DELHIVERY - Business CaseStudy

Introduction:

- **Delhivery**, established in 2011, is India's foremost logistics and supply chain service provider, offering a comprehensive range of solutions including express parcel transportation, warehousing, and last-mile delivery.
- Leveraging advanced technology and a vast delivery network, Delhivery efficiently manages nationwide movement of goods, earning trust across businesses of all sizes for its dedication to innovation and customer satisfaction.
- As the largest fully integrated player in India by revenue in Fiscal 2021, Delhivery aims to lead the industry by pioneering the commerce operating system, driven by top-tier infrastructure, logistics operations, and innovative data intelligence initiatives led by its Data team.

Why this case study?

Delhivery aims to establish itself as the premier player in the logistics industry. This case study is of paramount importance as it aligns with the company's core objectives and operational excellence.

It provides a practical framework for understanding and processing data, which is integral to their operations. By leveraging data engineering pipelines and data analysis techniques, Delhivery can achieve several critical goals.

First, it allows them to ensure data integrity and quality by addressing missing values and structuring the dataset appropriately.

Second, it enables the extraction of valuable features from raw data, which can be utilized for building accurate forecasting models.

Moreover, it facilitates the identification of patterns, insights, and actionable recommendations crucial for optimizing their logistics operations.

Byconducting hypothesis testing and outlier detection, Delhivery can refine their processes and further enhance the quality of service they provide.

How can you help here?

The company wants to understand and process the data coming out of data engineering pipelines:

- Clean, sanitize and manipulate data to get useful features out of raw fields
- Make sense out of the raw data and help the data science team to build forecasting models on it.

Features of the dataset:

- Column Profiling:

Feature	Description
data	tells whether the data is testing or training data
trip_creation_time	Timestamp of trip creation
route_schedule_uuid	Unique ID for a particular route schedule
route_type	**Transportation type**
a. FTL–Full Truck Load	FTL shipments get to the destination sooner, as the truck is making no other pickups or drop-offs along the way
b. Carting	Handling system consisting of small vehicles (carts)
trip_uuid	Unique ID given to a particular trip (A trip may include different source and destination centers)
source_center	Source ID of trip origin
source_name	Source Name of trip origin
destination_center	Destination ID
destination_name	Destination Name
od_start_time	Trip start time
od_end_time	Trip end time
start_scan_to_end_scan	Time taken to deliver from source to destination
is_cutoff	Unknown field
cutoff_factor	Unknown field
cutoff_timestamp	Unknown field
actual_distance_to_destination	Distance in kms between source and destination warehouse
actual_time	Actual time taken to complete the delivery (Cumulative)
osrm_time	An open-source routing engine time calculator which computes the shortest path between points in a given map (Includes usual traffic, distance through major and minor roads) and gives the time (Cumulative)
osrm_distance	An open-source routing engine which computes the shortest path between points in a given map (Includes usual traffic, distance through major and minor roads) (Cumulative)
factor	Unknown field
segment_actual_time	This is a segment time. Time taken by the subset of the package delivery
segment_osrm_time	This is the OSRM segment time. Time taken by the

Feature	Description
	subset of the package delivery
segment_osrm_distance	This is the OSRM distance. Distance covered by subset of the package delivery
segment_factor	Unknown field

```
# importing the required modules and packages

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
import re
from scipy.stats import norm,zscore,boxcox,probplot
from scipy.stats import ttest_ind,ttest_rel,mannwhitneyu,wilcoxon
from scipy.stats import shapiro,levene,kstest,anderson
import statsmodels.api as sm
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import StandardScaler , MinMaxScaler ,
OneHotEncoder
import warnings
warnings.filterwarnings('ignore')

# pd_reading the data
delhivery_data = pd.read_csv('delhivery_data.csv')

# setting the option of displaying all the columns
pd.set_option('display.max_columns', 50)

# making a deep copy for backup
dd = delhivery_data.copy()
dd.head()

       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

                                 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

                 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)


  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)

                od_start_time                 od_end_time  \
0  2018-09-20 03:21:32.418600  2018-09-20 04:47:45.236797
1  2018-09-20 03:21:32.418600  2018-09-20 04:47:45.236797
2  2018-09-20 03:21:32.418600  2018-09-20 04:47:45.236797
3  2018-09-20 03:21:32.418600  2018-09-20 04:47:45.236797
4  2018-09-20 03:21:32.418600  2018-09-20 04:47:45.236797

   start_scan_to_end_scan  is_cutoff  cutoff_factor  \
0                    86.0       True              9
1                    86.0       True             18
2                    86.0       True             27
3                    86.0       True             36
4                    86.0      False             39

             cutoff_timestamp  actual_distance_to_destination
actual_time  \
0         2018-09-20 04:27:55                       10.435660
14.0
1         2018-09-20 04:17:55                       18.936842
24.0
2  2018-09-20 04:01:19.505586                       27.637279
40.0
3         2018-09-20 03:39:57                       36.118028
62.0
4         2018-09-20 03:33:55                       39.386040
68.0

   osrm_time  osrm_distance    factor  segment_actual_time
segment_osrm_time  \
0       11.0        11.9653  1.272727                 14.0
11.0
1       20.0        21.7243  1.200000                 10.0
```

```
9.0
2       28.0        32.5395  1.428571                 16.0
7.0
3       40.0        45.5620  1.550000                 21.0
12.0
4       44.0        54.2181  1.545455                  6.0
5.0

   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
```

Exploration of data :

```
dd.shape
```

```
(144867, 24)
```

```
dd.columns
```

```
Index(['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'],
      dtype='object')
```

```
dd.info()
```

```
<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
```

Statistical Summary

```
dd.describe().T
```

```
                                   count        mean          std
min  \
start_scan_to_end_scan          144867.0  961.262986  1037.012769
20.000000
cutoff_factor                   144867.0  232.926567   344.755577
9.000000
actual_distance_to_destination  144867.0  234.073372   344.990009
9.000045
actual_time                     144867.0  416.927527   598.103621
9.000000
osrm_time                       144867.0  213.868272   308.011085
6.000000
osrm_distance                   144867.0  284.771297   421.119294
9.008200
factor                          144867.0    2.120107     1.715421
0.144000
segment_actual_time             144867.0   36.196111    53.571158 -
244.000000
segment_osrm_time               144867.0   18.507548    14.775960
0.000000
segment_osrm_distance           144867.0   22.829020    17.860660
0.000000
segment_factor                  144867.0    2.218368     4.847530  -
23.444444
```

```
                                      25%         50%          75%  \
start_scan_to_end_scan         161.000000  449.000000  1634.000000
cutoff_factor                   22.000000   66.000000   286.000000
actual_distance_to_destination  23.355874   66.126571   286.708875
actual_time                     51.000000  132.000000   513.000000
osrm_time                       27.000000   64.000000   257.000000
osrm_distance                   29.914700   78.525800   343.193250
factor                           1.604264    1.857143     2.213483
segment_actual_time             20.000000   29.000000    40.000000
segment_osrm_time               11.000000   17.000000    22.000000
segment_osrm_distance           12.070100   23.513000    27.813250
segment_factor                   1.347826    1.684211     2.250000

                                        max
start_scan_to_end_scan          7898.000000
cutoff_factor                   1927.000000
actual_distance_to_destination  1927.447705
actual_time                     4532.000000
osrm_time                       1686.000000
osrm_distance                   2326.199100
factor                            77.387097
segment_actual_time             3051.000000
segment_osrm_time               1611.000000
segment_osrm_distance           2191.403700
segment_factor                   574.250000
```

```
dd.describe(include=object).T
```

```
                       count unique  \
data                    144867      2
trip_creation_time      144867  14817
route_schedule_uuid     144867   1504
route_type              144867      2
trip_uuid               144867  14817
source_center           144867   1508
source_name             144574   1498
destination_center      144867   1481
destination_name        144606   1468
od_start_time           144867  26369
od_end_time             144867  26369
cutoff_timestamp        144867  93180

                                                                      top
freq
data                                                             training
104858
trip_creation_time                             2018-09-28 05:23:15.359220
101
route_schedule_uuid  thanos::sroute:4029a8a2-6c74-4b7e-a6d8-f9e069f...
```

```
1812
route_type                                                          FTL
99660
trip_uuid                                       trip-153811219535896559
101
source_center                                              IND000000ACB
23347
source_name                               Gurgaon_Bilaspur_HB (Haryana)
23347
destination_center                                         IND000000ACB
15192
destination_name                          Gurgaon_Bilaspur_HB (Haryana)
15192
od_start_time                                2018-09-21 18:37:09.322207
81
od_end_time                                  2018-09-24 09:59:15.691618
81
cutoff_timestamp                                    2018-09-24 05:19:20
40
```

###**Duplicate Detection**

```
dd[dd.duplicated()]

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: []
```

Insights

- The dataset does not contain any duplicates.

Null Detection

```
dd.isna().any()

data                               False
trip_creation_time                 False
route_schedule_uuid                False
route_type                         False
trip_uuid                          False
source_center                      False
source_name                         True
```

```
destination_center                  False
destination_name                     True
od_start_time                       False
od_end_time                         False
start_scan_to_end_scan              False
is_cutoff                           False
cutoff_factor                       False
cutoff_timestamp                    False
actual_distance_to_destination      False
actual_time                         False
osrm_time                           False
osrm_distance                       False
factor                              False
segment_actual_time                 False
segment_osrm_time                   False
segment_osrm_distance               False
segment_factor                      False
dtype: bool
```

```
dd.isnull().sum()
```

