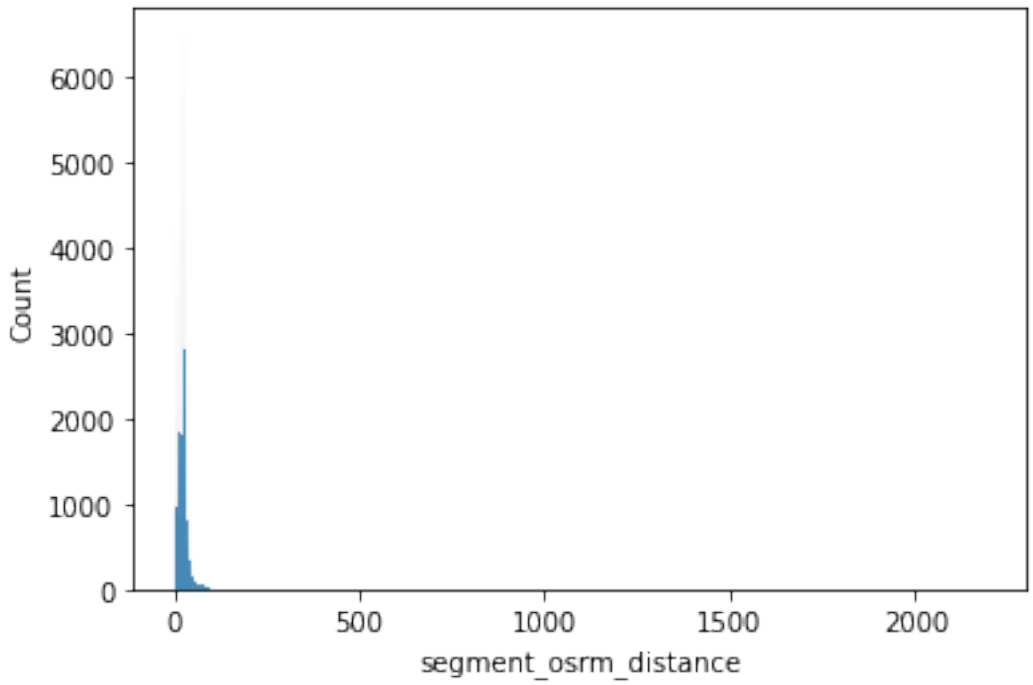
```
#Histplot for osrm_distance attribute
sns.histplot(df["osrm_distance"])
```

```
<AxesSubplot: xlabel='osrm_distance', ylabel='Count'>
```




```
#Histplot for segment_osrm_distance attribute
sns.histplot(df["segment_osrm_distance"])
```

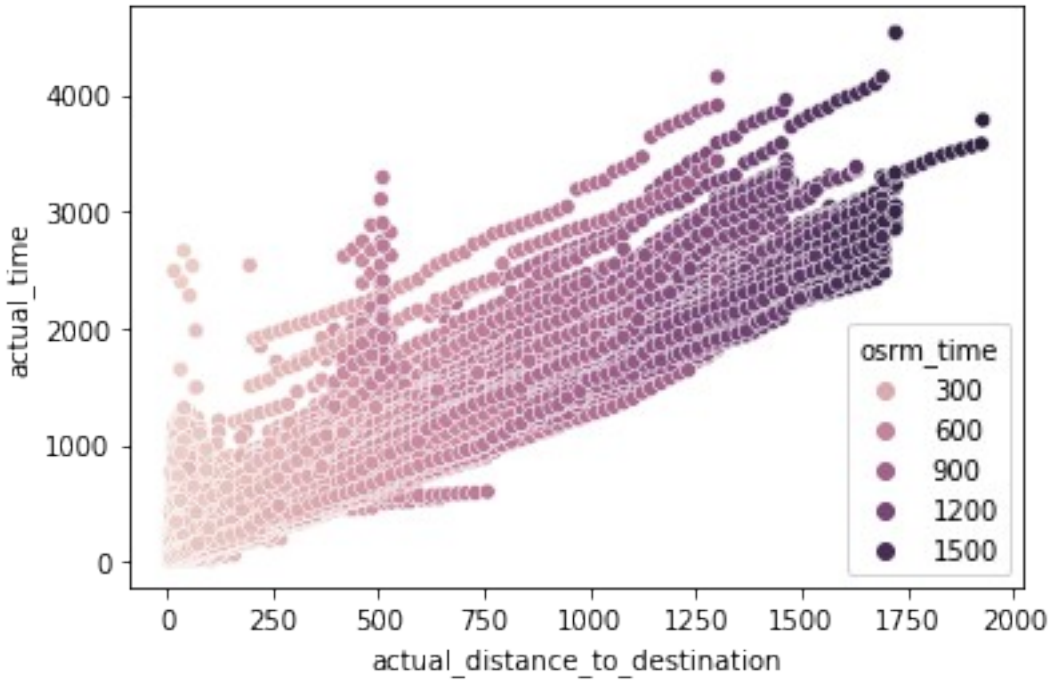
```
<AxesSubplot: xlabel='segment_osrm_distance', ylabel='Count'>
```



Bivariate Analysis

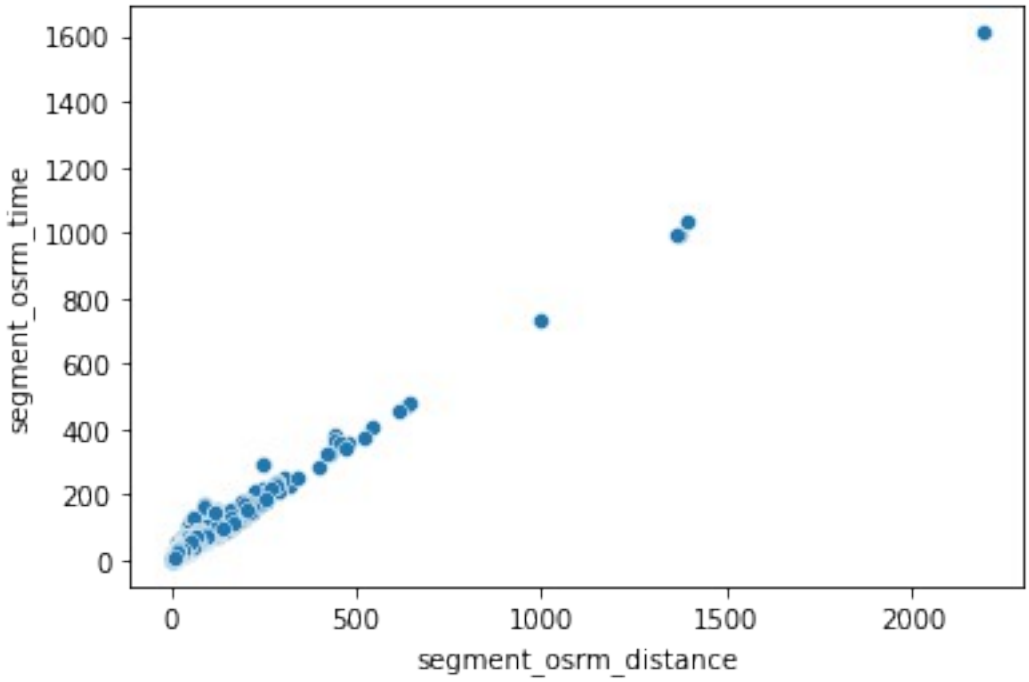
```
#Scatterplot between actual-distance_to_destination, actual_time and
osrm_time
sns.scatterplot(data=df,
x="actual_distance_to_destination",y="actual_time", hue="osrm_time")
```

```
<AxesSubplot: xlabel='actual_distance_to_destination',
ylabel='actual_time'>
```



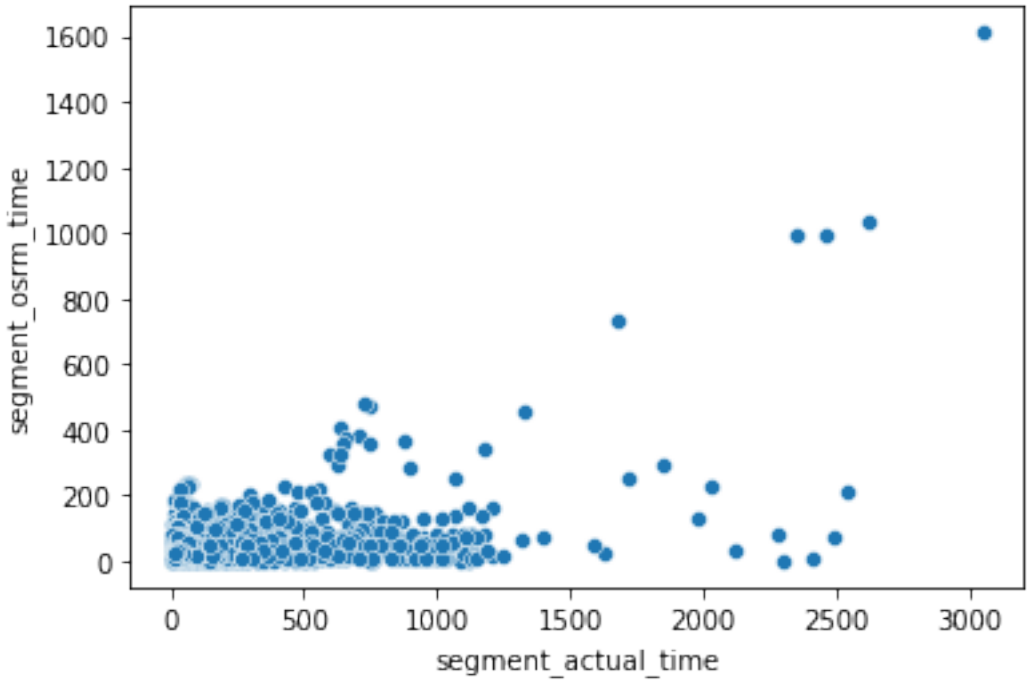

```
#scatterplot between segment_osrm_distance and segment_osrm_time
sns.scatterplot(data=df,
x="segment_osrm_distance",y="segment_osrm_time")
```

```
<AxesSubplot: xlabel='segment_osrm_distance',
ylabel='segment_osrm_time'>
```



```
#scatterplot between segment_actual_time and segment_osrm_time
sns.scatterplot(data=df,
x="segment_actual_time",y="segment_osrm_time")
```

```
<AxesSubplot: xlabel='segment_actual_time',
ylabel='segment_osrm_time'>
```




```
#correlation in dataframe
df.corr()
```

```
C:\Users\Pipaliya\AppData\Local\Temp\ipykernel_8836\2340352341.py:2:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  df.corr()
```

	start_scan_to_end_scan	is_cutoff	\
start_scan_to_end_scan	1.000000	0.299115	
is_cutoff	0.299115	1.000000	
cutoff_factor	0.784656	0.190819	
actual_distance_to_destination	0.784988	0.191574	
actual_time	0.785924	0.168270	
osrm_time	0.785283	0.186485	
osrm_distance	0.784120	0.188247	
factor	-0.023192	-0.121369	
segment_actual_time	0.093372	-0.006945	
segment_osrm_time	0.219844	0.216334	

```
segment_osrm_distance                          0.306972   0.254661
segment_factor                                -0.020225  -0.106518

                                  cutoff_factor
actual_distance_to_destination  \
start_scan_to_end_scan                0.784656
0.784988
is_cutoff                             0.190819
0.191574
cutoff_factor                         1.000000
0.999986
actual_distance_to_destination        0.999986
1.000000
actual_time                           0.978719
0.978658
osrm_time                             0.995833
0.995872
osrm_distance                         0.997116
0.997148
factor                               -0.064559                          -
0.064743
segment_actual_time                   0.045063
0.045320
segment_osrm_time                     0.157942
0.158836
segment_osrm_distance                 0.231109
0.232119
segment_factor                       -0.031439                          -
0.031588

                                  actual_time  osrm_time  osrm_distance
\
start_scan_to_end_scan               0.785924   0.785283       0.784120

is_cutoff                            0.168270   0.186485       0.188247

cutoff_factor                        0.978719   0.995833       0.997116

actual_distance_to_destination       0.978658   0.995872       0.997148

actual_time                          1.000000   0.977996       0.979398

osrm_time                            0.977996   1.000000       0.999119

osrm_distance                        0.979398   0.999119       1.000000

factor                               0.033498  -0.069081      -0.065391

segment_actual_time                  0.124483   0.049977       0.048787
```

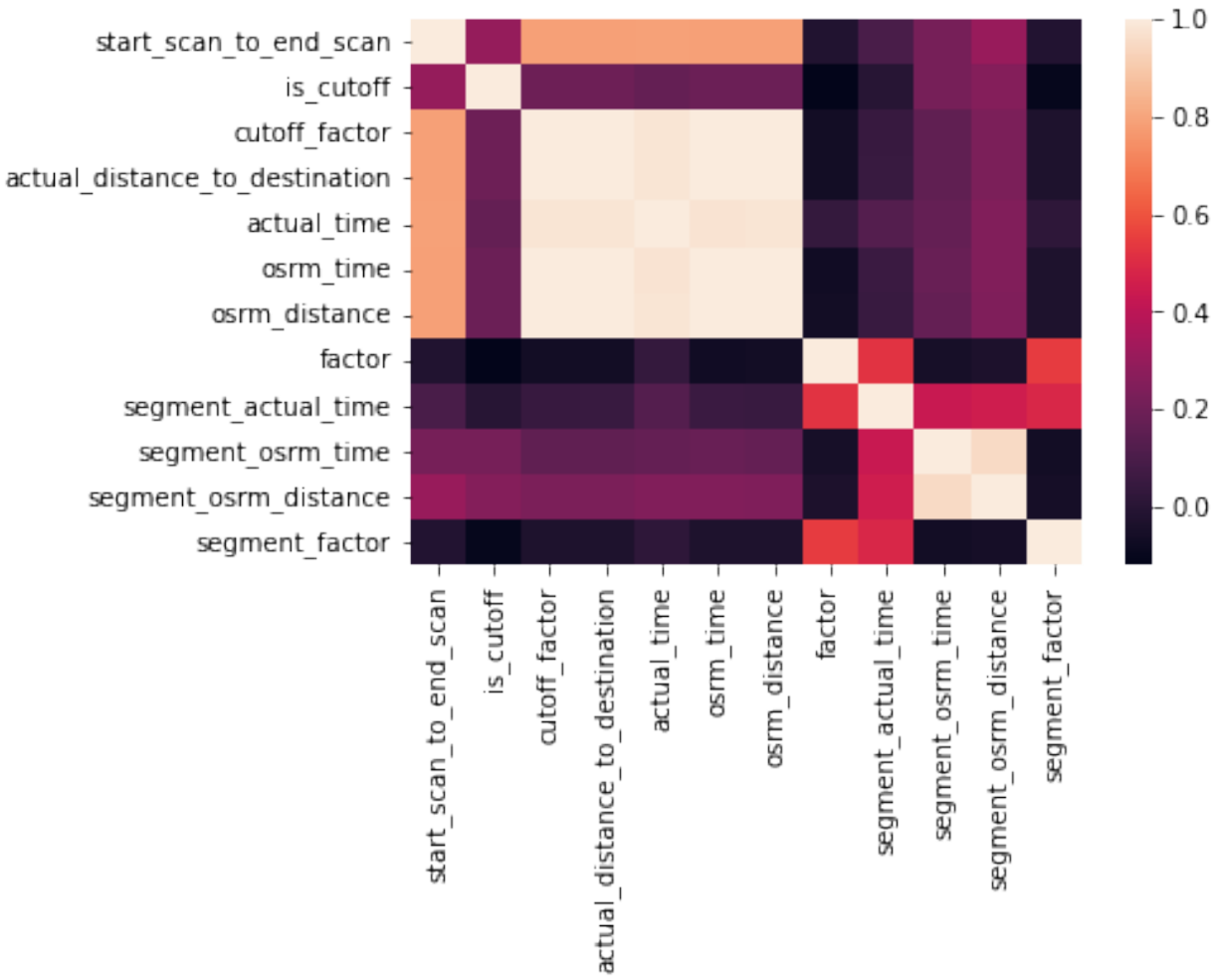
```
segment_osrm_time                  0.171480   0.177074       0.169157

segment_osrm_distance              0.242296   0.242288       0.239672

segment_factor                     0.017570  -0.033038      -0.031786


                                     factor  segment_actual_time  \
start_scan_to_end_scan            -0.023192             0.093372
is_cutoff                         -0.121369            -0.006945
cutoff_factor                     -0.064559             0.045063
actual_distance_to_destination    -0.064743             0.045320
actual_time                        0.033498             0.124483
osrm_time                         -0.069081             0.049977
osrm_distance                     -0.065391             0.048787
factor                             1.000000             0.518451
segment_actual_time                0.518451             1.000000
segment_osrm_time                 -0.053154             0.433604
segment_osrm_distance             -0.036724             0.449167
segment_factor                     0.540448             0.483699

                                  segment_osrm_time
segment_osrm_distance  \
start_scan_to_end_scan                     0.219844
0.306972
is_cutoff                                  0.216334
0.254661
cutoff_factor                              0.157942
0.231109
actual_distance_to_destination             0.158836
0.232119
actual_time                                0.171480
0.242296
osrm_time                                  0.177074
0.242288
osrm_distance                              0.169157
0.239672
factor                                    -0.053154                -
0.036724
segment_actual_time                        0.433604
0.449167
segment_osrm_time                          1.000000
0.948520
segment_osrm_distance                      0.948520
1.000000
segment_factor                            -0.068472                -
0.059317

                                  segment_factor
start_scan_to_end_scan                 -0.020225
```

```
is_cutoff                              -0.106518
cutoff_factor                          -0.031439
actual_distance_to_destination         -0.031588
actual_time                             0.017570
osrm_time                              -0.033038
osrm_distance                          -0.031786
factor                                  0.540448
segment_actual_time                     0.483699
segment_osrm_time                      -0.068472
segment_osrm_distance                  -0.059317
segment_factor                          1.000000
```

```
#heatmap of dataframe
sns.heatmap(df.corr())
```

```
C:\Users\Pipaliya\AppData\Local\Temp\ipykernel_8836\3354145055.py:2:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  sns.heatmap(df.corr())
```

```
<AxesSubplot: >
```