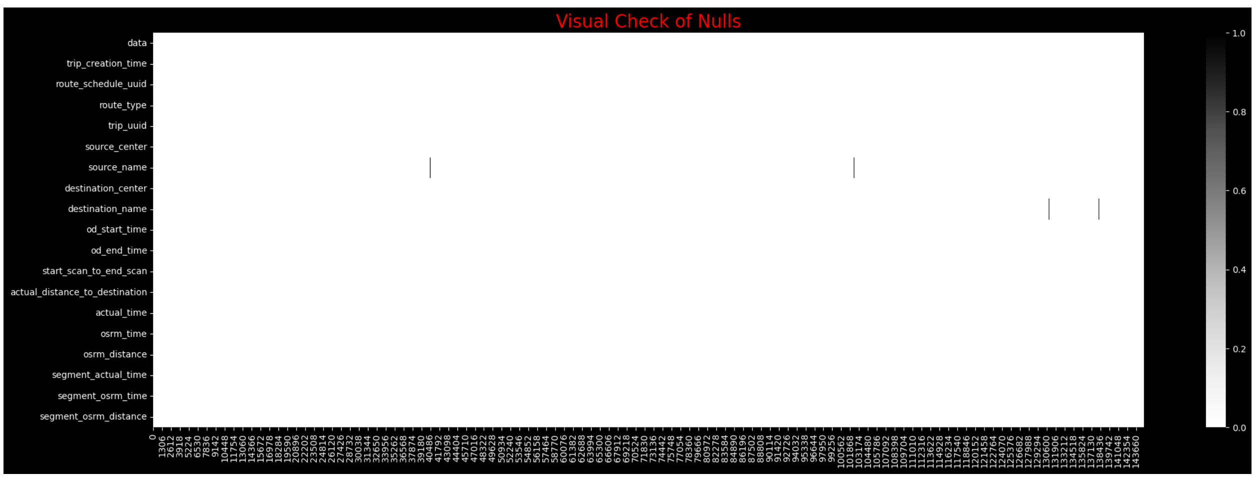
```
data                                  0
trip_creation_time                    0
route_schedule_uuid                   0
route_type                            0
trip_uuid                             0
source_center                         0
source_name                         293
destination_center                    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
```

```
def missing_data(df):
    total_missing_df = df.isnull().sum().sort_values(ascending =False)
    percent_missing_df =
```

```
(df.isnull().sum()/df.isna().count()*100).sort_values(ascending=False)
# ----> /len(dd)
    missing_data_df = pd.concat([total_missing_df,
percent_missing_df], axis=1, keys=['Total', 'Percent'])
    return missing_data_df

missing_pct = missing_data(dd)
missing_pct[missing_pct['Total']>0]
```

```
                  Total   Percent
source_name         293  0.202254
destination_name    261  0.180165
```

```
plt.figure(figsize=(25,8))
plt.style.use('dark_background')
sns.heatmap(dd.isnull().T,cmap='Greys')
plt.title('Visual Check of Nulls',fontsize=20,color='r')
plt.show()
```




```
# Dropping unknown fields

unknown_fields = ['is_cutoff', 'cutoff_factor', 'cutoff_timestamp',
'factor', 'segment_factor']
dd = dd.drop(columns = unknown_fields)

dd.sample()
```

```
        data          trip_creation_time  \
133488  test  2018-09-30 05:56:48.299467

                                      route_schedule_uuid
route_type  \
133488  thanos::sroute:6be6529b-f2ad-4714-b7ab-ac58f24...        FTL


                      trip_uuid source_center
```

```
source_name  \
133488  trip-153828700829921150  IND000000ACB  Gurgaon_Bilaspur_HB
(Haryana)

       destination_center                 destination_name  \
133488       IND600056AAB  MAA_Poonamallee_HB (Tamil Nadu)

                     od_start_time                od_end_time  \
133488  2018-09-30 05:56:48.299467  2018-10-02 10:36:25.970169

        start_scan_to_end_scan  actual_distance_to_destination
actual_time  \
133488                  3159.0                     1518.025696
2492.0

        osrm_time  osrm_distance  segment_actual_time
segment_osrm_time  \
133488     1400.0      1931.1737                 54.0
21.0

        segment_osrm_distance
133488                21.5097
```

```
dd.shape
```

```
(144867, 19)
```

```
#checking the unique values for columns
for _ in dd.columns:
    print()
    print(f'Total Unique Values in {_} column are :-
{dd[_].nunique()}')
    print(f'Unique Values in {_} column are :-\n {dd[_].unique()}')
    print()
    print('-'*120)
```

```
Total Unique Values in data column are :- 2
Unique Values in data column are :-
 ['training' 'test']

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in trip_creation_time column are :- 14817
Unique Values in trip_creation_time column are :-
 ['2018-09-20 02:35:36.476840' '2018-09-23 06:42:06.021680'
 '2018-09-14 15:42:46.437249' ... '2018-09-22 11:30:41.399439'
 '2018-09-17 11:35:28.838714' '2018-09-20 16:24:28.436231']

----------------------------------------------------------------------
```

```
--------------------------------------------------

Total Unique Values in route_schedule_uuid column are :- 1504
Unique Values in route_schedule_uuid column are :-
 ['thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3297ef'
 'thanos::sroute:ff52ef7a-4d0d-4063-9bfe-cc211728881b'
 'thanos::sroute:a16bfa03-3462-4bce-9c82-5784c7d315e6' ...
 'thanos::sroute:72cf9feb-f4e3-4a55-b92a-0b686ee8fabc'
 'thanos::sroute:5e08be79-8a4c-4a91-a514-5350403c0e31'
 'thanos::sroute:a3c30562-87e5-471c-9646-0ed49c150996']

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in route_type column are :- 2
Unique Values in route_type column are :-
 ['Carting' 'FTL']

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in trip_uuid column are :- 14817
Unique Values in trip_uuid column are :-
 ['trip-153741093647649320' 'trip-153768492602129387'
 'trip-153693976643699843' ... 'trip-153761584139918815'
 'trip-153718412883843340' 'trip-153746066843555182']

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in source_center column are :- 1508
Unique Values in source_center column are :-
 ['IND388121AAA' 'IND388620AAB' 'IND421302AAG' ... 'IND361335AAA'
 'IND562132AAC' 'IND639104AAB']

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in source_name column are :- 1498
Unique Values in source_name column are :-
 ['Anand_VUNagar_DC (Gujarat)' 'Khambhat_MotvdDPP_D (Gujarat)'
 'Bhiwandi_Mankoli_HB (Maharashtra)' ... 'Dwarka_StnRoad_DC (Gujarat)'
 'Bengaluru_Nelmngla_L (Karnataka)' 'Kulithalai_AnnaNGR_D (Tamil
Nadu)']

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in destination_center column are :- 1481
Unique Values in destination_center column are :-
```

```
 ['IND388620AAB' 'IND388320AAA' 'IND411033AAA' ... 'IND600004AAA'
 'IND134203AAA' 'IND400701AAA']

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in destination_name column are :- 1468
Unique Values in destination_name column are :-
 ['Khambhat_MotvdDPP_D (Gujarat)' 'Anand_Vaghasi_IP (Gujarat)'
 'Pune_Tathawde_H (Maharashtra)' ... 'Chennai_Mylapore (Tamil Nadu)'
 'Naraingarh_Ward2DPP_D (Haryana)' 'Mumbai_Ghansoli_DC (Maharashtra)']

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in od_start_time column are :- 26369
Unique Values in od_start_time column are :-
 ['2018-09-20 03:21:32.418600' '2018-09-20 04:47:45.236797'
 '2018-09-23 06:42:06.021680' ... '2018-09-22 11:30:41.399439'
 '2018-09-17 11:35:28.838714' '2018-09-20 16:24:28.436231']

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in od_end_time column are :- 26369
Unique Values in od_end_time column are :-
 ['2018-09-20 04:47:45.236797' '2018-09-20 06:36:55.627764'
 '2018-09-23 11:44:28.365845' ... '2018-09-22 21:45:05.128533'
 '2018-09-17 13:32:21.128357' '2018-09-20 23:32:09.618069']

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in start_scan_to_end_scan column are :- 1915
Unique Values in start_scan_to_end_scan column are :-
 [  86.  109.  302. ... 2476. 1161. 2949.]

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in actual_distance_to_destination column are :-
144515
Unique Values in actual_distance_to_destination column are :-
 [10.43566024 18.9368423  27.63727904 ... 66.16359134 73.68066734
 70.03901016]

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in actual_time column are :- 3182
```

```
Unique Values in actual_time column are :-
 [  14.   24.   40. ... 3169. 3318. 2980.]

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in osrm_time column are :- 1531
Unique Values in osrm_time column are :-
 [  11.   20.   28. ... 1340. 1439. 1312.]

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in osrm_distance column are :- 138046
Unique Values in osrm_distance column are :-
 [ 11.9653  21.7243  32.5395 ...  97.0933 111.2709  88.7319]

----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in segment_actual_time column are :- 747
Unique Values in segment_actual_time column are :-
 [ 1.400e+01  1.000e+01  1.600e+01  2.100e+01  6.000e+00  1.500e+01
  2.800e+01  2.600e+01  3.800e+01  3.700e+01  4.100e+01  2.300e+01
  4.600e+01  3.000e+01  5.000e+01  9.300e+01  6.200e+01  4.900e+01
  2.700e+01  3.500e+01  6.700e+01  2.000e+01  5.100e+01  9.400e+01
  1.900e+01  1.200e+01  1.800e+01  1.100e+01  2.000e+00  1.300e+01
  2.400e+01  5.700e+01  1.000e+00  0.000e+00  2.200e+01  2.500e+01
  4.500e+01  8.000e+00  3.600e+01  4.200e+01  4.400e+01  7.500e+01
  7.800e+01  2.900e+01  3.400e+01  3.200e+01  6.000e+01  4.300e+01
  7.900e+01  4.000e+01  6.900e+01  5.800e+01  5.200e+01  4.800e+01
  5.500e+01  5.400e+01  4.700e+01  9.000e+00  8.700e+01  1.700e+01
  6.800e+01  5.600e+01  3.300e+01  4.000e+00  5.300e+01  2.000e+02
  6.500e+01  3.100e+01  8.800e+01  7.000e+00  8.400e+01  8.200e+01
  3.900e+01  1.010e+02  1.900e+02  2.020e+02  9.700e+01  8.600e+01
  2.910e+02  1.620e+02  4.310e+02  1.060e+02  1.530e+02  8.900e+01
  7.300e+01  3.000e+00  1.360e+02  6.600e+01  6.300e+01  5.000e+00
  4.220e+02  7.600e+01  8.300e+01  1.230e+02  7.200e+01  1.320e+02
  6.850e+02  1.038e+03  6.100e+01  5.900e+01  1.710e+02  1.410e+02
  7.000e+01  7.700e+01  1.250e+02  9.200e+01  7.100e+01  6.400e+01
  1.040e+02  1.120e+02  9.000e+01  9.800e+01  3.030e+02  1.240e+02
  8.100e+01  1.730e+02  9.100e+01  2.200e+02  1.750e+02  2.920e+02
  1.170e+02  4.680e+02  6.940e+02  1.090e+02  1.300e+02  3.710e+02
  6.110e+02 -2.600e+01  1.480e+02  1.070e+02  5.040e+02  1.150e+02
  8.000e+01  1.790e+02  1.080e+02  9.600e+01  1.000e+02  8.500e+01
  4.930e+02  4.440e+02  4.240e+02  7.600e+02  1.030e+02  2.320e+02
  1.490e+02  2.050e+02  9.420e+02  1.270e+02  7.400e+01  1.660e+02
  9.500e+01  1.440e+02  2.220e+02  1.540e+02  1.210e+02  1.840e+02
  3.250e+02  1.020e+02  5.270e+02  1.110e+02  5.390e+02  1.590e+02
  5.860e+02  3.460e+02  1.180e+02  3.190e+02  2.690e+02  2.950e+02
```

6.580e+02	2.410e+02	2.960e+02	9.900e+01	1.160e+02	1.140e+02
1.520e+02	-2.100e+01	2.130e+02	1.050e+02	1.220e+02	1.670e+02
-5.000e+00	1.780e+02	1.136e+03	1.190e+02	1.820e+02	2.120e+02
2.930e+02	1.870e+02	1.350e+02	9.010e+02	1.600e+02	2.240e+02
2.790e+02	1.280e+02	6.370e+02	1.310e+02	1.340e+02	5.590e+02
1.580e+02	1.200e+02	5.580e+02	3.940e+02	2.280e+02	2.770e+02
2.040e+02	2.297e+03	1.630e+02	1.130e+02	5.700e+02	2.720e+02
1.510e+02	7.080e+02	1.380e+02	2.810e+02	8.330e+02	-1.000e+00
5.020e+02	1.100e+02	1.570e+02	1.650e+02	2.080e+02	1.910e+02
3.480e+02	1.500e+02	1.430e+02	2.430e+02	2.330e+02	1.470e+02
3.550e+02	1.370e+02	6.590e+02	2.620e+02	2.440e+02	6.200e+02
1.810e+02	1.560e+02	2.700e+02	1.420e+02	6.270e+02	2.480e+02
2.510e+02	1.770e+02	1.860e+02	1.390e+02	2.880e+02	2.530e+02
2.230e+02	1.400e+02	1.330e+02	2.150e+02	3.470e+02	3.560e+02
2.670e+02	1.720e+02	1.290e+02	6.800e+02	3.450e+02	1.450e+02
4.760e+02	3.300e+02	1.880e+02	3.950e+02	3.850e+02	7.190e+02
1.039e+03	5.510e+02	4.590e+02	4.890e+02	2.100e+02	4.740e+02
1.700e+02	9.900e+02	1.550e+02	2.170e+02	3.230e+02	4.850e+02
3.180e+02	1.690e+02	4.190e+02	6.360e+02	1.850e+02	1.260e+02
3.020e+02	6.350e+02	2.030e+02	1.980e+02	3.600e+02	2.090e+02
2.290e+02	7.430e+02	1.117e+03	3.790e+02	3.090e+02	2.500e+02
1.460e+02	2.780e+02	3.140e+02	1.760e+02	2.340e+02	6.300e+02
3.930e+02	1.890e+02	4.160e+02	4.610e+02	2.630e+02	2.380e+02
1.140e+03	4.210e+02	2.260e+02	2.760e+02	1.610e+02	2.060e+02
1.153e+03	4.270e+02	3.390e+02	8.410e+02	5.220e+02	2.140e+02
1.830e+02	4.490e+02	6.120e+02	1.017e+03	1.640e+02	2.160e+02
3.520e+02	4.140e+02	4.470e+02	6.710e+02	2.210e+02	3.800e+02
2.940e+02	2.070e+02	2.370e+02	3.900e+02	3.750e+02	2.010e+02
1.800e+02	1.847e+03	3.880e+02	9.430e+02	5.160e+02	9.930e+02
2.640e+02	5.150e+02	9.470e+02	6.700e+02	1.680e+02	4.280e+02
4.040e+02	3.980e+02	2.270e+02	2.890e+02	3.990e+02	7.320e+02
5.560e+02	5.980e+02	1.050e+03	2.350e+02	7.660e+02	4.920e+02
6.460e+02	3.120e+02	6.950e+02	2.580e+02	3.590e+02	2.360e+02
3.540e+02	6.010e+02	6.400e+02	6.410e+02	5.070e+02	3.720e+02
2.750e+02	5.180e+02	4.400e+02	2.390e+02	5.100e+02	1.716e+03
7.410e+02	9.370e+02	3.860e+02	2.180e+02	2.650e+02	2.820e+02
2.990e+02	1.990e+02	6.890e+02	6.870e+02	3.220e+02	4.460e+02
3.810e+02	4.950e+02	5.930e+02	2.300e+02	9.340e+02	1.143e+03
3.840e+02	9.940e+02	3.160e+02	8.770e+02	4.150e+02	1.086e+03
1.960e+02	8.790e+02	8.960e+02	6.600e+02	5.240e+02	3.360e+02
5.440e+02	3.380e+02	6.620e+02	7.050e+02	3.110e+02	2.680e+02
1.211e+03	5.630e+02	1.981e+03	6.670e+02	3.320e+02	2.310e+02
8.430e+02	8.220e+02	-5.800e+01	5.730e+02	3.000e+02	-2.110e+02
1.740e+02	6.440e+02	3.570e+02	2.190e+02	2.600e+02	1.940e+02
2.110e+02	2.450e+02	2.032e+03	2.860e+02	2.710e+02	4.200e+02
5.430e+02	3.200e+02	5.570e+02	4.320e+02	2.460e+02	5.010e+02
6.480e+02	3.690e+02	5.250e+02	3.920e+02	6.430e+02	7.570e+02
4.780e+02	7.670e+02	2.850e+02	2.250e+02	7.170e+02	1.970e+02
9.580e+02	5.890e+02	4.620e+02	4.050e+02	1.036e+03	6.560e+02

```
  2.351e+03  4.520e+02  6.530e+02  2.740e+02  1.077e+03  5.210e+02
  4.830e+02  3.370e+02  4.500e+02  2.610e+02  9.500e+02  6.830e+02
  3.500e+02  2.400e+02  3.910e+02  9.910e+02  2.590e+02  2.281e+03
  5.910e+02  1.083e+03  3.280e+02  1.124e+03  1.207e+03  3.640e+02
  5.360e+02  4.330e+02  5.870e+02  4.510e+02  7.110e+02  2.550e+02
  2.980e+02 -1.200e+01  8.500e+02  9.350e+02  2.660e+02  5.480e+02
  4.900e+02  2.464e+03  3.650e+02  5.750e+02  6.420e+02 -3.600e+01
  1.008e+03  7.800e+02  2.540e+02  1.950e+02  3.820e+02  6.250e+02
  6.510e+02  4.770e+02  5.060e+02  6.180e+02  4.350e+02  6.690e+02
  9.920e+02  6.470e+02  3.270e+02  9.180e+02  1.067e+03  4.720e+02
  1.125e+03  7.370e+02  4.130e+02  1.046e+03  6.970e+02  6.390e+02
  4.290e+02  5.850e+02  3.080e+02  3.780e+02  5.400e+02  4.670e+02
  5.170e+02  8.690e+02  5.660e+02  2.520e+02  4.340e+02  3.510e+02
  6.230e+02  3.060e+02  7.680e+02  4.110e+02  1.065e+03 -4.200e+01
  5.110e+02  3.490e+02  5.340e+02  5.090e+02  4.560e+02  1.055e+03
  2.490e+02  4.410e+02 -5.100e+01  9.020e+02  3.010e+02  3.350e+02
  3.050e+02  9.530e+02  9.050e+02  6.650e+02  4.090e+02  4.980e+02
  5.690e+02  5.670e+02  5.950e+02  5.740e+02  7.990e+02  3.130e+02
  6.280e+02  4.600e+02  4.870e+02  1.630e+03  7.700e+02  2.120e+03
  2.800e+02  4.750e+02  4.800e+02  6.020e+02  4.660e+02  3.530e+02
  6.980e+02  1.131e+03  7.620e+02  7.180e+02  9.950e+02  8.090e+02
  2.730e+02  3.340e+02  2.970e+02  4.640e+02  4.170e+02 -2.440e+02
  6.000e+02  4.970e+02  8.140e+02  9.320e+02  8.700e+02  3.580e+02
  1.097e+03  6.260e+02  3.680e+02  7.550e+02  1.061e+03  1.032e+03
  4.230e+02  8.910e+02  3.240e+02  3.420e+02  6.820e+02  1.152e+03
  5.880e+02  4.100e+02  9.680e+02  7.710e+02  3.290e+02  7.310e+02
 -3.000e+00  9.590e+02  4.020e+02  1.166e+03  8.150e+02  4.960e+02
  4.390e+02  9.160e+02  1.182e+03  8.490e+02  2.830e+02  8.940e+02
  5.940e+02  5.280e+02  2.470e+02  2.900e+02  7.120e+02  1.041e+03
  2.420e+02  1.128e+03 -7.400e+01  7.070e+02  6.290e+02  3.330e+02
  5.600e+02  6.770e+02  6.100e+02  9.820e+02  1.920e+02  8.550e+02
  3.610e+02  6.210e+02  6.740e+02  1.001e+03  9.610e+02  7.330e+02
  6.880e+02  7.200e+02  3.310e+02  2.570e+02  2.408e+03  5.310e+02
  1.025e+03  8.400e+02  1.584e+03  1.246e+03  7.470e+02  8.930e+02
  6.310e+02  6.780e+02  4.010e+02  5.970e+02  9.270e+02  1.167e+03
  1.115e+03  3.260e+02  7.150e+02  1.930e+02  1.395e+03  9.670e+02
  5.370e+02  6.040e+02  3.210e+02  3.770e+02  8.510e+02  1.016e+03
  1.031e+03  4.550e+02  6.220e+02  3.890e+02  5.830e+02 -4.800e+01
  4.180e+02  1.047e+03  6.930e+02  9.700e+02  7.040e+02  7.850e+02
 -2.000e+00  2.491e+03  9.460e+02  4.650e+02  2.541e+03  1.122e+03
  3.051e+03  9.740e+02  9.780e+02  9.040e+02 -1.600e+01  8.530e+02
  4.790e+02  1.148e+03  5.720e+02  4.250e+02  5.530e+02  4.060e+02
 -7.000e+00  3.070e+02  1.093e+03  4.630e+02  9.390e+02  5.450e+02
  1.325e+03  9.150e+02  5.460e+02  7.530e+02  5.290e+02  4.370e+02
  5.200e+02  8.300e+02  1.677e+03  1.020e+03  7.480e+02  4.880e+02
  6.130e+02  9.510e+02  3.740e+02  7.360e+02  9.330e+02  5.790e+02
  2.625e+03  7.520e+02 -1.500e+01  1.192e+03  6.640e+02  1.320e+03
  2.870e+02  3.700e+02  1.104e+03]
```

```
-----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in segment_osrm_time column are :- 214
Unique Values in segment_osrm_time column are :-
 [1.100e+01 9.000e+00 7.000e+00 1.200e+01 5.000e+00 6.000e+00
1.000e+01
 2.400e+01 2.700e+01 2.600e+01 1.400e+01 1.500e+01 3.000e+01 1.800e+01
 3.800e+01 3.700e+01 2.500e+01 1.700e+01 2.200e+01 3.600e+01 3.200e+01
 1.600e+01 7.000e+01 3.500e+01 4.500e+01 1.300e+01 0.000e+00 8.000e+00
 2.000e+00 1.900e+01 2.300e+01 2.800e+01 2.000e+01 2.100e+01 3.300e+01
 3.400e+01 8.100e+01 3.000e+00 4.400e+01 1.000e+00 4.000e+00 3.900e+01
 4.000e+01 2.900e+01 5.300e+01 3.100e+01 7.500e+01 7.900e+01 9.700e+01
 4.800e+01 4.100e+01 4.300e+01 5.000e+01 5.400e+01 6.800e+01 4.200e+01
 4.600e+01 6.000e+01 5.800e+01 7.600e+01 4.900e+01 1.300e+02 7.800e+01
 6.700e+01 6.400e+01 5.500e+01 5.100e+01 1.420e+02 7.700e+01 7.100e+01
 5.600e+01 6.600e+01 5.900e+01 9.200e+01 6.200e+01 5.200e+01 5.700e+01
 8.000e+01 4.700e+01 7.400e+01 6.500e+01 8.800e+01 7.200e+01 6.900e+01
 7.300e+01 8.400e+01 8.200e+01 8.300e+01 1.540e+02 9.100e+01 6.100e+01
 9.400e+01 1.220e+02 6.300e+01 2.180e+02 9.800e+01 8.700e+01 3.830e+02
 9.000e+01 1.080e+02 9.300e+01 8.600e+01 8.900e+01 1.020e+02 1.600e+02
 2.210e+02 1.050e+02 1.330e+02 1.000e+02 1.060e+02 4.070e+02 8.500e+01
 1.340e+02 4.690e+02 1.800e+02 2.340e+02 1.490e+02 1.010e+02 1.450e+02
 1.140e+02 1.840e+02 2.270e+02 1.740e+02 1.320e+02 9.900e+01 9.600e+01
 1.310e+02 1.110e+02 1.040e+02 1.750e+02 2.300e+02 9.500e+01 1.250e+02
 2.950e+02 1.560e+02 1.160e+02 1.460e+02 1.410e+02 1.030e+02 1.170e+02
 2.310e+02 2.540e+02 2.200e+02 2.330e+02 1.810e+02 1.210e+02 1.270e+02
 3.700e+02 3.750e+02 1.500e+02 1.070e+02 1.610e+02 2.320e+02 1.090e+02
 1.200e+02 1.100e+02 9.970e+02 1.790e+02 1.130e+02 1.660e+02 9.960e+02
 1.240e+02 2.150e+02 1.570e+02 3.620e+02 1.430e+02 1.150e+02 1.280e+02
 1.700e+02 1.440e+02 2.350e+02 1.510e+02 3.560e+02 1.180e+02 1.390e+02
 1.710e+02 1.290e+02 1.190e+02 1.690e+02 1.630e+02 2.040e+02 1.480e+02
 1.830e+02 4.810e+02 3.410e+02 3.280e+02 2.130e+02 1.890e+02 1.910e+02
 1.400e+02 1.470e+02 2.080e+02 2.860e+02 2.160e+02 1.720e+02 1.380e+02
 1.670e+02 2.940e+02 1.230e+02 1.260e+02 2.110e+02 1.611e+03 2.190e+02
 2.490e+02 1.850e+02 1.580e+02 3.240e+02 1.770e+02 4.530e+02 1.520e+02
 1.760e+02 7.370e+02 1.730e+02 1.032e+03]

-----------------------------------------------------------------------
--------------------------------------------------

Total Unique Values in segment_osrm_distance column are :- 113799
Unique Values in segment_osrm_distance column are :-
 [11.9653  9.759  10.8152 ... 20.7053 18.8885  8.8088]

-----------------------------------------------------------------------
--------------------------------------------------
```