Data Wrangling

```
#merging of rows based on trip_id and source and destination details
data=df.groupby(["route_type","trip_uuid","trip_creation_time","source
_center","source_name","destination_center","destination_name","od_sta
rt_time","od_end_time","start_scan_to_end_scan"]).aggregate({"cutoff_f
actor":"max","actual_distance_to_destination":"max","segment_actual_ti
me":"sum", "segment_osrm_time":"sum", "actual_time":"max",
"osrm_time":"max","osrm_distance":"max","segment_osrm_distance":"sum"}
).reset_index()
data
```

```
      route_type                 trip_uuid          trip_creation_time
\
0        Carting  trip-153671042288605164  2018-09-12 00:00:22.886430

1        Carting  trip-153671042288605164  2018-09-12 00:00:22.886430
```

```
2        Carting  trip-153671046011330457  2018-09-12 00:01:00.113710

3        Carting  trip-153671055416136166  2018-09-12 00:02:34.161600

4        Carting  trip-153671055416136166  2018-09-12 00:02:34.161600

...          ...                      ...                         ...

26218        FTL  trip-153861014185597051  2018-10-03 23:42:21.856227

26219        FTL  trip-153861023893369544  2018-10-03 23:43:58.933947

26220        FTL  trip-153861023893369544  2018-10-03 23:43:58.933947

26221        FTL  trip-153861118270144424  2018-10-03 23:59:42.701692

26222        FTL  trip-153861118270144424  2018-10-03 23:59:42.701692


      source_center                          source_name
destination_center  \
0      IND561203AAB   Doddablpur_ChikaDPP_D (Karnataka)
IND562101AAA
1      IND572101AAA       Tumkur_Veersagr_I (Karnataka)
IND561203AAB
2      IND400072AAB            Mumbai Hub (Maharashtra)
IND401104AAA
3      IND600056AAA    Chennai_Poonamallee (Tamil Nadu)
IND602105AAB
4      IND600116AAB      Chennai_Porur_DPC (Tamil Nadu)
IND600056AAA
...             ...                                  ...
...
26218  IND462022AAA  Bhopal_Trnsport_H (Madhya Pradesh)
IND209304AAA
26219  IND382715AAA           Kadi_KaranNGR_D (Gujarat)
IND382430AAB
26220  IND384205AAA        Mehsana_Panchot_IP (Gujarat)
IND382715AAA
26221  IND583119AAA       Sandur_WrdN1DPP_D (Karnataka)
IND583101AAA
26222  IND583201AAA                  Hospet (Karnataka)
IND583119AAA

                           destination_name
od_start_time  \
0          Chikblapur_ShntiSgr_D (Karnataka)  2018-09-12
02:03:09.655591
1          Doddablpur_ChikaDPP_D (Karnataka)  2018-09-12
00:00:22.886430
```

```
2             Mumbai_MiraRd_IP (Maharashtra)  2018-09-12
00:01:00.113710
3      Chennai_Sriperumbudur_Dc (Tamil Nadu)  2018-09-12
02:12:10.755603
4           Chennai_Poonamallee (Tamil Nadu)  2018-09-12
00:02:34.161600
...                                      ...                          .
..
26218     Kanpur_Central_H_6 (Uttar Pradesh)  2018-10-03
23:42:21.856227
26219           Ahmedabad_East_H_1 (Gujarat)  2018-10-04
01:48:54.382343
26220              Kadi_KaranNGR_D (Gujarat)  2018-10-03
23:43:58.933947
26221                 Bellary_Dc (Karnataka)  2018-10-04
03:58:40.726547
26222          Sandur_WrdN1DPP_D (Karnataka)  2018-10-04
02:51:44.712656

                      od_end_time  start_scan_to_end_scan
cutoff_factor  \
0      2018-09-12 03:01:59.598855                    58.0
24
1      2018-09-12 02:03:09.655591                   122.0
48
2      2018-09-12 01:41:29.809822                   100.0
17
3      2018-09-12 03:13:03.432532                    60.0
15
4      2018-09-12 02:12:10.755603                   129.0
9
...                            ...                     ...              .
..
26218  2018-10-04 19:57:34.928573                  1215.0
442
26219  2018-10-04 04:01:41.425627                   132.0
50
26220  2018-10-04 01:48:54.382343                   124.0
34
26221  2018-10-04 08:46:09.166940                   287.0
40
26222  2018-10-04 03:58:40.726547                    66.0
25

       actual_distance_to_destination  segment_actual_time
segment_osrm_time  \
0                           24.644021                 46.0
26.0
1                           48.542890                 95.0
```

```
39.0
2                            17.175274                  59.0
16.0
3                            15.325529                  39.0
12.0
4                             9.271519                  21.0
11.0
...                                ...                   ...
...
26218                      442.024575                 991.0
425.0
26219                        50.473578                 129.0
55.0
26220                        34.270235                  57.0
37.0
26221                        40.546740                 233.0
42.0
26222                        25.534793                  41.0
25.0
```

	actual_time	osrm_time	osrm_distance	segment_osrm_distance
0	47.0	26.0	28.1994	28.1995
1	96.0	42.0	56.9116	55.9899
2	59.0	15.0	19.6800	19.8766
3	40.0	12.0	16.2225	16.2225
4	21.0	11.0	11.8422	11.8422
...	...	...	...	...
26218	997.0	395.0	545.1256	573.6479
26219	130.0	54.0	61.9571	67.2659
26220	57.0	38.0	40.4257	40.4256
26221	233.0	42.0	52.5303	52.5303
26222	42.0	26.0	28.0484	28.0484

```
[26223 rows x 18 columns]
```

```
#Merging rows based on trip_id
data=data.groupby(["route_type","trip_uuid","trip_creation_time"]).agg
regate({"source_center":"first","source_name":"first","destination_cen
ter":"last",
                                    "destination_name":"last",
"od_start_time":"first",

"od_end_time":"last","cutoff_factor":"sum","actual_distance_to_destina
tion":"sum","osrm_distance":"sum",
                                    "start_scan_to_end_scan":"sum",
"segment_actual_time":"sum",

"segment_osrm_time":"sum","actual_time":"sum",
```

```
"osrm_time":"sum","segment_osrm_distance":"sum"}).reset_index()
data
```

```
      route_type                trip_uuid          trip_creation_time
\
0        Carting  trip-153671042288605164  2018-09-12 00:00:22.886430

1        Carting  trip-153671046011330457  2018-09-12 00:01:00.113710

2        Carting  trip-153671055416136166  2018-09-12 00:02:34.161600

3        Carting  trip-153671066201138152  2018-09-12 00:04:22.011653

4        Carting  trip-153671066826362165  2018-09-12 00:04:28.263977

...          ...                       ...                         ...

14782        FTL  trip-153861004148234782  2018-10-03 23:40:41.482736

14783        FTL  trip-153861007249500192  2018-10-03 23:41:12.495257

14784        FTL  trip-153861014185597051  2018-10-03 23:42:21.856227

14785        FTL  trip-153861023893369544  2018-10-03 23:43:58.933947

14786        FTL  trip-153861118270144424  2018-10-03 23:59:42.701692


      source_center                          source_name
destination_center  \
0      IND561203AAB  Doddablpur_ChikaDPP_D (Karnataka)
IND561203AAB
1      IND400072AAB           Mumbai Hub (Maharashtra)
IND401104AAA
2      IND600056AAA   Chennai_Poonamallee (Tamil Nadu)
IND600056AAA
3      IND600044AAD  Chennai_Chrompet_DPC (Tamil Nadu)
IND600048AAA
4      IND560043AAC          HBR Layout PC (Karnataka)
IND560043AAC
...             ...                                ...
...
14782  IND814101AAB        Dumka_Dudhani_D (Jharkhand)
IND815351AAA
14783  IND842001AAA        Muzaffrpur_Bbganj_I (Bihar)
IND842001AAA
14784  IND206001AAA  Etawah_MhraChng_D (Uttar Pradesh)
IND209304AAA
14785  IND382715AAA          Kadi_KaranNGR_D (Gujarat)
IND382715AAA
14786  IND583119AAA      Sandur_WrdN1DPP_D (Karnataka)
```

```
IND583119AAA

                          destination_name               od_start_time
\
0       Doddablpur_ChikaDPP_D (Karnataka)  2018-09-12 02:03:09.655591

1          Mumbai_MiraRd_IP (Maharashtra)  2018-09-12 00:01:00.113710

2        Chennai_Poonamallee (Tamil Nadu)  2018-09-12 02:12:10.755603

3        Chennai_Vandalur_Dc (Tamil Nadu)  2018-09-12 00:04:22.011653

4               HBR Layout PC (Karnataka)  2018-09-12 00:04:28.263977

...                                    ...                          ...

14782               Jamtara_D (Jharkhand)  2018-10-04 04:22:21.025250

14783         Muzaffrpur_Bbganj_I (Bihar)  2018-10-03 23:41:12.495257

14784  Kanpur_Central_H_6 (Uttar Pradesh)  2018-10-05 02:44:50.858859

14785           Kadi_KaranNGR_D (Gujarat)  2018-10-04 01:48:54.382343

14786       Sandur_WrdN1DPP_D (Karnataka)  2018-10-04 03:58:40.726547


                      od_end_time  cutoff_factor  \
0      2018-09-12 02:03:09.655591             72
1      2018-09-12 01:41:29.809822             17
2      2018-09-12 02:12:10.755603             24
3      2018-09-12 01:42:22.349694              9
4      2018-09-12 03:00:55.163423             22
...                            ...            ...
14782  2018-10-04 02:24:41.382263            167
14783  2018-10-04 16:40:41.713085            192
14784  2018-10-04 19:57:34.928573            835
14785  2018-10-04 01:48:54.382343             84
14786  2018-10-04 03:58:40.726547             65

       actual_distance_to_destination  osrm_distance
start_scan_to_end_scan  \
0                           73.186911        85.1110
180.0
1                           17.175274        19.6800
100.0
2                           24.597048        28.0647
189.0
3                            9.100510        12.0184
98.0
4                           22.424210        28.9203
```

```
146.0
...                                ...             ...
...
14782                       168.396341       207.4975
428.0
14783                       194.552260       229.2052
1017.0
14784                       836.072017       997.7577
2180.0
14785                        84.743813       102.3828
256.0
14786                        66.081533        80.5787
353.0

       segment_actual_time  segment_osrm_time  actual_time  osrm_time
\
0                    141.0               65.0        143.0       68.0

1                     59.0               16.0         59.0       15.0

2                     60.0               23.0         61.0       23.0

3                     24.0               13.0         24.0       13.0

4                     64.0               34.0         64.0       34.0

...                    ...                ...          ...        ...

14782                347.0              220.0        349.0      220.0

14783                845.0              178.0        847.0      178.0

14784               1660.0              891.0       1674.0      724.0

14785                186.0               92.0        187.0       92.0

14786                274.0               67.0        275.0       68.0


       segment_osrm_distance
0                    84.1894
1                    19.8766
2                    28.0647
3                    12.0184
4                    28.9203
...                      ...
14782               209.4499
14783               232.5811
14784              1166.3614
14785               107.6915
```

```
14786                  80.5787

[14787 rows x 18 columns]
```

```
data.nunique() # Unique values in the dataset
```

```
route_type                          2
trip_uuid                       14787
trip_creation_time              14787
source_center                     930
source_name                       930
destination_center               1035
destination_name                 1035
od_start_time                   14787
od_end_time                     14787
cutoff_factor                     684
actual_distance_to_destination  14771
osrm_distance                   14706
start_scan_to_end_scan           2203
segment_actual_time              1887
segment_osrm_time                1242
actual_time                      1850
osrm_time                         827
segment_osrm_distance           14724
dtype: int64
```

```
data.isna().sum() #nullvalues in the data frame
```

```
route_type                      0
trip_uuid                       0
trip_creation_time              0
source_center                   0
source_name                     0
destination_center              0
destination_name                0
od_start_time                   0
od_end_time                     0
cutoff_factor                   0
actual_distance_to_destination  0
osrm_distance                   0
start_scan_to_end_scan          0
segment_actual_time             0
segment_osrm_time               0
actual_time                     0
osrm_time                       0
segment_osrm_distance           0
dtype: int64
```

```
data.describe() #statistical summary of dataset
```

```
       cutoff_factor  actual_distance_to_destination  osrm_distance  \
count   14787.000000                    14787.000000   14787.000000
mean      163.379523                      164.290730     204.631953
std       305.558531                      305.678137     370.953239
min         9.000000                        9.002461       9.072900
25%        22.000000                       22.840056      30.875600
50%        48.000000                       48.376934      65.575600
75%       162.000000                      163.685113     207.087600
max      2185.000000                     2187.483994    2840.081000

       start_scan_to_end_scan  segment_actual_time  segment_osrm_time
\
count            14787.000000         14787.000000       14787.000000

mean               529.442754           353.118618         180.482924

std                658.286556           556.439155         314.622727

min                 23.000000             9.000000           6.000000

25%                149.000000            66.000000          30.000000

50%                279.000000           147.000000          65.000000

75%                632.000000           364.000000         184.000000

max               7898.000000          6230.000000        2564.000000


        actual_time     osrm_time  segment_osrm_distance
count  14787.000000  14787.000000            14787.00000
mean     356.316224    161.667072              222.66823
std      561.528033    272.406218              416.76499
min        9.000000      6.000000                9.07290
25%       67.000000     29.000000               32.57885
50%      148.000000     60.000000               69.78420
75%      367.000000    168.000000              216.46395
max     6265.000000   2032.000000             3523.63240

data.describe(include=object)

       route_type                trip_uuid          trip_creation_time
\
count       14787                    14787                       14787

unique          2                    14787                       14787

top       Carting  trip-153671042288605164  2018-09-12 00:00:22.886430

freq         8906                        1                           1
```

```
       source_center                    source_name destination_center
\
count          14787                          14787              14787

unique           930                            930               1035

top     IND000000ACB  Gurgaon_Bilaspur_HB (Haryana)       IND000000ACB

freq            1052                           1052                821


                      destination_name               od_start_time  \
count                            14787                       14787
unique                            1035                       14787
top     Gurgaon_Bilaspur_HB (Haryana)  2018-09-12 02:03:09.655591
freq                               821                           1

                        od_end_time
count                         14787
unique                        14787
top     2018-09-12 02:03:09.655591
freq                              1
```