** Changing the Datatype of Columns**

```
dd.sample()
```

```
            data          trip_creation_time  \
124444  training  2018-09-23 02:44:13.665024

                                       route_schedule_uuid
route_type  \
124444  thanos::sroute:f01c8bbd-655d-42ea-9abf-60d5040...        FTL


                      trip_uuid source_center
source_name  \
124444  trip-153767065366477819  IND821115AAB  Sasaram_Central_I_2
(Bihar)

       destination_center                   destination_name  \
124444       IND209304AAA  Kanpur_Central_H_6 (Uttar Pradesh)

                     od_start_time                 od_end_time  \
124444  2018-09-23 17:32:37.941229  2018-09-24 04:42:20.756776

        start_scan_to_end_scan  actual_distance_to_destination
actual_time  \
124444                   669.0                       22.302481
27.0

        osrm_time  osrm_distance  segment_actual_time
segment_osrm_time  \
124444       17.0        25.4394                 27.0
17.0

        segment_osrm_distance
124444                25.4394
```

```
dd.dtypes
```

```
data                               object
trip_creation_time                 object
route_schedule_uuid                object
route_type                         object
trip_uuid                          object
source_center                      object
source_name                        object
destination_center                 object
destination_name                   object
od_start_time                      object
od_end_time                        object
start_scan_to_end_scan            float64
actual_distance_to_destination    float64
```

```
actual_time                               float64
osrm_time                                 float64
osrm_distance                             float64
segment_actual_time                       float64
segment_osrm_time                         float64
segment_osrm_distance                     float64
dtype: object

# Converting the datatypes to category for columns like data and
route_type as they only have 2 values.
dd['data'] = dd['data'].astype('category')
dd['route_type'] = dd['route_type'].astype('category')

# Converting time columns to datetime format
datetime_cols = ['trip_creation_time', 'od_start_time', 'od_end_time']
for _ in datetime_cols:
    dd[_] = pd.to_datetime(dd[_])

dd.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 144867 entries, 0 to 144866
Data columns (total 19 columns):
 #   Column                          Non-Null Count   Dtype
---  ------                          --------------   -----
 0   data                            144867 non-null  category
 1   trip_creation_time              144867 non-null  datetime64[ns]
 2   route_schedule_uuid             144867 non-null  object
 3   route_type                      144867 non-null  category
 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  datetime64[ns]
 10  od_end_time                     144867 non-null  datetime64[ns]
 11  start_scan_to_end_scan          144867 non-null  float64
 12  actual_distance_to_destination  144867 non-null  float64
 13  actual_time                     144867 non-null  float64
 14  osrm_time                       144867 non-null  float64
 15  osrm_distance                   144867 non-null  float64
 16  segment_actual_time             144867 non-null  float64
 17  segment_osrm_time               144867 non-null  float64
 18  segment_osrm_distance           144867 non-null  float64
dtypes: category(2), datetime64[ns](3), float64(8), object(6)
memory usage: 19.1+ MB

float_cols = []
for _ in dd.columns:
    if isinstance(dd[_],'float64'):
```

```
        float_cols.append(_)
float_cols
```

see y it didnt work

```
float_cols = []
for _ in dd.columns:
    if dd[_].dtype=='float64':
        float_cols.append(_)
float_cols
```

```
['start_scan_to_end_scan',
 'actual_distance_to_destination',
 'actual_time',
 'osrm_time',
 'osrm_distance',
 'segment_actual_time',
 'segment_osrm_time',
 'segment_osrm_distance']
```

```
# reducing the float64 to float32 to save memory
for _ in float_cols:
    dd[_] = dd[_].astype('float32')

dd.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 144867 entries, 0 to 144866
Data columns (total 19 columns):
 #   Column                          Non-Null Count   Dtype
---  ------                          --------------   -----
 0   data                            144867 non-null  category
 1   trip_creation_time              144867 non-null  datetime64[ns]
 2   route_schedule_uuid             144867 non-null  object
 3   route_type                      144867 non-null  category
 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  datetime64[ns]
 10  od_end_time                     144867 non-null  datetime64[ns]
 11  start_scan_to_end_scan          144867 non-null  float32
 12  actual_distance_to_destination  144867 non-null  float32
 13  actual_time                     144867 non-null  float32
 14  osrm_time                       144867 non-null  float32
 15  osrm_distance                   144867 non-null  float32
 16  segment_actual_time             144867 non-null  float32
 17  segment_osrm_time               144867 non-null  float32
 18  segment_osrm_distance           144867 non-null  float32
```

```
dtypes: category(2), datetime64[ns](3), float32(8), object(6)
memory usage: 14.6+ MB
```

Insights:

- Earlier the dataset was using 25.6+ MB of memory but now it has been reduced to 14.6 + MB. Around 40.63 % reduction in the memory usage.

```
# Time period of data
dd['trip_creation_time'].max(), dd['trip_creation_time'].min() ,
dd['trip_creation_time'].max()-dd['trip_creation_time'].min()

(Timestamp('2018-10-03 23:59:42.701692'),
 Timestamp('2018-09-12 00:00:16.535741'),
 Timedelta('21 days 23:59:26.165951'))

# Time period of data
dd['od_start_time'].max(), dd['od_start_time'].min(),
dd['od_start_time'].max() - dd['od_start_time'].min()

(Timestamp('2018-10-06 04:27:23.392375'),
 Timestamp('2018-09-12 00:00:16.535741'),
 Timedelta('24 days 04:27:06.856634'))

# Time period of data
dd['od_end_time'].max(), dd['od_end_time'].min(),
dd['od_end_time'].max() - dd['od_end_time'].min()

(Timestamp('2018-10-08 03:00:24.353479'),
 Timestamp('2018-09-12 00:50:10.814399'),
 Timedelta('26 days 02:10:13.539080'))

data_time_frame =  dd['od_end_time'].max() -
dd['trip_creation_time'].min()
data_time_frame

Timedelta('26 days 03:00:07.817738')
```

Null Treatment:

Replace null values in 'source_name' and 'destination_name' columns with 'unknown' through scikit imputation

columns_to_impute = ['source_name', 'destination_name']
imputer = SimpleImputer(strategy='constant', fill_value='unknown')
dd[columns_to_impute] = imputer.fit_transform(dd[columns_to_impute])