Feature Generation

```
#Feature generation like source_state and destination_state
data["source_state"]=data["source_name"].apply(lambda x:
str(x).split("(")[1][:-1])
data["destination_state"]=data["destination_name"].apply(lambda x:
str(x).split("(")[1][:-1])
data
```

```
      route_type                trip_uuid          trip_creation_time
\
0        Carting  trip-153671042288605164  2018-09-12 00:00:22.886430

1        Carting  trip-153671046011330457  2018-09-12 00:01:00.113710

2        Carting  trip-153671055416136166  2018-09-12 00:02:34.161600

3        Carting  trip-153671066201138152  2018-09-12 00:04:22.011653

4        Carting  trip-153671066826362165  2018-09-12 00:04:28.263977

...          ...                      ...                         ...

14782        FTL  trip-153861004148234782  2018-10-03 23:40:41.482736
```

```
14783        FTL  trip-153861007249500192  2018-10-03 23:41:12.495257

14784        FTL  trip-153861014185597051  2018-10-03 23:42:21.856227

14785        FTL  trip-153861023893369544  2018-10-03 23:43:58.933947

14786        FTL  trip-153861118270144424  2018-10-03 23:59:42.701692


      source_center                          source_name
destination_center  \
0      IND561203AAB  Doddablpur_ChikaDPP_D (Karnataka)
IND561203AAB
1      IND400072AAB           Mumbai Hub (Maharashtra)
IND401104AAA
2      IND600056AAA   Chennai_Poonamallee (Tamil Nadu)
IND600056AAA
3      IND600044AAD  Chennai_Chrompet_DPC (Tamil Nadu)
IND600048AAA
4      IND560043AAC          HBR Layout PC (Karnataka)
IND560043AAC
...             ...                                ...
...
14782  IND814101AAB        Dumka_Dudhani_D (Jharkhand)
IND815351AAA
14783  IND842001AAA        Muzaffrpur_Bbganj_I (Bihar)
IND842001AAA
14784  IND206001AAA  Etawah_MhraChng_D (Uttar Pradesh)
IND209304AAA
14785  IND382715AAA          Kadi_KaranNGR_D (Gujarat)
IND382715AAA
14786  IND583119AAA      Sandur_WrdN1DPP_D (Karnataka)
IND583119AAA

                         destination_name               od_start_time
\
0       Doddablpur_ChikaDPP_D (Karnataka)  2018-09-12 02:03:09.655591

1          Mumbai_MiraRd_IP (Maharashtra)  2018-09-12 00:01:00.113710

2        Chennai_Poonamallee (Tamil Nadu)  2018-09-12 02:12:10.755603

3        Chennai_Vandalur_Dc (Tamil Nadu)  2018-09-12 00:04:22.011653

4               HBR Layout PC (Karnataka)  2018-09-12 00:04:28.263977

...                                   ...                           ...

14782               Jamtara_D (Jharkhand)  2018-10-04 04:22:21.025250
```

```
14783         Muzaffrpur_Bbganj_I (Bihar)  2018-10-03 23:41:12.495257

14784  Kanpur_Central_H_6 (Uttar Pradesh)  2018-10-05 02:44:50.858859

14785           Kadi_KaranNGR_D (Gujarat)  2018-10-04 01:48:54.382343

14786       Sandur_WrdN1DPP_D (Karnataka)  2018-10-04 03:58:40.726547


                      od_end_time  cutoff_factor  \
0      2018-09-12 02:03:09.655591             72
1      2018-09-12 01:41:29.809822             17
2      2018-09-12 02:12:10.755603             24
3      2018-09-12 01:42:22.349694              9
4      2018-09-12 03:00:55.163423             22
...                            ...            ...
14782  2018-10-04 02:24:41.382263            167
14783  2018-10-04 16:40:41.713085            192
14784  2018-10-04 19:57:34.928573            835
14785  2018-10-04 01:48:54.382343             84
14786  2018-10-04 03:58:40.726547             65

       actual_distance_to_destination  osrm_distance
start_scan_to_end_scan  \
0                           73.186911        85.1110
180.0
1                           17.175274        19.6800
100.0
2                           24.597048        28.0647
189.0
3                            9.100510        12.0184
98.0
4                           22.424210        28.9203
146.0
...                               ...            ...
...
14782                      168.396341       207.4975
428.0
14783                      194.552260       229.2052
1017.0
14784                      836.072017       997.7577
2180.0
14785                       84.743813       102.3828
256.0
14786                       66.081533        80.5787
353.0

       segment_actual_time  segment_osrm_time  actual_time  osrm_time
\
0                    141.0               65.0        143.0       68.0
```

```
1                      59.0                16.0         59.0        15.0
2                      60.0                23.0         61.0        23.0
3                      24.0                13.0         24.0        13.0
4                      64.0                34.0         64.0        34.0
...                     ...                 ...          ...         ...
14782                 347.0               220.0        349.0       220.0
14783                 845.0               178.0        847.0       178.0
14784                1660.0               891.0       1674.0       724.0
14785                 186.0                92.0        187.0        92.0
14786                 274.0                67.0        275.0        68.0
```

```
       segment_osrm_distance   source_state destination_state
0                    84.1894      Karnataka         Karnataka
1                    19.8766    Maharashtra       Maharashtra
2                    28.0647     Tamil Nadu        Tamil Nadu
3                    12.0184     Tamil Nadu        Tamil Nadu
4                    28.9203      Karnataka         Karnataka
...                      ...            ...               ...
14782               209.4499      Jharkhand         Jharkhand
14783               232.5811          Bihar             Bihar
14784              1166.3614  Uttar Pradesh     Uttar Pradesh
14785               107.6915        Gujarat           Gujarat
14786                80.5787      Karnataka         Karnataka

[14787 rows x 20 columns]
```

```
data.describe(include=object)
```

```
       route_type                 trip_uuid          trip_creation_time
\
count       14787                     14787                       14787
unique          2                     14787                       14787
top       Carting  trip-153671042288605164  2018-09-12 00:00:22.886430
freq         8906                         1                           1

       source_center                    source_name destination_center
```

```
\
count          14787                          14787                14787

unique           930                            930                 1035

top     IND000000ACB  Gurgaon_Bilaspur_HB (Haryana)       IND000000ACB

freq            1052                           1052                 821


                     destination_name               od_start_time  \
count                           14787                       14787
unique                           1035                       14787
top     Gurgaon_Bilaspur_HB (Haryana)  2018-09-12 02:03:09.655591
freq                              821                           1

                       od_end_time source_state destination_state
count                        14787        14787             14787
unique                       14787           29                31
top     2018-09-12 02:03:09.655591  Maharashtra       Maharashtra
freq                             1         2714              2561
```

```
data.nunique() #unique value in dataframe
```

```
route_type                         2
trip_uuid                      14787
trip_creation_time             14787
source_center                    930
source_name                      930
destination_center              1035
destination_name                1035
od_start_time                  14787
od_end_time                    14787
cutoff_factor                    684
actual_distance_to_destination   14771
osrm_distance                  14706
start_scan_to_end_scan          2203
segment_actual_time             1887
segment_osrm_time               1242
actual_time                     1850
osrm_time                        827
segment_osrm_distance          14724
source_state                      29
destination_state                 31
dtype: int64
```

```
data["source_state"].value_counts() #source-statewise trip count
```

```
Maharashtra               2714
Karnataka                 2143
Haryana                   1823
```

```
Tamil Nadu                1039
Telangana                  784
Uttar Pradesh              760
Gujarat                    750
Delhi                      725
West Bengal                665
Punjab                     536
Rajasthan                  514
Andhra Pradesh             435
Bihar                      351
Madhya Pradesh             318
Kerala                     289
Assam                      268
Jharkhand                  160
Uttarakhand                114
Orissa                     107
Chandigarh                  93
Goa                         65
Chhattisgarh                43
Himachal Pradesh            34
Jammu & Kashmir             17
Dadra and Nagar Haveli      15
Pondicherry                 12
Nagaland                     5
Arunachal Pradesh            4
Mizoram                      4
Name: source_state, dtype: int64
```

```
data["destination_state"].value_counts() #destination-statewise trip count
```

```
Maharashtra               2561
Karnataka                 2294
Haryana                   1640
Tamil Nadu                1084
Uttar Pradesh              805
Telangana                  784
Gujarat                    734
West Bengal                697
Delhi                      657
Punjab                     617
Rajasthan                  550
Andhra Pradesh             442
Bihar                      367
Madhya Pradesh             350
Kerala                     270
Assam                      232
Jharkhand                  181
Uttarakhand                122
Orissa                     119
```

```
Chandigarh                    65
Goa                           52
Chhattisgarh                  43
Himachal Pradesh              42
Arunachal Pradesh             25
Jammu & Kashmir               20
Dadra and Nagar Haveli        17
Meghalaya                      8
Mizoram                        6
Nagaland                       1
Daman & Diu                    1
Tripura                        1
Name: destination_state, dtype: int64
```

```
data["source_name"].value_counts().head()
```

```
Gurgaon_Bilaspur_HB (Haryana)        1052
Bhiwandi_Mankoli_HB (Maharashtra)     697
Bangalore_Nelmngla_H (Karnataka)      624
Bengaluru_Bomsndra_HB (Karnataka)     455
Pune_Tathawde_H (Maharashtra)         396
Name: source_name, dtype: int64
```

```
data["source_name"].value_counts().tail()
```

```
Chikodi_IndraNgr_D (Karnataka)          1
Atmakur_IndraNgr_D (Andhra Pradesh)     1
Jetpur_DC (Gujarat)                     1
Bantwal_Trmltmpl_D (Karnataka)          1
Sandur_WrdN1DPP_D (Karnataka)           1
Name: source_name, dtype: int64
```

```
data["destination_name"].value_counts().head()
```

```
Gurgaon_Bilaspur_HB (Haryana)        821
Bangalore_Nelmngla_H (Karnataka)     548
Bhiwandi_Mankoli_HB (Maharashtra)    403
Bengaluru_Bomsndra_HB (Karnataka)    342
Hyderabad_Shamshbd_H (Telangana)     280
Name: destination_name, dtype: int64
```

```
data["source-destination"]=data["source_name"] +
data["destination_name"]
```

```
data["source-destination"].value_counts() #Busiest Corridors
```

```
Bangalore_Nelmngla_H (Karnataka)Bengaluru_KGAirprt_HB (Karnataka)
151
Gurgaon_Bilaspur_HB (Haryana)Gurgaon_Bilaspur_HB (Haryana)
123
Bengaluru_Bomsndra_HB (Karnataka)Bengaluru_KGAirprt_HB (Karnataka)
```

```
121
Bengaluru_KGAirprt_HB (Karnataka)Bangalore_Nelmngla_H (Karnataka)
108
Bhiwandi_Mankoli_HB (Maharashtra)Mumbai Hub (Maharashtra)
105

...
Khammam_NSTRoad_I (Telangana)Nalgonda_HydRoad_DC (Telangana)
1
Kolkata_Dankuni_HB (West Bengal)Tarkeshwar_Naraynpr_D (West Bengal)
1
Bamangola_Central_D_1 (West Bengal)Malda_krshnPly_DC (West Bengal)
1
Nalbari_Bhgtpura_D (Assam)Dhubri_Tetultol_D (Assam)
1
Sandur_WrdN1DPP_D (Karnataka)Sandur_WrdN1DPP_D (Karnataka)
1
Name: source-destination, Length: 2165, dtype: int64
```

```
#Average distance
data[data["source-destination"]=="Bangalore_Nelmngla_H
(Karnataka)Bengaluru_KGAirprt_HB (Karnataka)"]
["actual_distance_to_destination"].mean()
```

```
28.03163476896394
```

```
#Average time
data[data["source-destination"]=="Bangalore_Nelmngla_H
(Karnataka)Bengaluru_KGAirprt_HB (Karnataka)"]["actual_time"].mean()
```

```
87.87417218543047
```

```
data.drop("source-destination",axis=1,inplace=True)
```

```
data["trip_creation_time"]=pd.to_datetime(df["trip_creation_time"]) #
conversion to datetime datatype
```

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14787 entries, 0 to 14786
Data columns (total 20 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   route_type                      14787 non-null  object
 1   trip_uuid                       14787 non-null  object
 2   trip_creation_time              14783 non-null  datetime64[ns]
 3   source_center                   14787 non-null  object
 4   source_name                     14787 non-null  object
 5   destination_center              14787 non-null  object
 6   destination_name                14787 non-null  object
```

```
 7   od_start_time                    14787 non-null  object
 8   od_end_time                      14787 non-null  object
 9   cutoff_factor                    14787 non-null  int64
 10  actual_distance_to_destination   14787 non-null  float64
 11  osrm_distance                    14787 non-null  float64
 12  start_scan_to_end_scan           14787 non-null  float64
 13  segment_actual_time              14787 non-null  float64
 14  segment_osrm_time                14787 non-null  float64
 15  actual_time                      14787 non-null  float64
 16  osrm_time                        14787 non-null  float64
 17  segment_osrm_distance            14787 non-null  float64
 18  source_state                     14787 non-null  object
 19  destination_state                14787 non-null  object
dtypes: datetime64[ns](1), float64(8), int64(1), object(10)
memory usage: 2.3+ MB
```

```
#Feature generation year
data["trip_creation_year"]=data["trip_creation_time"].dt.year
data["trip_creation_year"].value_counts()
```

```
2018.0    14783
Name: trip_creation_year, dtype: int64
```

```
#Feature generation month
data["trip_creation_month"]=data["trip_creation_time"].dt.month
data["trip_creation_month"].value_counts()
```

```
9.0     13092
10.0     1691
Name: trip_creation_month, dtype: int64
```

```
#Feature generation day
data["trip_creation_day"]=data["trip_creation_time"].dt.day
data["trip_creation_day"].value_counts()
```

```
25.0    1024
17.0    1000
20.0     854
23.0     820
15.0     809
12.0     779
14.0     762
28.0     731
3.0      695
24.0     674
16.0     657
21.0     657
26.0     642
18.0     580
19.0     571
30.0     552
```

```
22.0     544
1.0      539
13.0     516
29.0     463
27.0     457
2.0      457
Name: trip_creation_day, dtype: int64
```

```
#Feature generation triptime
data["od_start_time"]=pd.to_datetime(data["od_start_time"])
data["od_end_time"]=pd.to_datetime(data["od_end_time"])
data["trip_time"]=data["od_end_time"]-data["od_start_time"]
data
```

```
      route_type                trip_uuid
trip_creation_time  \
0        Carting  trip-153671042288605164 2018-09-20 02:35:36.476840

1        Carting  trip-153671046011330457 2018-09-20 02:35:36.476840

2        Carting  trip-153671055416136166 2018-09-20 02:35:36.476840

3        Carting  trip-153671066201138152 2018-09-20 02:35:36.476840

4        Carting  trip-153671066826362165 2018-09-20 02:35:36.476840

...          ...                       ...                         ...