but 'unknown' transactions will be more and to be omitted while analyzing ... Hence `no use of imputing`....

```
dd[(dd.source_name.isna())&(dd.destination_name.isna())]
```

```
           data         trip_creation_time  \
68006  training 2018-09-26 22:21:56.619259
68007  training 2018-09-26 22:21:56.619259
68008  training 2018-09-26 22:21:56.619259

                                     route_schedule_uuid route_type  \
68006  thanos::sroute:cfb575b8-df26-48f5-8427-6f48f9d...        FTL
68007  thanos::sroute:cfb575b8-df26-48f5-8427-6f48f9d...        FTL
68008  thanos::sroute:cfb575b8-df26-48f5-8427-6f48f9d...        FTL

                     trip_uuid source_center source_name
destination_center  \
68006  trip-153800051661903546  IND331022A1B         NaN
IND331001A1C
68007  trip-153800051661903546  IND331022A1B         NaN
IND331001A1C
68008  trip-153800051661903546  IND331022A1B         NaN
IND331001A1C

      destination_name              od_start_time
od_end_time  \
68006              NaN 2018-09-27 03:19:14.797080 2018-09-27
05:28:00.922915
68007              NaN 2018-09-27 03:19:14.797080 2018-09-27
05:28:00.922915
68008              NaN 2018-09-27 03:19:14.797080 2018-09-27
05:28:00.922915

       start_scan_to_end_scan  actual_distance_to_destination
actual_time  \
68006                   128.0                       25.178606
26.0
68007                   128.0                       45.101166
114.0
68008                   128.0                       50.844666
128.0

       osrm_time  osrm_distance  segment_actual_time
segment_osrm_time  \
68006       23.0      25.724600                 26.0
23.0
68007       44.0      54.611000                 88.0
21.0
68008       49.0      60.920502                 13.0
4.0

       segment_osrm_distance
68006              25.724600
68007              28.886299
68008               6.309600
```

```
dd[dd.source_name.isna()]
```

```
             data         trip_creation_time  \
112      training 2018-09-25 08:53:04.377810
113      training 2018-09-25 08:53:04.377810
114      training 2018-09-25 08:53:04.377810
115      training 2018-09-25 08:53:04.377810
116      training 2018-09-25 08:53:04.377810
...           ...                        ...
144484       test 2018-10-03 09:06:06.690094
144485       test 2018-10-03 09:06:06.690094
144486       test 2018-10-03 09:06:06.690094
144487       test 2018-10-03 09:06:06.690094
144488       test 2018-10-03 09:06:06.690094

                                       route_schedule_uuid 
route_type  \
112     thanos::sroute:4460a38d-ab9b-484e-bd4e-f4201d0...        FTL

113     thanos::sroute:4460a38d-ab9b-484e-bd4e-f4201d0...        FTL

114     thanos::sroute:4460a38d-ab9b-484e-bd4e-f4201d0...        FTL

115     thanos::sroute:4460a38d-ab9b-484e-bd4e-f4201d0...        FTL

116     thanos::sroute:4460a38d-ab9b-484e-bd4e-f4201d0...        FTL

...                                                   ...        ...

144484  thanos::sroute:cbef3b6a-79ea-4d5e-a215-b558a70...        FTL

144485  thanos::sroute:cbef3b6a-79ea-4d5e-a215-b558a70...        FTL

144486  thanos::sroute:cbef3b6a-79ea-4d5e-a215-b558a70...        FTL

144487  thanos::sroute:cbef3b6a-79ea-4d5e-a215-b558a70...        FTL

144488  thanos::sroute:cbef3b6a-79ea-4d5e-a215-b558a70...        FTL


                      trip_uuid source_center source_name 
destination_center  \
112     trip-153786558437756691  IND342902A1B         NaN 
IND302014AAA
113     trip-153786558437756691  IND342902A1B         NaN 
IND302014AAA
114     trip-153786558437756691  IND342902A1B         NaN 
IND302014AAA
115     trip-153786558437756691  IND342902A1B         NaN 
IND302014AAA
116     trip-153786558437756691  IND342902A1B         NaN
```

```
IND302014AAA
...                           ...          ...         ...
...
144484  trip-153855756668984584  IND282002AAD         NaN
IND474003AAA
144485  trip-153855756668984584  IND282002AAD         NaN
IND474003AAA
144486  trip-153855756668984584  IND282002AAD         NaN
IND474003AAA
144487  trip-153855756668984584  IND282002AAD         NaN
IND474003AAA
144488  trip-153855756668984584  IND282002AAD         NaN
IND474003AAA

                           destination_name              od_start_time
\
112                    Jaipur_Hub (Rajasthan) 2018-09-26 06:58:08.054001

113                    Jaipur_Hub (Rajasthan) 2018-09-26 06:58:08.054001

114                    Jaipur_Hub (Rajasthan) 2018-09-26 06:58:08.054001

115                    Jaipur_Hub (Rajasthan) 2018-09-26 06:58:08.054001

116                    Jaipur_Hub (Rajasthan) 2018-09-26 06:58:08.054001

...                                       ...                        ...

144484  Gwalior_HrihrNgr_I (Madhya Pradesh) 2018-10-03 17:34:21.835475

144485  Gwalior_HrihrNgr_I (Madhya Pradesh) 2018-10-03 17:34:21.835475

144486  Gwalior_HrihrNgr_I (Madhya Pradesh) 2018-10-03 17:34:21.835475

144487  Gwalior_HrihrNgr_I (Madhya Pradesh) 2018-10-03 17:34:21.835475

144488  Gwalior_HrihrNgr_I (Madhya Pradesh) 2018-10-03 17:34:21.835475


                      od_end_time  start_scan_to_end_scan  \
112    2018-09-26 15:54:14.280942                   536.0
113    2018-09-26 15:54:14.280942                   536.0
114    2018-09-26 15:54:14.280942                   536.0
115    2018-09-26 15:54:14.280942                   536.0
116    2018-09-26 15:54:14.280942                   536.0
...                           ...                     ...
144484 2018-10-03 22:10:43.366324                   276.0
144485 2018-10-03 22:10:43.366324                   276.0
144486 2018-10-03 22:10:43.366324                   276.0
144487 2018-10-03 22:10:43.366324                   276.0
```

```
144488 2018-10-03 22:10:43.366324                   276.0

        actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
112                          22.783440         48.0       34.0
37.774899
113                          46.071251         98.0       41.0
56.357498
114                          67.714996        127.0       58.0
80.481102
115                          88.149643        156.0       73.0
101.255600
116                         112.691978        212.0       92.0
127.986000
...                                ...          ...        ...
...
144484                       45.134384         62.0       45.0
47.773399
144485                       66.542267         86.0       71.0
71.954903
144486                       88.143959        116.0      114.0
112.694298
144487                      111.084419        173.0      123.0
134.194000
144488                      108.820946        181.0      123.0
121.359802

        segment_actual_time  segment_osrm_time  segment_osrm_distance

112                    48.0               34.0              37.774899

113                    49.0               33.0              34.166100

114                    29.0               17.0              24.123600

115                    28.0               14.0              20.774599

116                    55.0               18.0              26.730400

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

144484                 34.0               23.0              23.660101

144485                 23.0               25.0              24.181499

144486                 30.0               43.0              40.739399

144487                 57.0               45.0              46.921700

144488                  8.0                4.0               6.510100
```

```
[293 rows x 19 columns]

dd[dd.destination_name.isna()]

             data        trip_creation_time  \
110      training 2018-09-25 08:53:04.377810
111      training 2018-09-25 08:53:04.377810
982          test 2018-10-01 20:56:18.155260
983          test 2018-10-01 20:56:18.155260
4882     training 2018-09-24 07:18:06.087341
...           ...                        ...
144478       test 2018-10-03 09:06:06.690094
144479       test 2018-10-03 09:06:06.690094
144480       test 2018-10-03 09:06:06.690094
144481       test 2018-10-03 09:06:06.690094
144482       test 2018-10-03 09:06:06.690094

                                      route_schedule_uuid
route_type  \
110      thanos::sroute:4460a38d-ab9b-484e-bd4e-f4201d0...        FTL

111      thanos::sroute:4460a38d-ab9b-484e-bd4e-f4201d0...        FTL

982      thanos::sroute:d0ebdacd-e09b-47d3-be77-c9c4a05...        FTL

983      thanos::sroute:d0ebdacd-e09b-47d3-be77-c9c4a05...        FTL

4882     thanos::sroute:2f43f11e-d3ba-4590-9355-82928e1...        FTL

...                                                    ...        ...

144478   thanos::sroute:cbef3b6a-79ea-4d5e-a215-b558a70...        FTL

144479   thanos::sroute:cbef3b6a-79ea-4d5e-a215-b558a70...        FTL

144480   thanos::sroute:cbef3b6a-79ea-4d5e-a215-b558a70...        FTL

144481   thanos::sroute:cbef3b6a-79ea-4d5e-a215-b558a70...        FTL

144482   thanos::sroute:cbef3b6a-79ea-4d5e-a215-b558a70...        FTL


                      trip_uuid source_center  \
110      trip-153786558437756691  IND342601AAA
111      trip-153786558437756691  IND342601AAA
982      trip-153842737815495661  IND573103AAA
983      trip-153842737815495661  IND573103AAA
4882     trip-153777348608709328  IND202001AAB
...                          ...           ...
144478   trip-153855756668984584  IND000000ACB
```

```
144479  trip-153855756668984584  IND000000ACB
144480  trip-153855756668984584  IND000000ACB
144481  trip-153855756668984584  IND000000ACB
144482  trip-153855756668984584  IND000000ACB

                               source_name destination_center  \
110       Piparcity_BsstdDPP_D (Rajasthan)       IND342902A1B
111       Piparcity_BsstdDPP_D (Rajasthan)       IND342902A1B
982        Arsikere_HsnRdDPP_D (Karnataka)       IND577116AAA
983        Arsikere_HsnRdDPP_D (Karnataka)       IND577116AAA
4882    Aligarh_KhirByps_I (Uttar Pradesh)       IND282002AAD
...                                    ...                ...
144478       Gurgaon_Bilaspur_HB (Haryana)       IND282002AAD
144479       Gurgaon_Bilaspur_HB (Haryana)       IND282002AAD
144480       Gurgaon_Bilaspur_HB (Haryana)       IND282002AAD
144481       Gurgaon_Bilaspur_HB (Haryana)       IND282002AAD
144482       Gurgaon_Bilaspur_HB (Haryana)       IND282002AAD

       destination_name              od_start_time
od_end_time  \
110                 NaN 2018-09-26 05:04:49.254901 2018-09-26
06:58:08.054001
111                 NaN 2018-09-26 05:04:49.254901 2018-09-26
06:58:08.054001
982                 NaN 2018-10-02 01:22:21.450243 2018-10-02
02:07:27.840862
983                 NaN 2018-10-02 01:22:21.450243 2018-10-02
02:07:27.840862
4882                NaN 2018-09-24 15:02:13.760270 2018-09-24
18:49:23.454535
...                 ...                        ...
...
144478              NaN 2018-10-03 09:06:06.690094 2018-10-03
17:34:21.835475
144479              NaN 2018-10-03 09:06:06.690094 2018-10-03
17:34:21.835475
144480              NaN 2018-10-03 09:06:06.690094 2018-10-03
17:34:21.835475
144481              NaN 2018-10-03 09:06:06.690094 2018-10-03
17:34:21.835475
144482              NaN 2018-10-03 09:06:06.690094 2018-10-03
17:34:21.835475

        start_scan_to_end_scan  actual_distance_to_destination
actual_time  \
110                      113.0                       24.538214
58.0
111                      113.0                       34.657707
110.0
982                       45.0                       22.029638
```

```
21.0
983                          45.0                           35.528961
36.0
4882                        227.0                           22.193687
40.0
...                           ...                                 ...
...
144478                      508.0                           89.773705
108.0
144479                      508.0                          110.854080
138.0
144480                      508.0                          132.514236
304.0
144481                      508.0                          154.024567
337.0
144482                      508.0                          159.222534
345.0

        osrm_time  osrm_distance  segment_actual_time
segment_osrm_time  \
110          33.0      30.884501                 58.0
33.0
111          43.0      41.536098                 52.0
10.0
982          16.0      22.962999                 21.0
16.0
983          25.0      36.505001                 15.0
9.0
4882         26.0      28.981701                 40.0
26.0
...           ...            ...                  ...                .
..
144478       70.0      99.409599                 21.0
16.0
144479       94.0     124.659798                 30.0
24.0
144480      119.0     147.229507                166.0
24.0
144481      130.0     177.239395                 33.0
27.0
144482      136.0     182.447998                  8.0
5.0

        segment_osrm_distance
110                 30.884501
111                 10.651700
982                 22.962999
983                 13.542000
4882                28.981701
```

```
...                          ...
144478               23.359501
144479               25.250200
144480               22.569700
144481               24.978399
144482                5.208600

[261 rows x 19 columns]
```

```
ddd = dd.copy()
```

```
missing_source_name = ddd.loc[ddd['source_name'].isnull(),
'source_center'].unique()
missing_source_name
```

```
array(['IND342902A1B', 'IND577116AAA', 'IND282002AAD', 'IND465333A1B',
       'IND841301AAC', 'IND509103AAC', 'IND126116AAA', 'IND331022A1B',
       'IND505326AAB', 'IND852118A1B'], dtype=object)
```

```
missing_destination_name = ddd.loc[ddd['destination_name'].isnull(),
'destination_center'].unique()
missing_destination_name
```

```
array(['IND342902A1B', 'IND577116AAA', 'IND282002AAD', 'IND465333A1B',
       'IND841301AAC', 'IND505326AAB', 'IND852118A1B', 'IND126116AAA',
       'IND509103AAC', 'IND221005A1A', 'IND250002AAC', 'IND331001A1C',
       'IND122015AAC'], dtype=object)
```

```
# checking if element of one np.array isin another np.array

#np.all(df.loc[df['source_name'].isnull(),
'source_center'].isin(missing_destination_name))

np.in1d(missing_source_name, missing_destination_name).all()
```

```
False
```

```
for _ in missing_source_name:
    unique_source_name = ddd.loc[ddd['source_center'] == _,
'source_name'].unique()
    if pd.isna(unique_source_name):
        print("Source Center :", _, "-" * 5, "Source Name :", 'NA')
    else :
        print("Source Center :", _, "-" * 5, "Source Name :",
unique_source_name)
```

```
Source Center : IND342902A1B ----- Source Name : NA
Source Center : IND577116AAA ----- Source Name : NA
Source Center : IND282002AAD ----- Source Name : NA
Source Center : IND465333A1B ----- Source Name : NA
Source Center : IND841301AAC ----- Source Name : NA
Source Center : IND509103AAC ----- Source Name : NA
```

```
Source Center : IND126116AAA ----- Source Name : NA
Source Center : IND331022A1B ----- Source Name : NA
Source Center : IND505326AAB ----- Source Name : NA
Source Center : IND852118A1B ----- Source Name : NA
```

```
for _ in missing_destination_name:
    unique_destination_name = ddd.loc[ddd['destination_center'] == _,
'destination_name'].unique()
    if pd.isna(unique_destination_name):
        print("Destination Center :", _, "-" * 5, "Destination
Name :", 'NA')
    else :
        print("Destination Center :", _, "-" * 5, "Destination
Name :", unique_destination_name)
```

```
Destination Center : IND342902A1B ----- Destination Name : NA
Destination Center : IND577116AAA ----- Destination Name : NA
Destination Center : IND282002AAD ----- Destination Name : NA
Destination Center : IND465333A1B ----- Destination Name : NA
Destination Center : IND841301AAC ----- Destination Name : NA
Destination Center : IND505326AAB ----- Destination Name : NA
Destination Center : IND852118A1B ----- Destination Name : NA
Destination Center : IND126116AAA ----- Destination Name : NA
Destination Center : IND509103AAC ----- Destination Name : NA
Destination Center : IND221005A1A ----- Destination Name : NA
Destination Center : IND250002AAC ----- Destination Name : NA
Destination Center : IND331001A1C ----- Destination Name : NA
Destination Center : IND122015AAC ----- Destination Name : NA
```

```
count = 1
for i in missing_destination_name:
    ddd.loc[ddd['destination_center'] == i, 'destination_name'] =
ddd.loc[ddd['destination_center'] == i,

'destination_name'].replace(np.nan, f'location_{count}')
    count += 1

d = {}
for i in missing_source_name:
    d[i] = ddd.loc[ddd['destination_center'] == i,
'destination_name'].unique()
for idx, val in d.items():
    if len(val) == 0:
        d[idx] = [f'location_{count}']
        count += 1
d2 = {}
for idx, val in d.items():
    d2[idx] = val[0]
for i, v in d2.items():
    print(i, v)
```

```
IND342902A1B location_1
IND577116AAA location_2
IND282002AAD location_3
IND465333A1B location_4
IND841301AAC location_5
IND509103AAC location_9
IND126116AAA location_8
IND331022A1B location_14
IND505326AAB location_6
IND852118A1B location_7
```

```
for i in missing_source_name:
    ddd.loc[ddd['source_center'] == i, 'source_name'] =
ddd.loc[ddd['source_center'] == i, 'source_name'].replace(np.nan,
d2[i])
```

```
ddd.source_name.value_counts()
```

```
source_name
Gurgaon_Bilaspur_HB (Haryana)            23347
Bangalore_Nelmngla_H (Karnataka)          9975
Bhiwandi_Mankoli_HB (Maharashtra)         9088
Pune_Tathawde_H (Maharashtra)             4061
Hyderabad_Shamshbd_H (Telangana)          3340
                                         ...
Badkulla_Central_DPP_1 (West Bengal)         1
Kasganj_BnkrGate_D (Uttar Pradesh)           1
Shahjhnpur_NavdaCln_D (Uttar Pradesh)        1
Jaunpur_Katghara_D (Uttar Pradesh)           1
Krishnanagar_AnadiDPP_D (West Bengal)        1
Name: count, Length: 1508, dtype: int64
```

```
ddd.destination_name.value_counts()
```

```
destination_name
Gurgaon_Bilaspur_HB (Haryana)        15192
Bangalore_Nelmngla_H (Karnataka)     11019
Bhiwandi_Mankoli_HB (Maharashtra)     5492
Hyderabad_Shamshbd_H (Telangana)      5142
Kolkata_Dankuni_HB (West Bengal)      4892
                                     ...
Vijayawada (Andhra Pradesh)              1
Ranaghat_ArickDPP_D (West Bengal)        1
Mumbai_Sanpada_CP (Maharashtra)          1
Delhi_Lajwanti (Delhi)                   1
Luxettipet_ShivaDPP_D (Telangana)        1
Name: count, Length: 1481, dtype: int64
```