14782        FTL  trip-153861004148234782 2018-09-24 05:06:56.558662

14783        FTL  trip-153861007249500192 2018-09-24 05:06:56.558662

14784        FTL  trip-153861014185597051 2018-09-24 05:06:56.558662

14785        FTL  trip-153861023893369544 2018-09-24 05:06:56.558662

14786        FTL  trip-153861118270144424 2018-09-24 05:06:56.558662


      source_center                          source_name
destination_center  \
0      IND561203AAB  Doddablpur_ChikaDPP_D (Karnataka)
IND561203AAB
1      IND400072AAB           Mumbai Hub (Maharashtra)
IND401104AAA
2      IND600056AAA   Chennai_Poonamallee (Tamil Nadu)
IND600056AAA
3      IND600044AAD  Chennai_Chrompet_DPC (Tamil Nadu)
IND600048AAA
4      IND560043AAC          HBR Layout PC (Karnataka)
IND560043AAC
```

```
...             ...                                  ...
...
14782  IND814101AAB        Dumka_Dudhani_D (Jharkhand)
IND815351AAA
14783  IND842001AAA        Muzaffrpur_Bbganj_I (Bihar)
IND842001AAA
14784  IND206001AAA  Etawah_MhraChng_D (Uttar Pradesh)
IND209304AAA
14785  IND382715AAA          Kadi_KaranNGR_D (Gujarat)
IND382715AAA
14786  IND583119AAA      Sandur_WrdN1DPP_D (Karnataka)
IND583119AAA

                          destination_name
od_start_time  \
0       Doddablpur_ChikaDPP_D (Karnataka) 2018-09-12 02:03:09.655591

1          Mumbai_MiraRd_IP (Maharashtra) 2018-09-12 00:01:00.113710

2        Chennai_Poonamallee (Tamil Nadu) 2018-09-12 02:12:10.755603

3        Chennai_Vandalur_Dc (Tamil Nadu) 2018-09-12 00:04:22.011653

4               HBR Layout PC (Karnataka) 2018-09-12 00:04:28.263977

...                                    ...                          ...

14782               Jamtara_D (Jharkhand) 2018-10-04 04:22:21.025250

14783         Muzaffrpur_Bbganj_I (Bihar) 2018-10-03 23:41:12.495257

14784  Kanpur_Central_H_6 (Uttar Pradesh) 2018-10-05 02:44:50.858859

14785           Kadi_KaranNGR_D (Gujarat) 2018-10-04 01:48:54.382343

14786       Sandur_WrdN1DPP_D (Karnataka) 2018-10-04 03:58:40.726547


                     od_end_time  cutoff_factor  ...
segment_osrm_time  \
0     2018-09-12 02:03:09.655591             72  ...
65.0
1     2018-09-12 01:41:29.809822             17  ...
16.0
2     2018-09-12 02:12:10.755603             24  ...
23.0
3     2018-09-12 01:42:22.349694              9  ...
13.0
4     2018-09-12 03:00:55.163423             22  ...
34.0
```

```
...                          ...            ...  ...                ..
.
14782 2018-10-04 02:24:41.382263            167  ...
220.0
14783 2018-10-04 16:40:41.713085            192  ...
178.0
14784 2018-10-04 19:57:34.928573            835  ...
891.0
14785 2018-10-04 01:48:54.382343             84  ...
92.0
14786 2018-10-04 03:58:40.726547             65  ...
67.0

       actual_time  osrm_time  segment_osrm_distance   source_state  \
0            143.0       68.0                84.1894      Karnataka
1             59.0       15.0                19.8766    Maharashtra
2             61.0       23.0                28.0647     Tamil Nadu
3             24.0       13.0                12.0184     Tamil Nadu
4             64.0       34.0                28.9203      Karnataka
...            ...        ...                    ...            ...
14782        349.0      220.0               209.4499      Jharkhand
14783        847.0      178.0               232.5811          Bihar
14784       1674.0      724.0              1166.3614  Uttar Pradesh
14785        187.0       92.0               107.6915        Gujarat
14786        275.0       68.0                80.5787      Karnataka

       destination_state  trip_creation_year  trip_creation_month  \
0              Karnataka              2018.0                  9.0
1            Maharashtra              2018.0                  9.0
2             Tamil Nadu              2018.0                  9.0
3             Tamil Nadu              2018.0                  9.0
4              Karnataka              2018.0                  9.0
...                  ...                 ...                  ...
14782          Jharkhand              2018.0                  9.0
14783              Bihar              2018.0                  9.0
14784      Uttar Pradesh              2018.0                  9.0
14785            Gujarat              2018.0                  9.0
14786          Karnataka              2018.0                  9.0

      trip_creation_day                trip_time
0                  20.0          0 days 00:00:00
1                  20.0   0 days 01:40:29.696112
2                  20.0          0 days 00:00:00
3                  20.0   0 days 01:38:00.338041
4                  20.0   0 days 02:56:26.899446
...                 ...                      ...
14782              24.0 -1 days +22:02:20.357013
14783              24.0   0 days 16:59:29.217828
14784              24.0 -1 days +17:12:44.069714
14785              24.0          0 days 00:00:00
```

```
14786               24.0          0 days 00:00:00

[14787 rows x 24 columns]
```

```
data.isnull().sum()
```

```
route_type                          0
trip_uuid                           0
trip_creation_time                  4
source_center                       0
source_name                         0
destination_center                  0
destination_name                    0
od_start_time                       0
od_end_time                         0
cutoff_factor                       0
actual_distance_to_destination      0
osrm_distance                       0
start_scan_to_end_scan              0
segment_actual_time                 0
segment_osrm_time                   0
actual_time                         0
osrm_time                           0
segment_osrm_distance               0
source_state                        0
destination_state                   0
trip_creation_year                  4
trip_creation_month                 4
trip_creation_day                   4
trip_time                           0
dtype: int64
```

```
data.dropna(inplace=True)
```

```
data.isnull().sum()
```

```
route_type                          0
trip_uuid                           0
trip_creation_time                  0
source_center                       0
source_name                         0
destination_center                  0
destination_name                    0
od_start_time                       0
od_end_time                         0
cutoff_factor                       0
actual_distance_to_destination      0
osrm_distance                       0
start_scan_to_end_scan              0
segment_actual_time                 0
```

```
segment_osrm_time                0
actual_time                      0
osrm_time                        0
segment_osrm_distance            0
source_state                     0
destination_state                0
trip_creation_year               0
trip_creation_month              0
trip_creation_day                0
trip_time                        0
dtype: int64
```

```
data.shape
```

```
(14783, 24)
```

```
#conversion of triptime to float type data
data["triptime_sec"]=data["trip_time"].dt.total_seconds()
```

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 14783 entries, 0 to 14786
Data columns (total 25 columns):
 #   Column                           Non-Null Count  Dtype
---  ------                           --------------  -----
 0   route_type                       14783 non-null  object
 1   trip_uuid                        14783 non-null  object
 2   trip_creation_time               14783 non-null  datetime64[ns]
 3   source_center                    14783 non-null  object
 4   source_name                      14783 non-null  object
 5   destination_center               14783 non-null  object
 6   destination_name                 14783 non-null  object
 7   od_start_time                    14783 non-null  datetime64[ns]
 8   od_end_time                      14783 non-null  datetime64[ns]
 9   cutoff_factor                    14783 non-null  int64
 10  actual_distance_to_destination   14783 non-null  float64
 11  osrm_distance                    14783 non-null  float64
 12  start_scan_to_end_scan           14783 non-null  float64
 13  segment_actual_time              14783 non-null  float64
 14  segment_osrm_time                14783 non-null  float64
 15  actual_time                      14783 non-null  float64
 16  osrm_time                        14783 non-null  float64
 17  segment_osrm_distance            14783 non-null  float64
 18  source_state                     14783 non-null  object
 19  destination_state                14783 non-null  object
 20  trip_creation_year               14783 non-null  float64
 21  trip_creation_month              14783 non-null  float64
 22  trip_creation_day                14783 non-null  float64
 23  trip_time                        14783 non-null  timedelta64[ns]
```

```
 24  triptime_sec                   14783 non-null  float64
dtypes: datetime64[ns](3), float64(12), int64(1), object(8),
timedelta64[ns](1)
memory usage: 2.9+ MB
```

```
data[data["triptime_sec"]<0]
```

```
      route_type                trip_uuid
trip_creation_time  \
5        Carting  trip-153671074033284934 2018-09-20 02:35:36.476840

14       Carting  trip-153671202698783427 2018-09-23 06:42:06.021680

16       Carting  trip-153671225291120891 2018-09-14 15:42:46.437249

31       Carting  trip-153671440490445199 2018-09-13 20:44:19.424489

35       Carting  trip-153671508851597828 2018-09-29 22:21:45.149226

...          ...                       ...                        ...

14768        FTL  trip-153860767482259863 2018-09-24 05:06:56.558662

14779        FTL  trip-153860945742225615 2018-09-24 05:06:56.558662

14781        FTL  trip-153860985527721606 2018-09-24 05:06:56.558662

14782        FTL  trip-153861004148234782 2018-09-24 05:06:56.558662

14784        FTL  trip-153861014185597051 2018-09-24 05:06:56.558662


      source_center                          source_name
destination_center  \
5      IND395009AAA       Surat_Central_D_12 (Gujarat)
IND395004AAB
14     IND395001AAA        Surat_Central_D_9 (Gujarat)
IND395006AAA
16     IND712103AAA      Hoogly_Bandel_D (West Bengal)
IND712124AAA
31     IND140501AAA          Lalru_OnkarDPP_D (Punjab)
IND134203AAA
35     IND360530AAB       Jamjodhpur_Court_D (Gujarat)
IND360575AAA
...             ...                                ...
...
14768  IND505122AAA  Jammikunta_ConduDPP_D (Telangana)
IND505467AAA
14779  IND140001AAA     RoopNagar_ChotiHvl_DC (Punjab)
IND140301AAA
14781  IND814133AAB      Godda_Central_D_2 (Jharkhand)
```

```
IND815301AAA
14782  IND814101AAB        Dumka_Dudhani_D (Jharkhand)
IND815351AAA
14784  IND206001AAA  Etawah_MhraChng_D (Uttar Pradesh)
IND209304AAA

                          destination_name
od_start_time  \
5              Surat_Central_D_3 (Gujarat) 2018-09-12 02:31:39.246238

14             Surat_Varachha_DC (Gujarat) 2018-09-12 02:37:19.832796

16                Hooghly_DC (West Bengal) 2018-09-12 03:09:08.473151

31         Naraingarh_Ward2DPP_D (Haryana) 2018-09-12 07:36:00.152620

35                  Porbandar_DC (Gujarat) 2018-09-12 06:04:58.698852

...                                     ...                          ...

14768     Husnabad_Greenmkt_D (Telangana) 2018-10-04 03:51:10.928009

14779   Chandigarh_Kharar_DC (Chandigarh) 2018-10-04 03:46:12.300247

14781      Giridih_Shivalya_D (Jharkhand) 2018-10-04 08:29:20.440999

14782               Jamtara_D (Jharkhand) 2018-10-04 04:22:21.025250

14784  Kanpur_Central_H_6 (Uttar Pradesh) 2018-10-05 02:44:50.858859


                       od_end_time  cutoff_factor  ...  actual_time
osrm_time  \
5     2018-09-12 02:01:41.638015             25  ...        161.0
29.0
14    2018-09-12 02:04:22.360575             19  ...        170.0
29.0
16    2018-09-12 02:16:17.710493             51  ...        222.0
58.0
31    2018-09-12 03:55:15.023521             47  ...        147.0
64.0
35    2018-09-12 03:43:56.169739            178  ...        553.0
192.0
...                          ...            ...  ...          ...
...
14768 2018-10-04 02:25:04.243970            104  ...        380.0
119.0
14779 2018-10-04 02:52:02.434753            183  ...        281.0
207.0
14781 2018-10-04 03:01:57.954149            226  ...        511.0
```

```
248.0
14782 2018-10-04 02:24:41.382263            167  ...        349.0
220.0
14784 2018-10-04 19:57:34.928573            835  ...       1674.0
724.0

       segment_osrm_distance   source_state  destination_state  \
5                    30.9358        Gujarat            Gujarat
14                   30.5457        Gujarat            Gujarat
16                   71.3328    West Bengal        West Bengal
31                  103.6903         Punjab            Haryana
35                  245.2043        Gujarat            Gujarat
...                      ...            ...                ...
14768               140.2444      Telangana          Telangana
14779               216.3882         Punjab          Chandigarh
14781               378.6774      Jharkhand           Jharkhand
14782               209.4499      Jharkhand           Jharkhand
14784              1166.3614  Uttar Pradesh       Uttar Pradesh

       trip_creation_year  trip_creation_month  trip_creation_day  \
5                  2018.0                  9.0               20.0
14                 2018.0                  9.0               23.0
16                 2018.0                  9.0               14.0
31                 2018.0                  9.0               13.0
35                 2018.0                  9.0               29.0
...                   ...                  ...                ...
14768              2018.0                  9.0               24.0
14779              2018.0                  9.0               24.0
14781              2018.0                  9.0               24.0
14782              2018.0                  9.0               24.0
14784              2018.0                  9.0               24.0

                     trip_time  triptime_sec
5     -1 days +23:30:02.391777  -1797.608223
14    -1 days +23:27:02.527779  -1977.472221
16    -1 days +23:07:09.237342  -3170.762658
31    -1 days +20:19:14.870901 -13245.129099
35    -1 days +21:38:57.470887  -8462.529113
...                        ...           ...
14768 -1 days +22:33:53.315961  -5166.684039
14779 -1 days +23:05:50.134506  -3249.865494
14781 -1 days +18:32:37.513150 -19642.486850
14782 -1 days +22:02:20.357013  -7059.642987
14784 -1 days +17:12:44.069714 -24435.930286

[891 rows x 25 columns]
```

```
#Here Triptime can not be negative values as travelling time should
always be positive, so we will drop that rows as its false values
data.drop(data[data["triptime_sec"]<0].index,inplace=True)
```

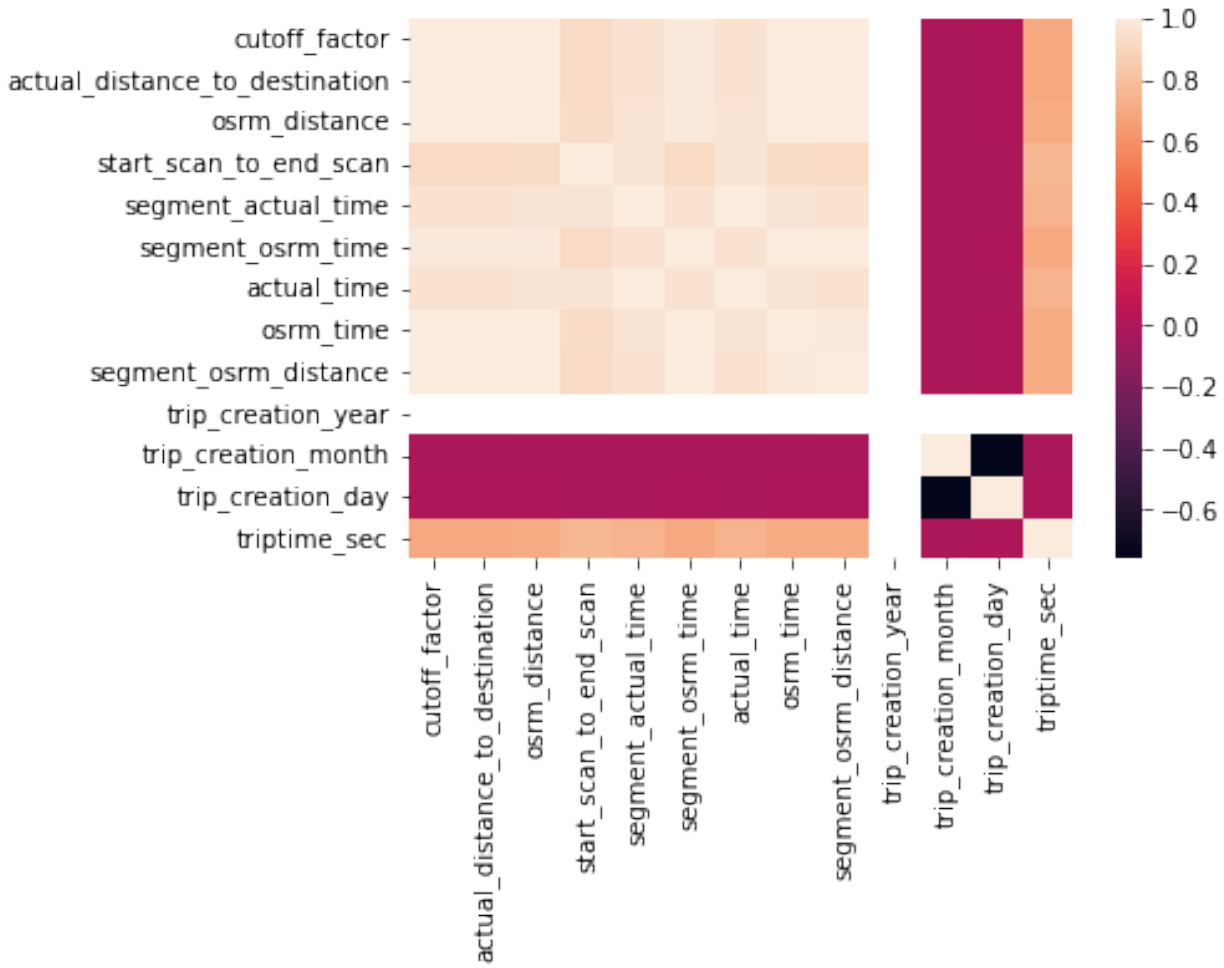
```
data.describe()
```

```
       cutoff_factor  actual_distance_to_destination  osrm_distance  \
count   13892.000000                    13892.000000   13892.000000
mean      159.986251                      160.852618     200.437664
std       307.520122                      307.627703     373.619022
min         9.000000                        9.002461       9.072900
25%        21.000000                       22.037144      29.802900
50%        46.000000                       46.163919      61.108100
75%       148.000000                      149.281573     193.689125
max      2185.000000                     2187.483994    2840.081000

       start_scan_to_end_scan  segment_actual_time  segment_osrm_time
\
count            13892.000000         13892.000000       13892.000000

mean               515.603657           346.118557         176.627627

std                660.357703           561.918712         316.580388

min                 23.000000             9.000000           6.000000

25%                144.000000            64.000000          30.000000

50%                264.000000           136.000000          62.000000

75%                595.000000           349.000000         176.000000

max               7898.000000          6230.000000        2564.000000


        actual_time     osrm_time  segment_osrm_distance
trip_creation_year  \
count  13892.000000  13892.000000           13892.000000
13892.0
mean     349.267492    157.980564             218.437771
2018.0
std      567.051777    274.050917             419.933226
0.0
min        9.000000      6.000000               9.072900
2018.0
25%       65.000000     29.000000              31.349950
2018.0
50%      138.000000     57.500000              65.614850
2018.0
75%      353.000000    163.250000             204.588700
2018.0
max     6265.000000   2032.000000            3523.632400
2018.0

       trip_creation_month  trip_creation_day
```

```
trip_time  \
count         13892.000000       13892.000000
13892
mean              9.114310          18.547653  0 days
06:45:04.119232843
std               0.318199           7.753191  0 days
09:33:47.061593031
min               9.000000           1.000000            0 days
00:00:00
25%               9.000000          14.000000  0 days
01:51:56.299656750
50%               9.000000          20.000000     0 days
03:30:54.417636
75%               9.000000          25.000000  0 days
07:04:21.465968500
max              10.000000          30.000000     5 days
11:38:33.117274

        triptime_sec
count   13892.000000
mean    24304.119233
std     34427.061593
min         0.000000
25%      6716.299657
50%     12654.417636
75%     25461.465969
max    473913.117274
```

```
#Heatmap of dataframe
sns.heatmap(data.corr())
```

```
C:\Users\Pipaliya\AppData\Local\Temp\ipykernel_8836\1199273054.py:2:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  sns.heatmap(data.corr())

<AxesSubplot: >
```




```
data.corr()
```

```
C:\Users\Pipaliya\AppData\Local\Temp\ipykernel_8836\2627137660.py:1:
FutureWarning: The default value of numeric_only in DataFrame.corr is
deprecated. In a future version, it will default to False. Select only
valid columns or specify the value of numeric_only to silence this
warning.
  data.corr()
```

```
                                cutoff_factor
actual_distance_to_destination  \
cutoff_factor                       1.000000
0.999997
actual_distance_to_destination      0.999997
1.000000
osrm_distance                       0.997444
0.997471
start_scan_to_end_scan              0.921081
0.921345
segment_actual_time                 0.954552
```

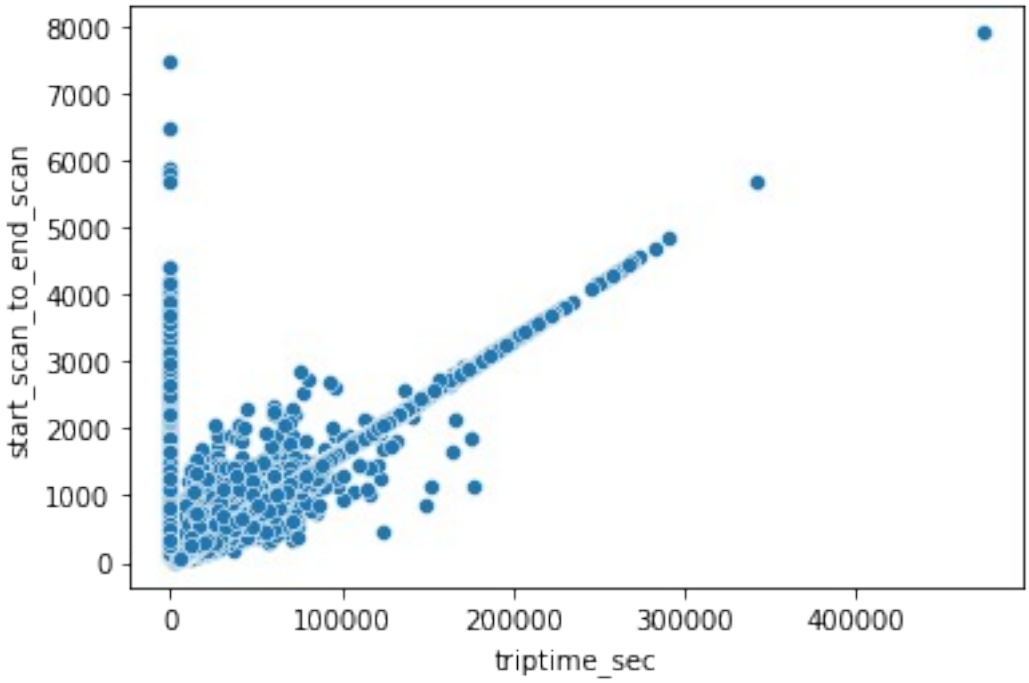
```
0.954682
segment_osrm_time                     0.988451                                 
0.988498
actual_time                           0.955434                                 
0.955563
osrm_time                             0.994283                                 
0.994361
segment_osrm_distance                 0.993405                                 
0.993410
trip_creation_year                         NaN                                 
NaN
trip_creation_month                  -0.019440                                -
0.019482
trip_creation_day                    -0.011132                                -
0.011104
triptime_sec                          0.703598                                 
0.703577

                                  osrm_distance  start_scan_to_end_scan
\
cutoff_factor                          0.997444                0.921081

actual_distance_to_destination         0.997471                0.921345

osrm_distance                          1.000000                0.927050

start_scan_to_end_scan                 0.927050                1.000000

segment_actual_time                    0.959676                0.963516

segment_osrm_time                      0.992424                0.921375

actual_time                            0.960492                0.963525

osrm_time                              0.997933                0.929408

segment_osrm_distance                  0.995036                0.922120

trip_creation_year                          NaN                     NaN

trip_creation_month                   -0.018993               -0.019450

trip_creation_day                     -0.011031               -0.014236

triptime_sec                           0.704835                0.765778


                                  segment_actual_time  segment_osrm_time
\
cutoff_factor                                0.954552           0.988451
```

```
actual_distance_to_destination              0.954682              0.988498
osrm_distance                               0.959676              0.992424
start_scan_to_end_scan                      0.963516              0.921375
segment_actual_time                         1.000000              0.954571
segment_osrm_time                           0.954571              1.000000
actual_time                                 0.999978              0.955367
osrm_time                                   0.959483              0.993647
segment_osrm_distance                       0.957497              0.996487
trip_creation_year                               NaN                   NaN
trip_creation_month                        -0.017506             -0.019008
trip_creation_day                          -0.013692             -0.010119
triptime_sec                                0.745170              0.701954


                                  actual_time  osrm_time
segment_osrm_distance  \
cutoff_factor                        0.955434   0.994283
0.993405
actual_distance_to_destination       0.955563   0.994361
0.993410
osrm_distance                        0.960492   0.997933
0.995036
start_scan_to_end_scan               0.963525   0.929408
0.922120
segment_actual_time                  0.999978   0.959483
0.957497
segment_osrm_time                    0.955367   0.993647
0.996487
actual_time                          1.000000   0.960269
0.958320
osrm_time                            0.960269   1.000000
0.992408
segment_osrm_distance                0.958320   0.992408
1.000000
trip_creation_year                        NaN        NaN
NaN
trip_creation_month                 -0.017533  -0.020042                -
0.019023
trip_creation_day                   -0.013676  -0.010269                -
```

```
0.010496
triptime_sec                          0.745080   0.704238
0.707998

                                   trip_creation_year
trip_creation_month  \
cutoff_factor                                     NaN             -
0.019440
actual_distance_to_destination                    NaN             -
0.019482
osrm_distance                                     NaN             -
0.018993
start_scan_to_end_scan                            NaN             -
0.019450
segment_actual_time                               NaN             -
0.017506
segment_osrm_time                                 NaN             -
0.019008
actual_time                                       NaN             -
0.017533
osrm_time                                         NaN             -
0.020042
segment_osrm_distance                             NaN             -
0.019023
trip_creation_year                                NaN
NaN
trip_creation_month                               NaN
1.000000
trip_creation_day                                 NaN             -
0.762671
triptime_sec                                      NaN             -
0.015866

                                   trip_creation_day  triptime_sec
cutoff_factor                              -0.011132      0.703598
actual_distance_to_destination             -0.011104      0.703577
osrm_distance                              -0.011031      0.704835
start_scan_to_end_scan                     -0.014236      0.765778
segment_actual_time                        -0.013692      0.745170
segment_osrm_time                          -0.010119      0.701954
actual_time                                -0.013676      0.745080
osrm_time                                  -0.010269      0.704238
segment_osrm_distance                      -0.010496      0.707998
trip_creation_year                               NaN           NaN
trip_creation_month                        -0.762671     -0.015866
trip_creation_day                           1.000000     -0.009683
triptime_sec                               -0.009683      1.000000
```

```
#Visualization of triptime and start_scan_to_end_scan
sns.scatterplot(x=data["triptime_sec"],
y=data["start_scan_to_end_scan"])
```

```
<AxesSubplot: xlabel='triptime_sec', ylabel='start_scan_to_end_scan'>
```



Hypothesis Testiing

Pearson Test between triptime and start_scan_to_end_scan

H0: Both Variables are not correlated

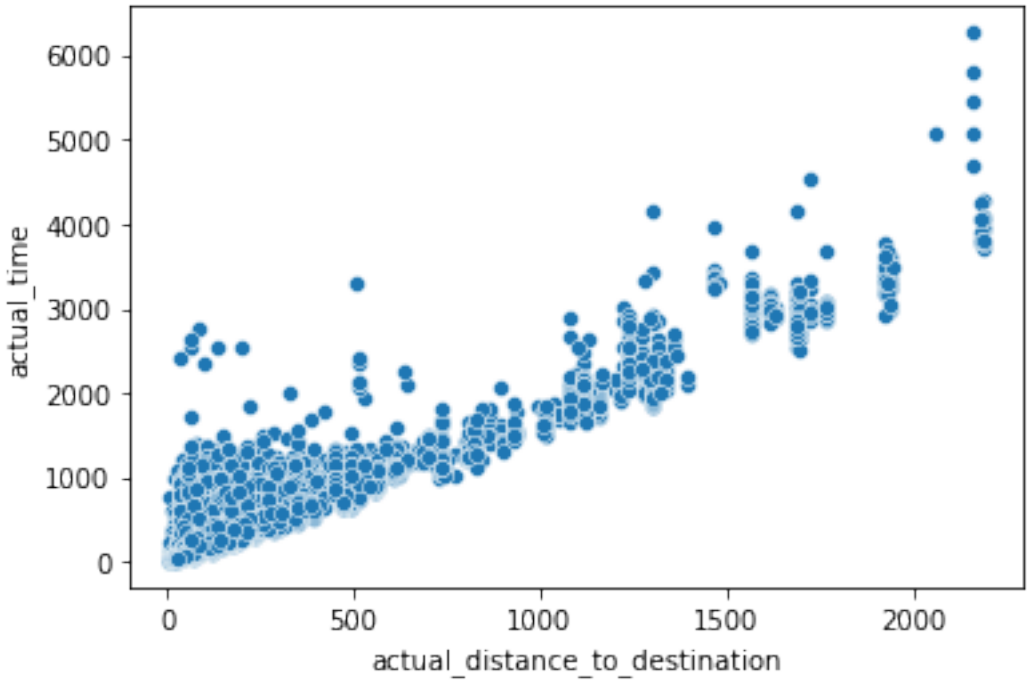
Ha: Both variables are correlated

```
#Let us set siginificance level 0.05, confidence level 95%
alpha=0.05

test_statistics,p_value=pearsonr(data["triptime_sec"],
data["start_scan_to_end_scan"])
print(p_value)
if p_value < alpha:
    print("Reject Null Hypotheis, Both Variables are correlated")
else:
    print("Fail to Reject Null Hypothesis,Both Variables are not
correlated")
```

```
0.0
Reject Null Hypotheis, Both Variables are correlated
```

```
#Visualization between distance and time
sns.scatterplot(x=data["actual_distance_to_destination"],y=data["actua
l_time"])
```

```
<AxesSubplot: xlabel='actual_distance_to_destination',
ylabel='actual_time'>
```