even if we replace these nulls with some values, those are not gonna have any impact on the data.... so we can drop it as well..

```
261+290
```

```
551
```

```
len(delhivery_data)
```

```
144867
```

```
144867 - 551
```

```
144316
```

```
df = dd.dropna()
```

```
df.isna().sum().any()
```

```
False
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 144316 entries, 0 to 144866
Data columns (total 19 columns):
 #   Column                          Non-Null Count   Dtype
---  ------                          --------------   -----
 0   data                            144316 non-null  category
 1   trip_creation_time              144316 non-null  datetime64[ns]
 2   route_schedule_uuid             144316 non-null  object
 3   route_type                      144316 non-null  category
 4   trip_uuid                       144316 non-null  object
 5   source_center                   144316 non-null  object
 6   source_name                     144316 non-null  object
 7   destination_center              144316 non-null  object
 8   destination_name                144316 non-null  object
 9   od_start_time                   144316 non-null  datetime64[ns]
 10  od_end_time                     144316 non-null  datetime64[ns]
 11  start_scan_to_end_scan          144316 non-null  float32
 12  actual_distance_to_destination  144316 non-null  float32
 13  actual_time                     144316 non-null  float32
 14  osrm_time                       144316 non-null  float32
 15  osrm_distance                   144316 non-null  float32
 16  segment_actual_time             144316 non-null  float32
 17  segment_osrm_time               144316 non-null  float32
 18  segment_osrm_distance           144316 non-null  float32
dtypes: category(2), datetime64[ns](3), float32(8), object(6)
memory usage: 15.7+ MB
```

Insights:

- Only two fields have a tiny fraction of missing values, less than 0.05% of the whole dataset.

- Since we have plenty of data to work with, we're choosing to just get rid of the missing values instead of trying to guess them using methods like using the average or most common value.
- I'm dropping the missing values to keep things simple and not mess up how the features are spread out. But if a lot more data was missing, we could have used other methods like guessing based on what's there or using the most common values.

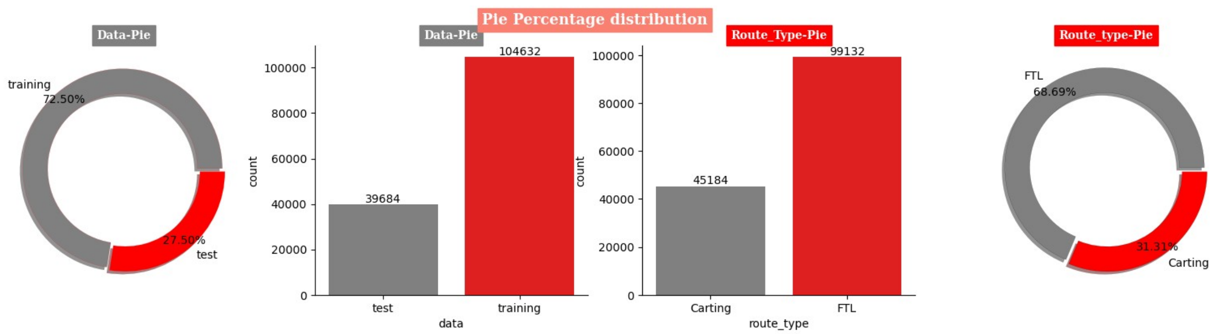
Exploratory Data Analysis

```
cp =
['gray','red','dimgrey','tomato','dimgray','orangered','k','salmon','g
ray','red','dimgrey','tomato','dimgray','orangered','k','salmon']

df.sample()
```

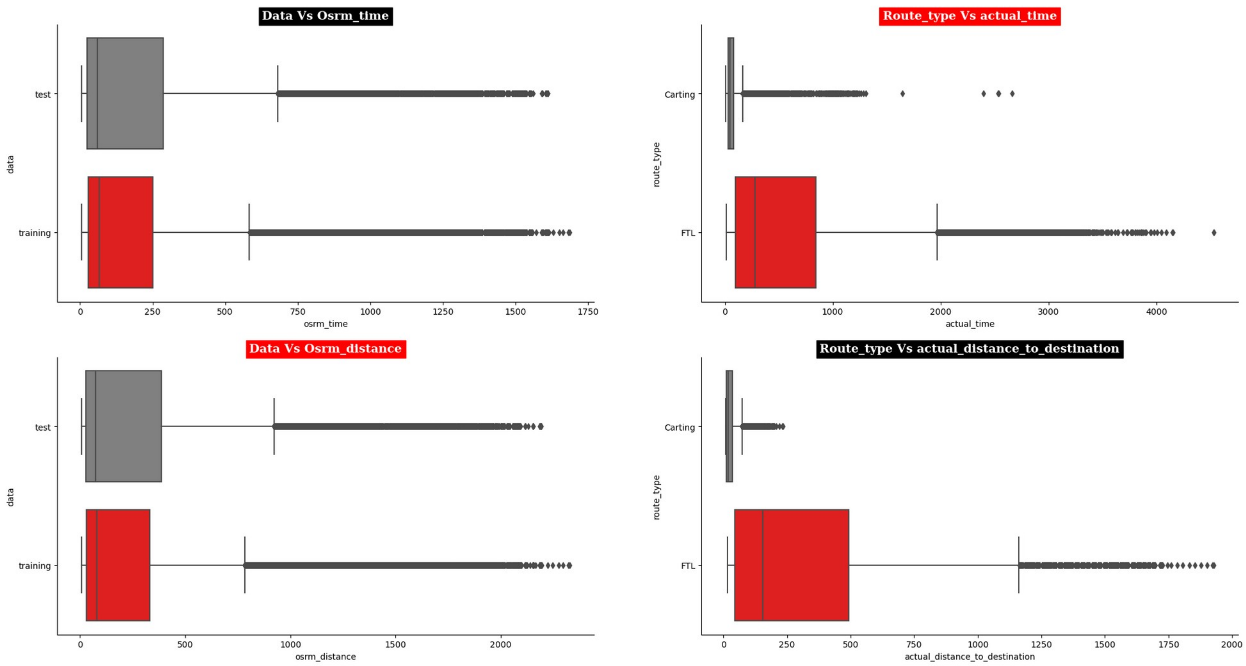
```
           data         trip_creation_time  \
92389  training 2018-09-14 23:36:50.771430

                                     route_schedule_uuid route_type  \
92389  thanos::sroute:3f001d56-e933-4ba1-a7cf-26828f7...    Carting

                     trip_uuid source_center  \
92389  trip-153696821077115152  IND515201AAA

                              source_name destination_center  \
92389  Hindupur_Parigi_D (Andhra Pradesh)       IND515301AAA

                             destination_name
od_start_time  \
92389  Madakasira_RTCStand_D (Andhra Pradesh) 2018-09-15
01:35:41.452946

                     od_end_time  start_scan_to_end_scan  \
92389 2018-09-15 02:46:18.759915                    70.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
92389                       25.308775         51.0       21.0
30.9918

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
92389                 20.0                5.0                 8.1409


                                             segment_key  \
92389  trip-153696821077115152+IND515201AAA+IND515301AAA

       segment_actual_time_sum  segment_osrm_distance_sum  \
92389                     50.0                  30.991899
```

```
       segment_osrm_time_sum
92389                   20.0
```

```
plt.figure(figsize=(20,4))
plt.suptitle('Pie Percentage
distribution',fontsize=13,fontfamily='serif',fontweight='bold',backgro
undcolor=cp[-1],color='w')

plt.subplot(141)
plt.pie(df['data'].value_counts(),
labels=df['data'].value_counts().index, colors=cp,counterclock=True ,
explode=(0.02,0.02) , autopct='%.2f%%', pctdistance=0.905,
       textprops={'color':'k','fontsize':10} , shadow=True,
radius=1,wedgeprops=dict(edgecolor='r',linewidth=0.1,width=0.25))
plt.title('Data-
Pie',fontsize=10,fontfamily='serif',fontweight='bold',backgroundcolor=
cp[0],color='w')

plt.subplot(142)
a = sns.barplot(x=df['data'].value_counts().index,
y=df['data'].value_counts(), palette=cp)
a.bar_label(a.containers[0], label_type='edge',fmt='%d')
plt.title('Data-
Pie',fontsize=10,fontfamily='serif',fontweight='bold',backgroundcolor=
cp[0],color='w')

plt.subplot(143)
b = sns.barplot(x=df['route_type'].value_counts().index,
y=df['route_type'].value_counts(), palette=cp)
b.bar_label(b.containers[0], label_type='edge',fmt='%d')
plt.title('Route_Type-
Pie',fontsize=10,fontfamily='serif',fontweight='bold',backgroundcolor=
cp[1],color='w')

plt.subplot(144)
plt.pie(df['route_type'].value_counts(),
labels=df['route_type'].value_counts().index,
colors=cp,counterclock=True , explode=(0.03,0.02) , autopct='%.2f%%',
pctdistance=0.905,
       textprops={'color':'k','fontsize':10} , shadow=True,
radius=1,wedgeprops=dict(edgecolor='k',linewidth=0.1,width=0.25))
plt.title('Route_type-
Pie',fontsize=10,fontfamily='serif',fontweight='bold',backgroundcolor=
cp[1],color='w')

sns.despine()
plt.show()
```




```
plt.figure(figsize=(25,13))
plt.style.use('default')
plt.style.use('seaborn-bright')

plt.subplot(221)
sns.boxplot(data=df,y='data',x='osrm_time',palette=cp)
plt.title('Data Vs Osrm_time',fontsize=14,fontfamily='serif',fontweight='bold',backgroundcolor='k',color='w')

plt.subplot(222)
sns.boxplot(data=df,y='route_type',x='actual_time',palette=cp)
plt.title('Route_type Vs actual_time',fontsize=14,fontfamily='serif',fontweight='bold',backgroundcolor='r',color='w')

plt.subplot(223)
sns.boxplot(data=df,y='data',x='osrm_distance',palette=cp)
plt.title('Data Vs Osrm_distance',fontsize=14,fontfamily='serif',fontweight='bold',backgroundcolor='r',color='w')

plt.subplot(224)
sns.boxplot(data=df,y='route_type',x='actual_distance_to_destination',palette=cp)
plt.title('Route_type Vs actual_distance_to_destination',fontsize=14,fontfamily='serif',fontweight='bold',backgroundcolor='k',color='w')
sns.despine()
plt.show()
```



Observations:

- Both training and test data have the same range of osrm time recorded
- FTL route type has more actual time compared to Carting. This can also be since FTL is used a lot more than carting in the data available to us
- Both training and test data have the same range of osrm distance recorded
- FTL route type has more actual distance compared to Carting. This can also be since FTL is used a lot more than carting in the data available to us

---

2.Merging of rows and aggregation of fields

Merging of rows and aggregation of fields

- Since delivery details of one package are divided into several rows (think of it as connecting flights to reach a particular destination). Now think about how we should treat their fields if we combine these rows? What aggregation would make sense if we merge. What would happen to the numeric fields if we merge the rows.

```
# Grouping by segment
# Creating a unique identifier for each segment of a trip

segment_cols = ['segment_actual_time', 'segment_osrm_distance',
'segment_osrm_time']

df['segment_key'] = df['trip_uuid'] + '+' + df['source_center'] + '+'
+ df['destination_center']

for col in segment_cols:
    df[col + '_sum'] = df.groupby('segment_key')[col].cumsum()
```

```
df[['segment_key', 'segment_actual_time',
'segment_actual_time_sum','segment_osrm_distance',
'segment_osrm_distance_sum','segment_osrm_time',
'segment_osrm_time_sum']]
```

```
                                             segment_key  \
0       trip-153741093647649320+IND388121AAA+IND388620AAB
1       trip-153741093647649320+IND388121AAA+IND388620AAB
2       trip-153741093647649320+IND388121AAA+IND388620AAB
3       trip-153741093647649320+IND388121AAA+IND388620AAB
4       trip-153741093647649320+IND388121AAA+IND388620AAB
...                                                  ...
144862  trip-153746066843555182+IND131028AAB+IND000000ACB
144863  trip-153746066843555182+IND131028AAB+IND000000ACB
144864  trip-153746066843555182+IND131028AAB+IND000000ACB
144865  trip-153746066843555182+IND131028AAB+IND000000ACB
144866  trip-153746066843555182+IND131028AAB+IND000000ACB

        segment_actual_time  segment_actual_time_sum
segment_osrm_distance  \
0                      14.0                     14.0
11.965300
1                      10.0                     24.0
9.759000
2                      16.0                     40.0
10.815200
3                      21.0                     61.0
13.022400
4                       6.0                     67.0
3.915300
...                     ...                      ...
...
144862                 12.0                     92.0
8.185800
144863                 26.0                    118.0
17.372499
144864                 20.0                    138.0
20.705299
144865                 17.0                    155.0
18.888500
144866                268.0                    423.0
8.808800

        segment_osrm_distance_sum  segment_osrm_time
segment_osrm_time_sum
0                       11.965300               11.0
11.0
1                       21.724300                9.0
20.0
```

```
2                            32.539497                    7.0
27.0
3                            45.561897                   12.0
39.0
4                            49.477200                    5.0
44.0
...                                ...                    ...
...
144862                       65.348701                   12.0
94.0
144863                       82.721199                   21.0
115.0
144864                      103.426498                   34.0
149.0
144865                      122.315002                   27.0
176.0
144866                      131.123795                    9.0
185.0

[144316 rows x 7 columns]
```

```
# Aggregating at segment level & Creating a dictionary for aggregation
at segment level

segment_dict = {
  'trip_uuid' : 'first',
  'data': 'first',
  'route_type': 'first',
  'trip_creation_time': 'first',
  'source_name': 'first',
  'destination_name': 'last',
  'od_start_time': 'first',
  'od_end_time': 'last',
  'start_scan_to_end_scan': 'first',
  'actual_distance_to_destination': 'last',
  'actual_time': 'last',
  'osrm_time': 'last',
  'osrm_distance': 'last',
  'segment_actual_time' : 'sum',
  'segment_osrm_time' : 'sum',
  'segment_osrm_distance' : 'sum',
  'segment_actual_time_sum': 'last',
  'segment_osrm_time_sum': 'last',
  'segment_osrm_distance_sum': 'last',
}

# Grouping by segment_key and aggregating
segment_agg_data =
df.groupby('segment_key').agg(segment_dict).reset_index()
segment_agg_data =
```

```
segment_agg_data.sort_values(by=['segment_key','od_end_time'])
segment_agg_data
```

```
                                                   segment_key  \
0      trip-153671041653548748+IND209304AAA+IND000000ACB
1      trip-153671041653548748+IND462022AAA+IND209304AAA
2      trip-153671042288605164+IND561203AAB+IND562101AAA
3      trip-153671042288605164+IND572101AAA+IND561203AAB
4      trip-153671043369099517+IND000000ACB+IND160002AAC
...                                                  ...
26217  trip-153861115439069069+IND628204AAA+IND627657AAA
26218  trip-153861115439069069+IND628613AAA+IND627005AAA
26219  trip-153861115439069069+IND628801AAA+IND628204AAA
26220  trip-153861118270144424+IND583119AAA+IND583101AAA
26221  trip-153861118270144424+IND583201AAA+IND583119AAA

                     trip_uuid      data route_type  \
0      trip-153671041653548748  training        FTL
1      trip-153671041653548748  training        FTL
2      trip-153671042288605164  training    Carting
3      trip-153671042288605164  training    Carting
4      trip-153671043369099517  training        FTL
...                        ...       ...        ...
26217  trip-153861115439069069      test    Carting
26218  trip-153861115439069069      test    Carting
26219  trip-153861115439069069      test    Carting
26220  trip-153861118270144424      test        FTL
26221  trip-153861118270144424      test        FTL

              trip_creation_time
source_name  \
0     2018-09-12 00:00:16.535741  Kanpur_Central_H_6 (Uttar Pradesh)

1     2018-09-12 00:00:16.535741  Bhopal_Trnsport_H (Madhya Pradesh)

2     2018-09-12 00:00:22.886430   Doddablpur_ChikaDPP_D (Karnataka)

3     2018-09-12 00:00:22.886430       Tumkur_Veersagr_I (Karnataka)

4     2018-09-12 00:00:33.691250       Gurgaon_Bilaspur_HB (Haryana)

...                          ...                                 ...

26217 2018-10-03 23:59:14.390954  Tirchchndr_Shnmgprm_D (Tamil Nadu)

26218 2018-10-03 23:59:14.390954   Peikulam_SriVnktpm_D (Tamil Nadu)

26219 2018-10-03 23:59:14.390954        Eral_Busstand_D (Tamil Nadu)

26220 2018-10-03 23:59:42.701692       Sandur_WrdN1DPP_D (Karnataka)
```

```
26221 2018-10-03 23:59:42.701692                  Hospet (Karnataka)


                            destination_name
od_start_time  \
0              Gurgaon_Bilaspur_HB (Haryana) 2018-09-12
16:39:46.858469
1         Kanpur_Central_H_6 (Uttar Pradesh) 2018-09-12
00:00:16.535741
2          Chikblapur_ShntiSgr_D (Karnataka) 2018-09-12
02:03:09.655591
3          Doddablpur_ChikaDPP_D (Karnataka) 2018-09-12
00:00:22.886430
4             Chandigarh_Mehmdpur_H (Punjab) 2018-09-14
03:40:17.106733
...                                      ...                        ..
.
26217  Thisayanvilai_UdnkdiRD_D (Tamil Nadu) 2018-10-04
02:29:04.272194
26218    Tirunelveli_VdkkuSrt_I (Tamil Nadu) 2018-10-04
04:16:39.894872
26219     Tirchchndr_Shnmgprm_D (Tamil Nadu) 2018-10-04
01:44:53.808000
26220                Bellary_Dc (Karnataka) 2018-10-04
03:58:40.726547
26221           Sandur_WrdN1DPP_D (Karnataka) 2018-10-04
02:51:44.712656

                      od_end_time  start_scan_to_end_scan  \
0     2018-09-13 13:40:23.123744                  1260.0
1     2018-09-12 16:39:46.858469                   999.0
2     2018-09-12 03:01:59.598855                    58.0
3     2018-09-12 02:03:09.655591                   122.0
4     2018-09-14 17:34:55.442454                   834.0
...                          ...                     ...
26217 2018-10-04 03:31:11.183797                    62.0
26218 2018-10-04 05:47:45.162682                    91.0
26219 2018-10-04 02:29:04.272194                    44.0
26220 2018-10-04 08:46:09.166940                   287.0
26221 2018-10-04 03:58:40.726547                    66.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                          383.759155        732.0      329.0
446.549591
1                          440.973694        830.0      388.0
544.802673
2                           24.644020         47.0       26.0
28.199400
3                           48.542889         96.0       42.0
```

```
56.911598
4                           237.439606       611.0      212.0
281.210907
...                                ...         ...        ...
...
26217                        33.627182        51.0       41.0
42.521301
26218                        33.673836        90.0       48.0
40.608002
26219                        12.661944        30.0       14.0
16.018499
26220                        40.546738       233.0       42.0
52.530300
26221                        25.534794        42.0       26.0
28.048401

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                    728.0              534.0             670.620483

1                    820.0              474.0             649.852783

2                     46.0               26.0              28.199501

3                     95.0               39.0              55.989899

4                    608.0              231.0             317.740784

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

26217                 49.0               42.0              42.143101

26218                 89.0               77.0              78.586899

26219                 29.0               14.0              16.018400

26220                233.0               42.0              52.530300

26221                 41.0               25.0              28.048401


       segment_actual_time_sum  segment_osrm_time_sum  \
0                        728.0                  534.0
1                        820.0                  474.0
2                         46.0                   26.0
3                         95.0                   39.0
4                        608.0                  231.0
...                        ...                    ...
26217                     49.0                   42.0
26218                     89.0                   77.0
```

```
26219                           29.0                       14.0
26220                          233.0                       42.0
26221                           41.0                       25.0

       segment_osrm_distance_sum
0                     670.620483
1                     649.852783
2                      28.199501
3                      55.989899
4                     317.740784
...                          ...
26217                  42.143101
26218                  78.586899
26219                  16.018400
26220                  52.530300
26221                  28.048401

[26222 rows x 20 columns]
```

Understanding:

- The rows have been merged based on the unique segment_key, which is a combination of trip_uuid, source_center, and destination_center.
- The aggregated dataset reflects the total values for each segment of the trip.