Pearson Test actual_time and actual_distance_to_destination

H0: Both Variables are not correlated

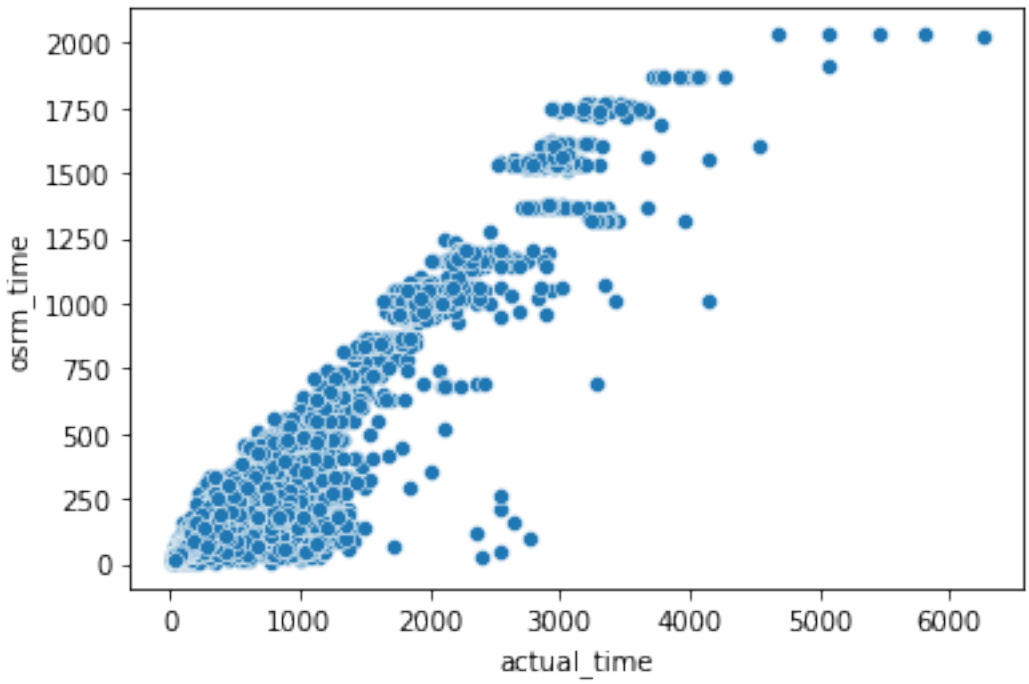
Ha: Both variables are correlated

```
#Let us set siginificance level 0.05, confidence level 95%
alpha=0.05

test_statistics,p_value=pearsonr(data["actual_time"],data["actual_dist
ance_to_destination"])
print(p_value)
if p_value < alpha:
    print("Reject Null Hypotheis, Both Variables are correlated")
else:
    print("Fail to Reject Null Hypothesis,Both Variables are not
correlated")
```

```
0.0
Reject Null Hypotheis, Both Variables are correlated
```

```
#Visualization between distance and time
sns.scatterplot(x=data["actual_time"],y=data["osrm_time"])
```

```
<AxesSubplot: xlabel='actual_time', ylabel='osrm_time'>
```



T-Test for actual_time and osrm_time

H0: Mean of actual_time and osrm_time are same (mu_1 = mu_2)

Ha: Mean of actual_time is higher than osrm_time (mu_1 > mu_2)

```
#Let us set siginificance level 0.05, confidence level 95%
alpha=0.05

test_statistics,p_value=ttest_ind(data["actual_time"],data["osrm_time"
], alternative="greater")
print(p_value)
if p_value < alpha:
    print("Reject Null Hypotheis, Mean of actual_time and osrm_time
are same")
else:
    print("Fail to Reject Null Hypothesis,ean of actual_time is higher
than osrm_time")
```

```
1.0113592493195362e-274
Reject Null Hypotheis, Mean of actual_time and osrm_time are same
```

Pearson Test actual_time and osrm_time

H0: Both Variables are not correlated

Ha: Both variables are correlated

```
#Let us set siginificance level 0.05, confidence level 95%
alpha=0.05

test_statistics,p_value=pearsonr(data["actual_time"],data["osrm_time"]
)
print(p_value)
if p_value < alpha:
    print("Reject Null Hypotheis, Both Variables are correlated")
else:
    print("Fail to Reject Null Hypothesis,Both Variables are not
correlated")
```

```
0.0
Reject Null Hypotheis, Both Variables are correlated
```

T-Test for actual_time and segment_actual_time

H0: Mean of actual_time and segment_actual_time are same (mu_1 = mu_2)

Ha: Mean of actual_time and segment_actual_time are not same (mu_1 != mu_2)

```
#Let us set siginificance level 0.05, confidence level 95%
alpha=0.05

test_statistics,p_value=ttest_ind(data["actual_time"],data["segment_ac
tual_time"])
print(p_value)
if p_value < alpha:
    print("Reject Null Hypotheis, Mean of actual_time and
segment_actual_time are not same")
else:
    print("Fail to Reject Null Hypothesis,Mean of actual_time and
segment_actual_time are same")
```

```
0.6419956696137739
Fail to Reject Null Hypothesis,Mean of actual_time and
segment_actual_time are same
```

T-Test for osrm_time and segment_osrm_time

H0: Mean of osrm_time and segment_osrm_time are same (mu_1 = mu_2)

Ha: Mean of osrm_time and segment_osrm_time are not same (mu_1 != mu_2)

```
#Let us set siginificance level 0.05, confidence level 95%
alpha=0.05

test_statistics,p_value=ttest_ind(data["osrm_time"],data["segment_osrm
_time"])
print(p_value)
if p_value < alpha:
    print("Reject Null Hypotheis, Mean of osrm_time and
segment_osrm_time are not same")
else:
    print("Fail to Reject Null Hypothesis,Mean of osrm_time and
segment_osrm_time are same")
```

```
1.541327181059453e-07
Reject Null Hypotheis, Mean of osrm_time and segment_osrm_time are not
same
```

T-Test for osrm_distance and segment_osrm_distance

H0: Mean of osrm_distance and segment_osrm_distance are same (mu_1 = mu_2)

Ha: Mean of osrm_distance and segment_osrm_distance are not same (mu_1 != mu_2)

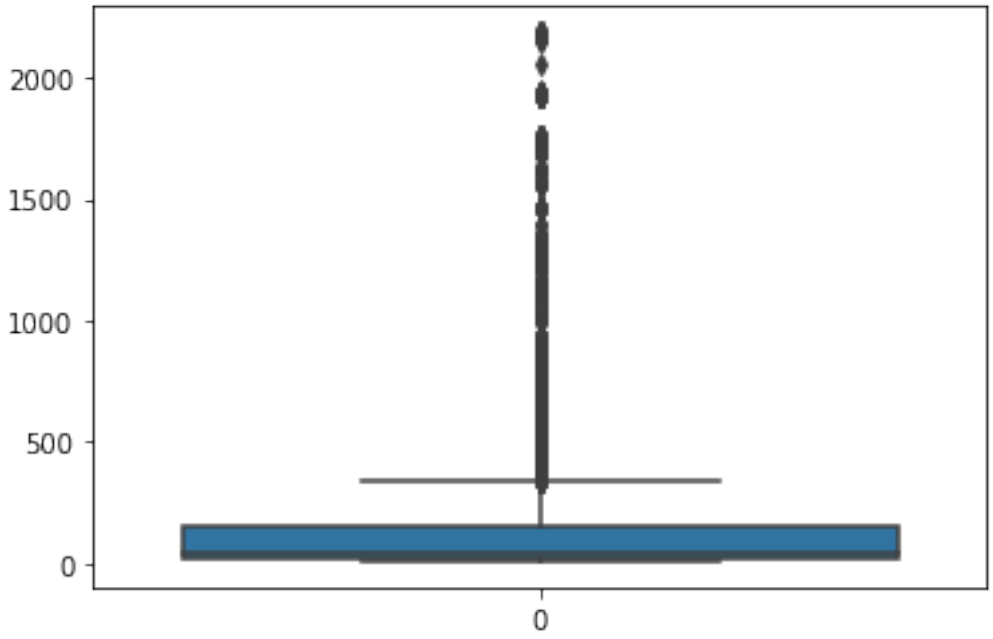
```
#Let us set siginificance level 0.05, confidence level 95%
alpha=0.05

test_statistics,p_value=ttest_ind(data["osrm_distance"],data["segment_
osrm_distance"])
print(p_value)
if p_value < alpha:
    print("Reject Null Hypotheis, Mean of osrm_distance and
segment_osrm_distance are not same")
else:
    print("Fail to Reject Null Hypothesis,Mean of osrm_distance and
segment_osrm_distance are same")
```

```
0.0001606670222265932
Reject Null Hypotheis, Mean of osrm_distance and segment_osrm_distance
are not same
```

Outliers Detection Using IQR Method

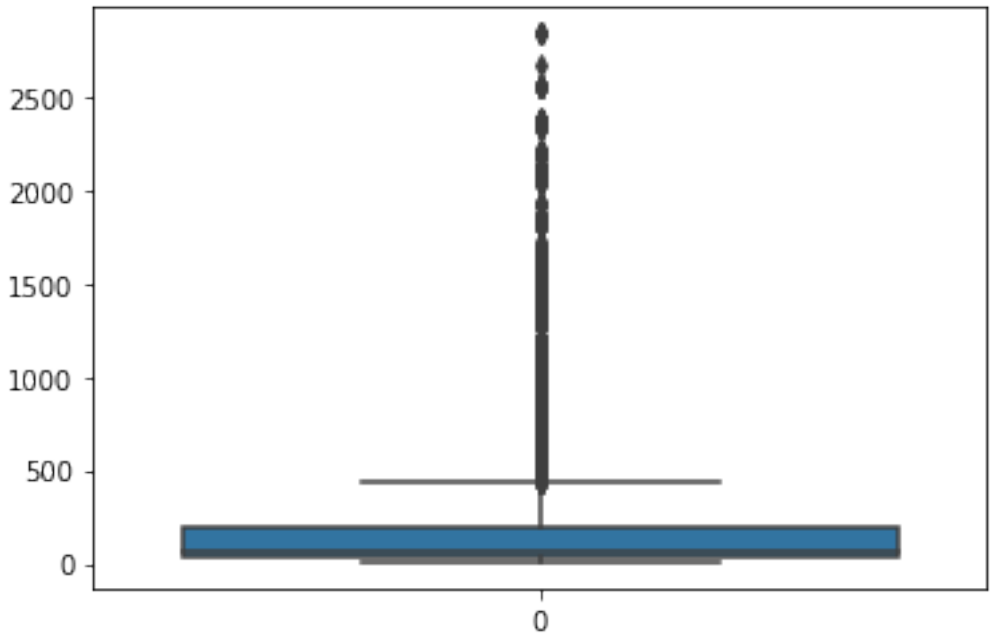
```
sns.boxplot(data["actual_distance_to_destination"])
```

```
<AxesSubplot: >
```



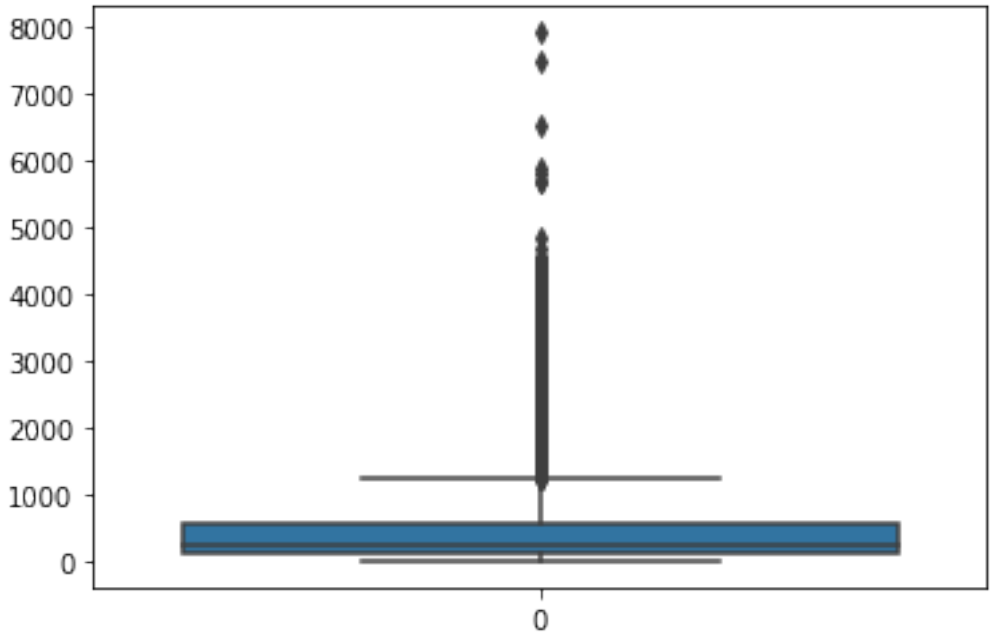

```
sns.boxplot(data["osrm_distance"])
```

```
<AxesSubplot: >
```



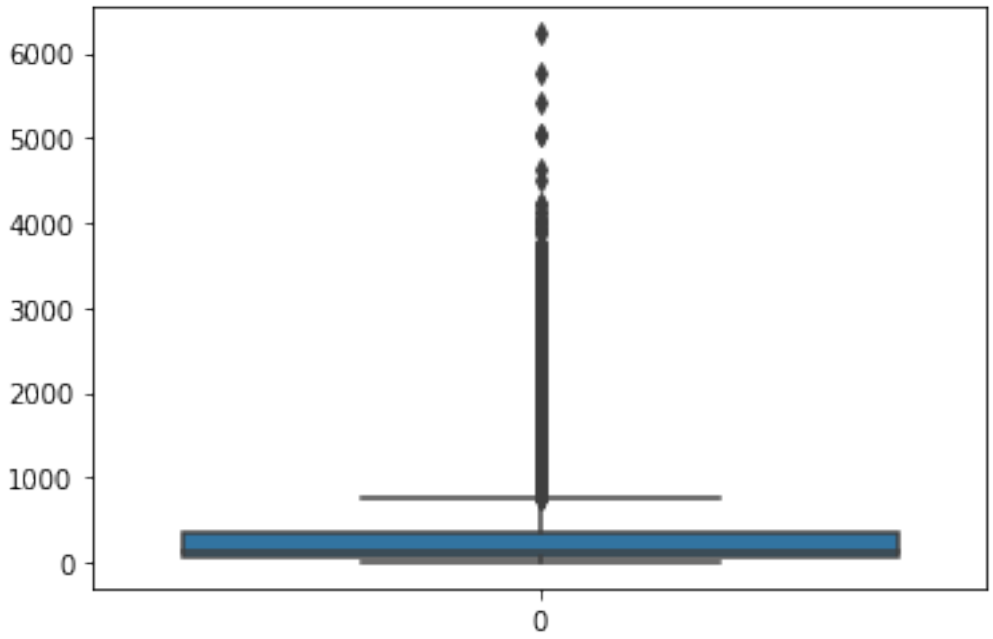

```
sns.boxplot(data["start_scan_to_end_scan"])
```

```
<AxesSubplot: >
```



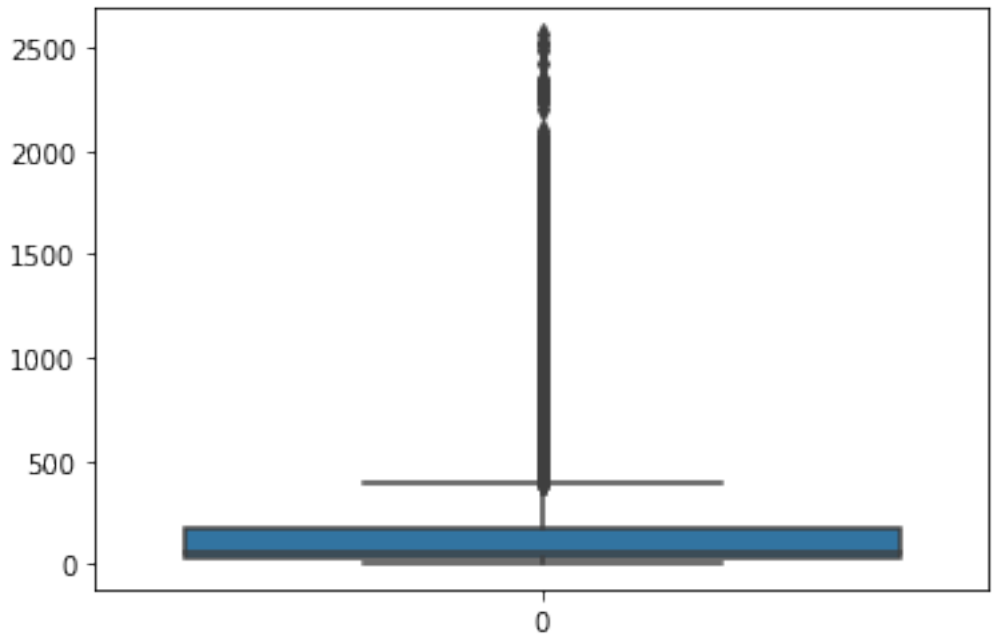

```
sns.boxplot(data["segment_actual_time"])
```

```
<AxesSubplot: >
```



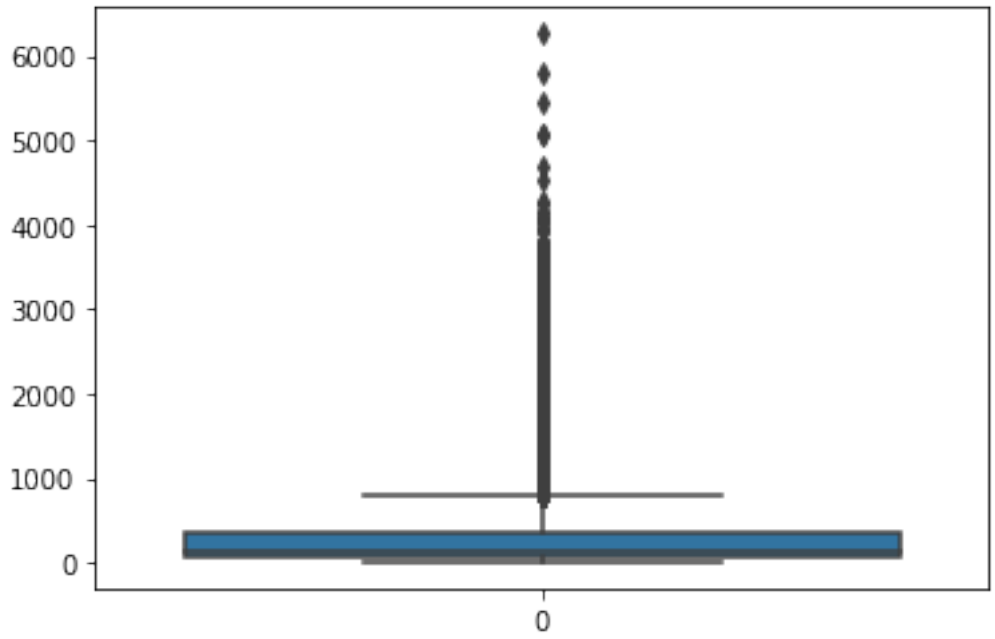

```
sns.boxplot(data["segment_osrm_time"])
```

```
<AxesSubplot: >
```



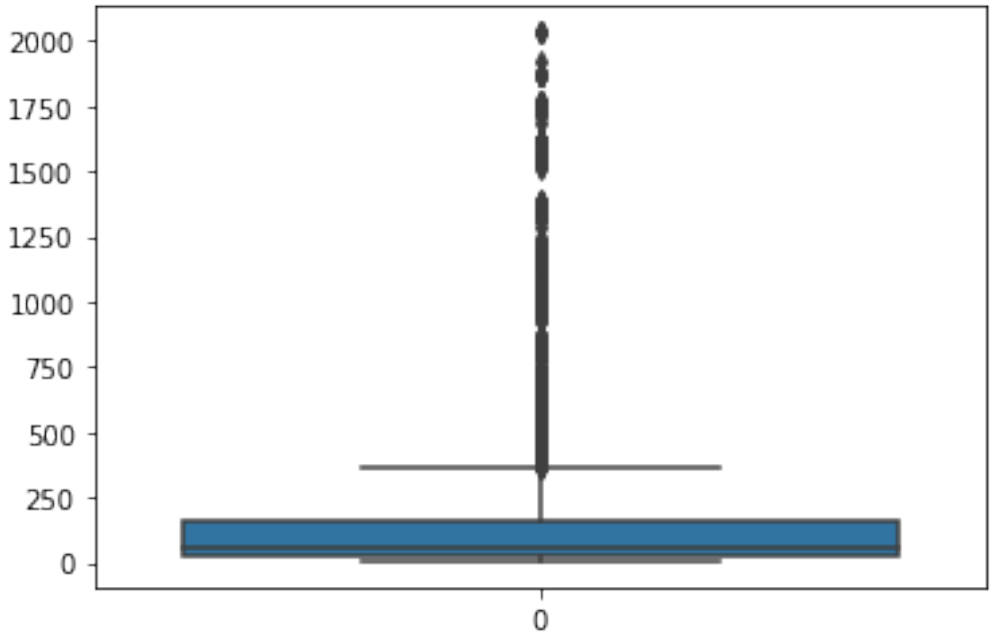

```
sns.boxplot(data["actual_time"])
```

```
<AxesSubplot: >
```



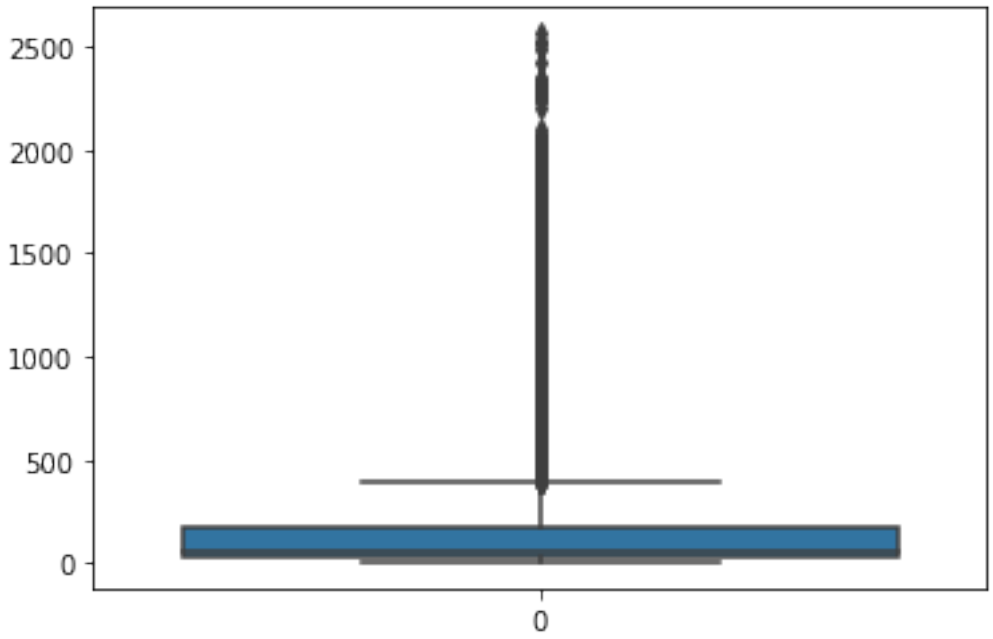

```
sns.boxplot(data["osrm_time"])
```

```
<AxesSubplot: >
```



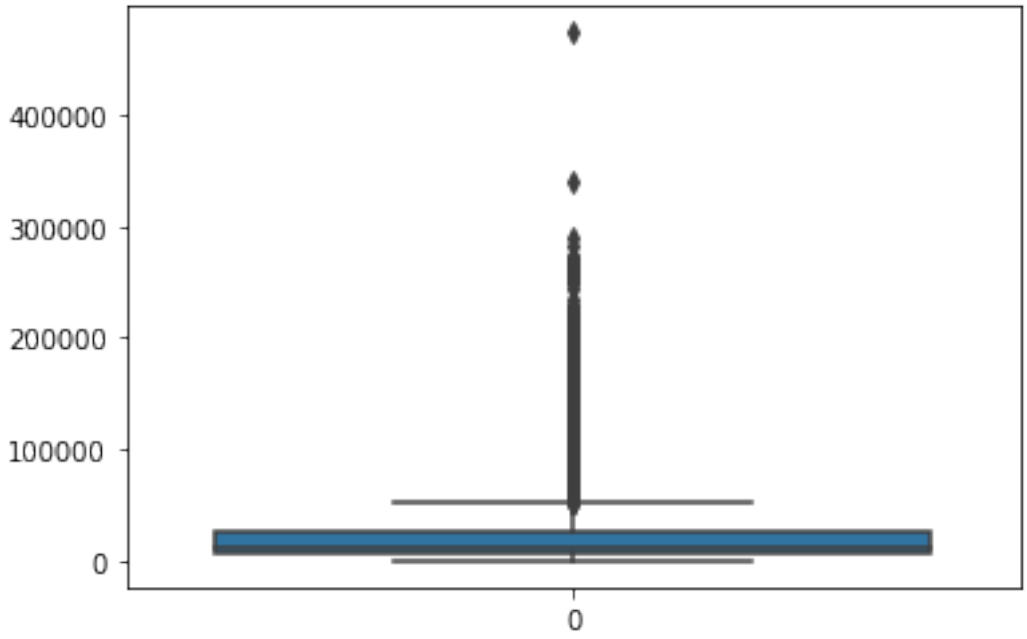

```
sns.boxplot(data["segment_osrm_time"])
```

```
<AxesSubplot: >
```




```
sns.boxplot(data["triptime_sec"])
```

```
<AxesSubplot: >
```




```
data.describe()
```

	cutoff_factor	actual_distance_to_destination	osrm_distance	\
count	13892.000000	13892.000000	13892.000000	
mean	159.986251	160.852618	200.437664	
std	307.520122	307.627703	373.619022	
min	9.000000	9.002461	9.072900	
25%	21.000000	22.037144	29.802900	
50%	46.000000	46.163919	61.108100	
75%	148.000000	149.281573	193.689125	
max	2185.000000	2187.483994	2840.081000	

	start_scan_to_end_scan	segment_actual_time	segment_osrm_time	\
count	13892.000000	13892.000000	13892.000000	
mean	515.603657	346.118557	176.627627	
std	660.357703	561.918712	316.580388	
min	23.000000	9.000000	6.000000	
25%	144.000000	64.000000	30.000000	
50%	264.000000	136.000000	62.000000	
75%	595.000000	349.000000	176.000000	
max	7898.000000	6230.000000	2564.000000	

```
        actual_time     osrm_time  segment_osrm_distance
trip_creation_year  \
count  13892.000000  13892.000000           13892.000000
13892.0
mean     349.267492    157.980564             218.437771
2018.0
std      567.051777    274.050917             419.933226
0.0
min        9.000000      6.000000               9.072900
2018.0
25%       65.000000     29.000000              31.349950
2018.0
50%      138.000000     57.500000              65.614850
2018.0
75%      353.000000    163.250000             204.588700
2018.0
max     6265.000000   2032.000000            3523.632400
2018.0

       trip_creation_month  trip_creation_day
trip_time  \
count         13892.000000       13892.000000
13892
mean              9.114310          18.547653  0 days
06:45:04.119232843
std               0.318199           7.753191  0 days
09:33:47.061593031
min               9.000000           1.000000            0 days
00:00:00
25%               9.000000          14.000000  0 days
01:51:56.299656750
50%               9.000000          20.000000     0 days
03:30:54.417636
75%               9.000000          25.000000  0 days
07:04:21.465968500
max              10.000000          30.000000     5 days
11:38:33.117274

        triptime_sec
count   13892.000000
mean    24304.119233
std     34427.061593
min         0.000000
25%      6716.299657
50%     12654.417636
75%     25461.465969
max    473913.117274
```

Outliers Treatment

```
#Let's remove outliers using IQR Method
sses25th = 44
sses75th = 595
iqr = sses75th - sses25th
ssesuw = sses75th +1.5*iqr
ssesuw
```

```
1421.5
```

```
data[data["start_scan_to_end_scan"]> ssesuw]
```

```
      route_type                trip_uuid
trip_creation_time  \
875      Carting  trip-153688139008597141 2018-10-03 20:11:38.080296

1187     Carting  trip-153695358056452857 2018-09-28 21:57:19.197648

1221     Carting  trip-153695825653985603 2018-09-30 07:30:32.488364

1316     Carting  trip-153696880159964742 2018-09-21 20:55:53.211057

1402     Carting  trip-153697923702522443 2018-09-23 15:30:38.146740

...          ...                       ...                       ...

14744        FTL  trip-153860352246282031 2018-09-24 05:06:56.558662

14748        FTL  trip-153860451596867762 2018-09-24 05:06:56.558662

14754        FTL  trip-153860570045461434 2018-09-24 05:06:56.558662

14764        FTL  trip-153860698042160875 2018-09-24 05:06:56.558662

14773        FTL  trip-153860879439383883 2018-09-24 05:06:56.558662


      source_center                                source_name  \
875    IND395023AAD               Surat_Central_I_4 (Gujarat)
1187   IND431112AAB             Sillod_ZebaTWR_D (Maharashtra)
1221   IND530012AAA  Visakhapatnam_Gajuwaka_IP (Andhra Pradesh)
1316   IND395023AAD               Surat_Central_I_4 (Gujarat)
1402   IND211002AAB      Allahabad_Central_H_1 (Uttar Pradesh)
...             ...                                       ...
14744  IND000000ACB            Gurgaon_Bilaspur_HB (Haryana)
14748  IND712311AAA          Kolkata_Dankuni_HB (West Bengal)
14754  IND000000ACB            Gurgaon_Bilaspur_HB (Haryana)
14764  IND131028AAB               Sonipat_Kundli_H (Haryana)
14773  IND000000ACB            Gurgaon_Bilaspur_HB (Haryana)
```

```
      destination_center
destination_name  \
875         IND396321AAA                          Bilimora_DC (Gujarat)

1187        IND431203AAA                Jalna_BhgyaNgr_D (Maharashtra)

1221        IND530012AAA  Visakhapatnam_Gajuwaka_IP (Andhra Pradesh)

1316        IND396321AAA                          Bilimora_DC (Gujarat)

1402        IND212402AAA            Phulpur_Shekhpur_D (Uttar Pradesh)

...                  ...                                           ...

14744       IND712311AAA              Kolkata_Dankuni_HB (West Bengal)

14748       IND712311AAA              Kolkata_Dankuni_HB (West Bengal)

14754       IND834002AAB                          Ranchi_Hub (Jharkhand)

14764       IND131028AAB                    Sonipat_Kundli_H (Haryana)

14773       IND000000ACB                  Gurgaon_Bilaspur_HB (Haryana)


                    od_start_time                 od_end_time
cutoff_factor  \
875   2018-09-13 23:29:50.086266 2018-09-14 02:58:24.884963
137
1187  2018-09-15 04:40:33.384907 2018-09-16 01:06:53.762074
207
1221  2018-09-14 20:50:56.540060 2018-09-15 23:00:45.715950
194
1316  2018-09-14 23:46:41.600072 2018-09-15 03:21:56.351119
113
1402  2018-09-15 02:40:37.025475 2018-09-15 07:54:57.848178
93
...                           ...                           ...
...
14744 2018-10-03 21:52:02.463089 2018-10-05 09:06:25.403171
1300
14748 2018-10-03 22:08:35.968978 2018-10-04 22:26:30.408004
159
14754 2018-10-03 22:28:20.454881 2018-10-05 08:39:47.996375
1010
14764 2018-10-05 08:35:15.664489 2018-10-05 08:35:15.664489
1321
14773 2018-10-06 04:27:23.392375 2018-10-06 04:27:23.392375
1931
```

```
       ...  actual_time  osrm_time  segment_osrm_distance
source_state  \
875    ...       1108.0      145.0               271.4230
Gujarat
1187   ...        586.0      169.0               295.9635
Maharashtra
1221   ...        303.0      169.0               228.7358  Andhra
Pradesh
1316   ...        258.0      127.0               206.7191
Gujarat
1402   ...       1204.0       90.0               117.4880   Uttar
Pradesh
...    ...          ...        ...                    ...
...
14744  ...       1930.0     1016.0              1497.6331
Haryana
14748  ...       1342.0      145.0               197.2656     West
Bengal
14754  ...       1625.0      851.0              1222.2127
Haryana
14764  ...       2003.0     1166.0              1747.4544
Haryana
14773  ...       3307.0     1739.0              2600.9869
Haryana

       destination_state  trip_creation_year  trip_creation_month  \
875              Gujarat              2018.0                 10.0
1187         Maharashtra              2018.0                  9.0
1221       Andhra Pradesh             2018.0                  9.0
1316             Gujarat              2018.0                  9.0
1402        Uttar Pradesh             2018.0                  9.0
...                   ...                ...                  ...
14744         West Bengal             2018.0                  9.0
14748         West Bengal             2018.0                  9.0
14754           Jharkhand             2018.0                  9.0
14764             Haryana             2018.0                  9.0
14773             Haryana             2018.0                  9.0

       trip_creation_day              trip_time   triptime_sec
875                 3.0 0 days 03:28:34.798697   12514.798697
1187               28.0 0 days 20:26:20.377167   73580.377167
1221               30.0 1 days 02:09:49.175890   94189.175890
1316               21.0 0 days 03:35:14.751047   12914.751047
1402               23.0 0 days 05:14:20.822703   18860.822703
...                 ...                   ...            ...
14744              24.0 1 days 11:14:22.940082  126862.940082
14748              24.0 1 days 00:17:54.439026   87474.439026
14754              24.0 1 days 10:11:27.541494  123087.541494
14764              24.0        0 days 00:00:00       0.000000
```

```
14773                24.0        0 days 00:00:00       0.000000

[1040 rows x 25 columns]

#We will drop outliers which we have found using IQR Method
data.drop(data[data["start_scan_to_end_scan"]> ssesuw].index,
inplace=True)

data.describe()
```

```
       cutoff_factor  actual_distance_to_destination  osrm_distance  \
count   12852.000000                    12852.000000   12852.000000
mean       88.108077                       88.962952     113.436786
std       108.676646                      108.964263     135.904653
min         9.000000                        9.002461       9.072900
25%        21.000000                       21.513693      28.613375
50%        39.000000                       39.995569      51.578350
75%       117.000000                      118.535713     151.928175
max       830.000000                      830.517272     970.943400

       start_scan_to_end_scan  segment_actual_time  segment_osrm_time
\
count            12852.000000         12852.000000       12852.000000

mean               363.109088           216.271709         103.763305

std                320.783878           237.050219         117.762542

min                 23.000000             9.000000           6.000000

25%                137.000000            61.000000          28.000000

50%                240.000000           119.000000          56.000000

75%                471.000000           282.000000         144.000000

max               1421.000000          1372.000000         867.000000


        actual_time     osrm_time  segment_osrm_distance
trip_creation_year  \
count  12852.000000  12852.000000           12852.000000
12852.0
mean     218.170557     94.566838             121.064327
2018.0
std      238.554090    105.277546             146.155991
0.0
min        9.000000      6.000000               9.072900
2018.0
25%       62.000000     27.750000              29.653100
2018.0
```

```
50%      120.000000     52.000000              56.815650
2018.0
75%      284.000000    125.000000             159.915625
2018.0
max     1372.000000    712.000000            1150.617300
2018.0

       trip_creation_month  trip_creation_day
trip_time  \
count          12852.000000       12852.000000
12852
mean               9.114846          18.584967  0 days
05:00:24.581706652
std                0.318848           7.786337  0 days
04:58:46.808724515
min                9.000000           1.000000            0 days
00:00:00
25%                9.000000          14.000000  0 days
01:51:31.947565250
50%                9.000000          20.000000     0 days
03:21:36.093887
75%                9.000000          25.000000  0 days
06:17:26.963298250
max               10.000000          30.000000     2 days
01:09:57.136511

        triptime_sec
count   12852.000000
mean    18024.581707
std     17926.808725
min         0.000000
25%      6691.947565
50%     12096.093887
75%     22646.963298
max    176997.136511
```

Here We can observe that by removing outliers in start_scan_to_end_scan column, other columns max values has been decreased significantly and further dropping columns will lead to loss of valuable data

Data Encoding

```
data_encoding=data.copy()

data_encoding.shape

(12852, 25)
```

Label Encoding

```
#Here We will use label encoder for encoding route_type column
le = LabelEncoder()

col="route_type"
data_encoding[col].value_counts()
```

```
Carting    8503
FTL        4349
Name: route_type, dtype: int64
```

```
data_encoding[col]=le.fit_transform(data_encoding[col])
data_encoding[col].value_counts()
```

```
0    8503
1    4349
Name: route_type, dtype: int64
```

Target Encoding

```
from category_encoders import TargetEncoder

te=TargetEncoder()

#Here we will do target encoding for
"source_center","source_name","destination_center","destination_name",
"source_state","destination_state" columns
columns=["source_center","source_name","destination_center","destinati
on_name","source_state","destination_state"]
for col in columns:
    data_encoding[col]=te.fit_transform(data_encoding[col],
data_encoding["route_type"])

data_encoding.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 12852 entries, 0 to 14786
Data columns (total 25 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   route_type                      12852 non-null  int32
 1   trip_uuid                       12852 non-null  object
 2   trip_creation_time              12852 non-null  datetime64[ns]
 3   source_center                   12852 non-null  float64
 4   source_name                     12852 non-null  float64
 5   destination_center              12852 non-null  float64
 6   destination_name                12852 non-null  float64
 7   od_start_time                   12852 non-null  datetime64[ns]
```

```
 8   od_end_time                       12852 non-null  datetime64[ns]
 9   cutoff_factor                     12852 non-null  int64
 10  actual_distance_to_destination    12852 non-null  float64
 11  osrm_distance                     12852 non-null  float64
 12  start_scan_to_end_scan            12852 non-null  float64
 13  segment_actual_time               12852 non-null  float64
 14  segment_osrm_time                 12852 non-null  float64
 15  actual_time                       12852 non-null  float64
 16  osrm_time                         12852 non-null  float64
 17  segment_osrm_distance             12852 non-null  float64
 18  source_state                      12852 non-null  float64
 19  destination_state                 12852 non-null  float64
 20  trip_creation_year                12852 non-null  float64
 21  trip_creation_month               12852 non-null  float64
 22  trip_creation_day                 12852 non-null  float64
 23  trip_time                         12852 non-null  timedelta64[ns]
 24  triptime_sec                      12852 non-null  float64
dtypes: datetime64[ns](3), float64(18), int32(1), int64(1), object(1),
timedelta64[ns](1)
memory usage: 2.5+ MB
```

```
data_encoding.drop(["trip_uuid","trip_creation_time","od_start_time","
od_end_time","trip_time"],axis=1, inplace=True)
```

```
data_encoding
```

```
       route_type  source_center  source_name  destination_center  \
0               0       0.233481     0.233481        2.405789e-01
1               0       0.026667     0.026667        5.140380e-08
2               0       0.265919     0.265919        2.943634e-01
3               0       0.019398     0.019398        2.261087e-01
4               0       0.000924     0.000924        4.186833e-06
...           ...            ...          ...                 ...
14778           1       0.432241     0.432241        8.583065e-01
14780           1       0.636225     0.636225        9.449722e-01
14783           1       0.888157     0.888157        8.955545e-01
14785           1       0.636225     0.636225        6.362248e-01
14786           1       0.424472     0.424472        5.036211e-01

       destination_name  cutoff_factor  actual_distance_to_destination
\
0          2.405789e-01             72                       73.186911

1          5.140380e-08             17                       17.175274

2          2.943634e-01             24                       24.597048

3          2.261087e-01              9                        9.100510

4          4.186833e-06             22                       22.424210
```

```
...                 ...           ...                          ...

14778      8.583065e-01           143                   144.794266

14780      9.449722e-01           174                   176.546661

14783      8.955545e-01           192                   194.552260

14785      6.362248e-01            84                    84.743813

14786      5.036211e-01            65                    66.081533


       osrm_distance  start_scan_to_end_scan  segment_actual_time  \
0            85.1110                   180.0                141.0
1            19.6800                   100.0                 59.0
2            28.0647                   189.0                 60.0
3            12.0184                    98.0                 24.0
4            28.9203                   146.0                 64.0
...              ...                     ...                  ...
14778       191.0458                   852.0                270.0
14780       220.3007                   678.0                378.0
14783       229.2052                  1017.0                845.0
14785       102.3828                   256.0                186.0
14786        80.5787                   353.0                274.0

       segment_osrm_time  actual_time  osrm_time
segment_osrm_distance  \
0                   65.0        143.0       68.0
84.1894
1                   16.0         59.0       15.0
19.8766
2                   23.0         61.0       23.0
28.0647
3                   13.0         24.0       13.0
12.0184
4                   34.0         64.0       34.0
28.9203
...                  ...          ...        ...                    ..
.
14778              136.0        272.0      139.0
172.9107
14780              194.0        378.0      192.0
212.8530
14783              178.0        847.0      178.0
232.5811
14785               92.0        187.0       92.0
107.6915
14786               67.0        275.0       68.0
80.5787
```

```
       source_state  destination_state  trip_creation_year  \
0          0.132353           0.167293              2018.0
1          0.213544           0.189456              2018.0
2          0.263959           0.277888              2018.0
3          0.263959           0.277888              2018.0
4          0.132353           0.167293              2018.0
...             ...                ...                 ...
14778      0.417819           0.398413              2018.0
14780      0.456364           0.505843              2018.0
14783      0.940594           0.940594              2018.0
14785      0.456364           0.505843              2018.0
14786      0.132353           0.167293              2018.0

       trip_creation_month  trip_creation_day  triptime_sec
0                      9.0               20.0      0.000000
1                      9.0               20.0   6029.696112
2                      9.0               20.0      0.000000
3                      9.0               20.0   5880.338041
4                      9.0               20.0  10586.899446
...                    ...                ...          ...
14778                  9.0               24.0  51184.266566
14780                  9.0               24.0  40779.500123
14783                  9.0               24.0  61169.217828
14785                  9.0               24.0      0.000000
14786                  9.0               24.0      0.000000

[12852 rows x 20 columns]
```

Standardization

```
#Here We will use MinMaxScaler method for standardizing dataframe
scaler=MinMaxScaler()
std_data=scaler.fit_transform(data_encoding)
std_data=pd.DataFrame(std_data, columns=data_encoding.columns)

std_data
```

```
       route_type  source_center  source_name  destination_center  \
0             0.0       0.234251     0.234251        2.521111e-01
1             0.0       0.026755     0.026755        5.386383e-08
2             0.0       0.266796     0.266796        3.084738e-01
3             0.0       0.019462     0.019462        2.369473e-01
4             0.0       0.000928     0.000928        4.387526e-06
...           ...            ...          ...                 ...
12847         1.0       0.433666     0.433666        8.994497e-01
12848         1.0       0.638322     0.638322        9.902697e-01
12849         1.0       0.891085     0.891085        9.384832e-01
```

```
12850         1.0       0.638322     0.638322        6.667225e-01
12851         1.0       0.425871     0.425871        5.277623e-01

       destination_name  cutoff_factor  actual_distance_to_destination
\
0          2.521111e-01       0.076736                        0.078129

1          5.386383e-08       0.009744                        0.009948

2          3.084738e-01       0.018270                        0.018983

3          2.369473e-01       0.000000                        0.000119

4          4.387526e-06       0.015834                        0.016338

...                 ...            ...                             ...

12847      8.994497e-01       0.163216                        0.165294

12848      9.902697e-01       0.200974                        0.203945

12849      9.384832e-01       0.222899                        0.225863

12850      6.667225e-01       0.091352                        0.092197

12851      5.277623e-01       0.068210                        0.069480


       osrm_distance  start_scan_to_end_scan  segment_actual_time  \
0           0.079052                0.112303             0.096845
1           0.011028                0.055079             0.036684
2           0.019745                0.118741             0.037417
3           0.003062                0.053648             0.011005
4           0.020634                0.087983             0.040352
...              ...                     ...                  ...
12847       0.189186                0.592990             0.191489
12848       0.219601                0.468526             0.270726
12849       0.228859                0.711016             0.613353
12850       0.097009                0.166667             0.129861
12851       0.074340                0.236052             0.194424

       segment_osrm_time  actual_time  osrm_time
segment_osrm_distance  \
0               0.068525     0.098313   0.087819
0.065803
1               0.011614     0.036684   0.012748
0.009464
2               0.019744     0.038151   0.024079
0.016637
3               0.008130     0.011005   0.009915
0.002580
```

```
4               0.032520     0.040352   0.039660
0.017386
...                  ...          ...        ...                       ..
.
12847           0.150987     0.192957   0.188385
0.143523
12848           0.218351     0.270726   0.263456
0.178513
12849           0.199768     0.614820   0.243626
0.195795
12850           0.099884     0.130594   0.121813
0.086391
12851           0.070848     0.195158   0.087819
0.062640

       source_state  destination_state  trip_creation_year  \
0          0.108790           0.094519                 0.0
1          0.197365           0.118627                 0.0
2          0.252366           0.214823                 0.0
3          0.252366           0.214823                 0.0
4          0.108790           0.094519                 0.0
...             ...                ...                 ...
12847      0.420218           0.345928                 0.0
12848      0.462268           0.462789                 0.0
12849      0.990537           0.935705                 0.0
12850      0.462268           0.462789                 0.0
12851      0.108790           0.094519                 0.0

       trip_creation_month  trip_creation_day  triptime_sec
0                      0.0           0.655172      0.000000
1                      0.0           0.655172      0.034067
2                      0.0           0.655172      0.000000
3                      0.0           0.655172      0.033223
4                      0.0           0.655172      0.059814
...                    ...                ...           ...
12847                  0.0           0.793103      0.289181
12848                  0.0           0.793103      0.230396
12849                  0.0           0.793103      0.345594
12850                  0.0           0.793103      0.000000
12851                  0.0           0.793103      0.000000

[12852 rows x 20 columns]
```

Business Insights

By doing Hypothesis testing between osrm data and actual data, we can observe that mean of both data is not the same.

Distance and time attributes are highly correlated, so its obvious that distance between places will matter in speedy delivery

Maximum orders are found from Maharashtra, so we can say more customers in the state.

Minimum trips are from North-Eastern states so business needs improvement in that states

The busiest warehouses are Gurgaon_Bilaspur, Bhiwandi, and Bangalore, So, They should be more focused.

The Busiest route is Bangalore_Nalamngla_H (Karnataka) to Bengaluru_KGAirport_HB (Karnataka). The average distance between them is 28.03 and the average time taken for the given trip is 87.87

Recommendations

From the above analysis, It can be observed that the actual time taken for delivery is higher compared to osrm time. So we can optimize our services using osrm.

We have the busiest route in Bangaluru, so we can increase our service by providing different outlets and increasing the manpower

In Maharashtra, we have the highest number of trips, so we should increase outlets in the state.

In North-Eastern states, we have very less business, so we need to optimize their condition and also provide marketing to increase services.

We have the busiest warehouse in Gurgaon_Bilaspur, so we need to increase the number of warehouses or increase manpower to efficiently handle the load.

OSRM provides us best minimal distance