Feature Engineering

```
# 1. Calculating time difference between od_start_time and od_end_time
segment_agg_data['od_total_time']=(segment_agg_data['od_end_time'] -
segment_agg_data['od_start_time'])
segment_agg_data['od_time_diff_hour'] =
(segment_agg_data['od_total_time']).dt.total_seconds()/3600
segment_agg_data
```

```
                                                 segment_key  \
0      trip-153671041653548748+IND209304AAA+IND000000ACB
1      trip-153671041653548748+IND462022AAA+IND209304AAA
2      trip-153671042288605164+IND561203AAB+IND562101AAA
3      trip-153671042288605164+IND572101AAA+IND561203AAB
4      trip-153671043369099517+IND000000ACB+IND160002AAC
...                                                  ...
26217  trip-153861115439069069+IND628204AAA+IND627657AAA
26218  trip-153861115439069069+IND628613AAA+IND627005AAA
26219  trip-153861115439069069+IND628801AAA+IND628204AAA
26220  trip-153861118270144424+IND583119AAA+IND583101AAA
26221  trip-153861118270144424+IND583201AAA+IND583119AAA

                     trip_uuid      data route_type  \
```

```
0      trip-153671041653548748  training       FTL
1      trip-153671041653548748  training       FTL
2      trip-153671042288605164  training   Carting
3      trip-153671042288605164  training   Carting
4      trip-153671043369099517  training       FTL
...                        ...       ...       ...
26217  trip-153861115439069069      test   Carting
26218  trip-153861115439069069      test   Carting
26219  trip-153861115439069069      test   Carting
26220  trip-153861118270144424      test       FTL
26221  trip-153861118270144424      test       FTL

              trip_creation_time
source_name  \
0     2018-09-12 00:00:16.535741  Kanpur_Central_H_6 (Uttar Pradesh)

1     2018-09-12 00:00:16.535741  Bhopal_Trnsport_H (Madhya Pradesh)

2     2018-09-12 00:00:22.886430   Doddablpur_ChikaDPP_D (Karnataka)

3     2018-09-12 00:00:22.886430       Tumkur_Veersagr_I (Karnataka)

4     2018-09-12 00:00:33.691250       Gurgaon_Bilaspur_HB (Haryana)

...                          ...                                 ...

26217 2018-10-03 23:59:14.390954  Tirchchndr_Shnmgprm_D (Tamil Nadu)

26218 2018-10-03 23:59:14.390954   Peikulam_SriVnktpm_D (Tamil Nadu)

26219 2018-10-03 23:59:14.390954        Eral_Busstand_D (Tamil Nadu)

26220 2018-10-03 23:59:42.701692       Sandur_WrdN1DPP_D (Karnataka)

26221 2018-10-03 23:59:42.701692                  Hospet (Karnataka)


                            destination_name
od_start_time  \
0              Gurgaon_Bilaspur_HB (Haryana) 2018-09-12
16:39:46.858469
1         Kanpur_Central_H_6 (Uttar Pradesh) 2018-09-12
00:00:16.535741
2          Chikblapur_ShntiSgr_D (Karnataka) 2018-09-12
02:03:09.655591
3          Doddablpur_ChikaDPP_D (Karnataka) 2018-09-12
00:00:22.886430
4             Chandigarh_Mehmdpur_H (Punjab) 2018-09-14
03:40:17.106733
...                                      ...                       ..
```

```
.
26217  Thisayanvilai_UdnkdiRD_D (Tamil Nadu) 2018-10-04
02:29:04.272194
26218    Tirunelveli_VdkkuSrt_I (Tamil Nadu) 2018-10-04
04:16:39.894872
26219     Tirchchndr_Shnmgprm_D (Tamil Nadu) 2018-10-04
01:44:53.808000
26220                Bellary_Dc (Karnataka) 2018-10-04
03:58:40.726547
26221          Sandur_WrdN1DPP_D (Karnataka) 2018-10-04
02:51:44.712656

                     od_end_time  start_scan_to_end_scan  \
0     2018-09-13 13:40:23.123744                  1260.0
1     2018-09-12 16:39:46.858469                   999.0
2     2018-09-12 03:01:59.598855                    58.0
3     2018-09-12 02:03:09.655591                   122.0
4     2018-09-14 17:34:55.442454                   834.0
...                          ...                     ...
26217 2018-10-04 03:31:11.183797                    62.0
26218 2018-10-04 05:47:45.162682                    91.0
26219 2018-10-04 02:29:04.272194                    44.0
26220 2018-10-04 08:46:09.166940                   287.0
26221 2018-10-04 03:58:40.726547                    66.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                          383.759155        732.0      329.0
446.549591
1                          440.973694        830.0      388.0
544.802673
2                           24.644020         47.0       26.0
28.199400
3                           48.542889         96.0       42.0
56.911598
4                          237.439606        611.0      212.0
281.210907
...                               ...          ...        ...
...
26217                       33.627182         51.0       41.0
42.521301
26218                       33.673836         90.0       48.0
40.608002
26219                       12.661944         30.0       14.0
16.018499
26220                       40.546738        233.0       42.0
52.530300
26221                       25.534794         42.0       26.0
28.048401
```

```
       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                    728.0              534.0              670.620483

1                    820.0              474.0              649.852783

2                     46.0               26.0               28.199501

3                     95.0               39.0               55.989899

4                    608.0              231.0              317.740784

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

26217                 49.0               42.0               42.143101

26218                 89.0               77.0               78.586899

26219                 29.0               14.0               16.018400

26220                233.0               42.0               52.530300

26221                 41.0               25.0               28.048401


       segment_actual_time_sum  segment_osrm_time_sum  \
0                        728.0                  534.0
1                        820.0                  474.0
2                         46.0                   26.0
3                         95.0                   39.0
4                        608.0                  231.0
...                        ...                    ...
26217                     49.0                   42.0
26218                     89.0                   77.0
26219                     29.0                   14.0
26220                    233.0                   42.0
26221                     41.0                   25.0

       segment_osrm_distance_sum          od_total_time
od_time_diff_hour
0                     670.620483 0 days 21:00:36.265275
21.010074
1                     649.852783 0 days 16:39:30.322728
16.658423
2                      28.199501 0 days 00:58:49.943264
0.980540
3                      55.989899 0 days 02:02:46.769161
2.046325
4                     317.740784 0 days 13:54:38.335721
13.910649
```

```
...                            ...                      ...
...
26217                  42.143101 0 days 01:02:06.911603
1.035253
26218                  78.586899 0 days 01:31:05.267810
1.518130
26219                  16.018400 0 days 00:44:10.464194
0.736240
26220                  52.530300 0 days 04:47:28.440393
4.791233
26221                  28.048401 0 days 01:06:56.013891
1.115559

[26222 rows x 22 columns]
```

```
segment_agg_data.sample()
```

```
                                            segment_key  \
4965  trip-153704666810685062+IND173025AAA+IND160002AAC

                    trip_uuid      data route_type
trip_creation_time  \
4965  trip-153704666810685062  training        FTL 2018-09-15
21:24:28.108007

                                   source_name  \
4965  PaontSahib_Gurudwar_D (Himachal Pradesh)

                    destination_name              od_start_time  \
4965  Chandigarh_Mehmdpur_H (Punjab) 2018-09-16 09:10:26.756767

                    od_end_time  start_scan_to_end_scan  \
4965 2018-09-16 14:11:04.351703                   300.0

      actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
4965                       85.146751        198.0      100.0
106.438904

      segment_actual_time  segment_osrm_time  segment_osrm_distance  \
4965                197.0               99.0             121.251198

      segment_actual_time_sum  segment_osrm_time_sum  \
4965                    197.0                   99.0

      segment_osrm_distance_sum          od_total_time
od_time_diff_hour
4965                 121.251198 0 days 05:00:37.594936
5.010443
```

```
# de =
segment_agg_data.drop(columns=['source_city','source_state','source_pl
ace','destination_place','destination_city','destination_state'])
de = segment_agg_data.copy()

de.sample()

                                            segment_key  \
4962  trip-153704666399260818+IND421302AAG+IND401104AAA

                    trip_uuid      data route_type
trip_creation_time  \
4962  trip-153704666399260818  training    Carting 2018-09-15
21:24:23.992906

                            source_name
destination_name  \
4962  Bhiwandi_Mankoli_HB (Maharashtra)  Mumbai_MiraRd_IP
(Maharashtra)

                  od_start_time                od_end_time  \
4962 2018-09-15 21:24:23.992906 2018-09-16 01:16:04.776133

      start_scan_to_end_scan  actual_distance_to_destination
actual_time  \
4962                   231.0                        16.74782
102.0

      osrm_time  osrm_distance  segment_actual_time  segment_osrm_time
\
4962       26.0      29.297199                102.0               25.0


      segment_osrm_distance  segment_actual_time_sum
segment_osrm_time_sum  \
4962              29.297199                    102.0
25.0

      segment_osrm_distance_sum          od_total_time
od_time_diff_hour
4962                  29.297199 0 days 03:51:40.783227
3.861329

# # could have done this --- but some major error ... check it....
# sad = segment_agg_data.copy()
# sad["source_city"] = sad["source_name"].str.split("
",n=1,expand=True)[0].str.split("_",n=1,expand=True)[0]
# sad["source_state"] = sad["source_name"].str.split("
",n=1,expand=True)[1].str.replace("(","").str.replace(")","")

# sad["destination_city"] = sad["destination_name"].str.split("
```

```
",n=1,expand=True)[0].str.split("_",n=1,expand=True)[0]
# sad["destination_state"] = sad["destination_name"].str.split("
",n=1,expand=True)[1].str.replace("(","").str.replace(")","")

# sad["source_place"] =
sad["source_name"].str.split("_",n=2,expand=True)[1]
# sad["destination_place"] =
sad["destination_name"].str.split("_",n=2,expand=True)[1]

# using regex pattern to seperate the city,place,state
def extract_info(name):
    pattern = r'^(?P<city>[^\s_]+)_?(?P<place>[^\(\)]*)\s?\((?
P<state>[A-Za-z\s&]+)\)$'
    match = re.match(pattern, name)
    if match:
        city = match.group('city').strip()
        place = match.group('place').strip() if match.group('place')
else city
        state = match.group('state').strip()
        return city, place, state
    else:
        return None, None, None

de[['source_city', 'source_place', 'source_state']] =
de['source_name'].apply(lambda x: pd.Series(extract_info(x)))

de[['destination_city', 'destination_place', 'destination_state']] =
de['destination_name'].apply(lambda x: pd.Series(extract_info(x)))

de
```

```
                                             segment_key  \
0      trip-153671041653548748+IND209304AAA+IND000000ACB
1      trip-153671041653548748+IND462022AAA+IND209304AAA
2      trip-153671042288605164+IND561203AAB+IND562101AAA
3      trip-153671042288605164+IND572101AAA+IND561203AAB
4      trip-153671043369099517+IND000000ACB+IND160002AAC
...                                                  ...
26217  trip-153861115439069069+IND628204AAA+IND627657AAA
26218  trip-153861115439069069+IND628613AAA+IND627005AAA
26219  trip-153861115439069069+IND628801AAA+IND628204AAA
26220  trip-153861118270144424+IND583119AAA+IND583101AAA
26221  trip-153861118270144424+IND583201AAA+IND583119AAA

                     trip_uuid      data route_type  \
0      trip-153671041653548748  training        FTL
1      trip-153671041653548748  training        FTL
2      trip-153671042288605164  training    Carting
3      trip-153671042288605164  training    Carting
4      trip-153671043369099517  training        FTL
...                        ...       ...        ...
```

```
26217  trip-153861115439069069      test    Carting
26218  trip-153861115439069069      test    Carting
26219  trip-153861115439069069      test    Carting
26220  trip-153861118270144424      test        FTL
26221  trip-153861118270144424      test        FTL

              trip_creation_time
source_name  \
0     2018-09-12 00:00:16.535741  Kanpur_Central_H_6 (Uttar Pradesh)

1     2018-09-12 00:00:16.535741  Bhopal_Trnsport_H (Madhya Pradesh)

2     2018-09-12 00:00:22.886430   Doddablpur_ChikaDPP_D (Karnataka)

3     2018-09-12 00:00:22.886430       Tumkur_Veersagr_I (Karnataka)

4     2018-09-12 00:00:33.691250       Gurgaon_Bilaspur_HB (Haryana)

...                          ...                                 ...

26217 2018-10-03 23:59:14.390954  Tirchchndr_Shnmgprm_D (Tamil Nadu)

26218 2018-10-03 23:59:14.390954   Peikulam_SriVnktpm_D (Tamil Nadu)

26219 2018-10-03 23:59:14.390954        Eral_Busstand_D (Tamil Nadu)

26220 2018-10-03 23:59:42.701692       Sandur_WrdN1DPP_D (Karnataka)

26221 2018-10-03 23:59:42.701692                  Hospet (Karnataka)


                            destination_name
od_start_time  \
0               Gurgaon_Bilaspur_HB (Haryana) 2018-09-12
16:39:46.858469
1          Kanpur_Central_H_6 (Uttar Pradesh) 2018-09-12
00:00:16.535741
2           Chikblapur_ShntiSgr_D (Karnataka) 2018-09-12
02:03:09.655591
3           Doddablpur_ChikaDPP_D (Karnataka) 2018-09-12
00:00:22.886430
4              Chandigarh_Mehmdpur_H (Punjab) 2018-09-14
03:40:17.106733
...                                       ...                        ..
.
26217  Thisayanvilai_UdnkdiRD_D (Tamil Nadu) 2018-10-04
02:29:04.272194
26218    Tirunelveli_VdkkuSrt_I (Tamil Nadu) 2018-10-04
04:16:39.894872
26219     Tirchchndr_Shnmgprm_D (Tamil Nadu) 2018-10-04
```

```
01:44:53.808000
26220                 Bellary_Dc (Karnataka) 2018-10-04
03:58:40.726547
26221          Sandur_WrdN1DPP_D (Karnataka) 2018-10-04
02:51:44.712656

                      od_end_time  start_scan_to_end_scan  \
0     2018-09-13 13:40:23.123744                  1260.0
1     2018-09-12 16:39:46.858469                   999.0
2     2018-09-12 03:01:59.598855                    58.0
3     2018-09-12 02:03:09.655591                   122.0
4     2018-09-14 17:34:55.442454                   834.0
...                          ...                     ...
26217 2018-10-04 03:31:11.183797                    62.0
26218 2018-10-04 05:47:45.162682                    91.0
26219 2018-10-04 02:29:04.272194                    44.0
26220 2018-10-04 08:46:09.166940                   287.0
26221 2018-10-04 03:58:40.726547                    66.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                          383.759155        732.0      329.0
446.549591
1                          440.973694        830.0      388.0
544.802673
2                           24.644020         47.0       26.0
28.199400
3                           48.542889         96.0       42.0
56.911598
4                          237.439606        611.0      212.0
281.210907
...                               ...          ...        ...
...
26217                       33.627182         51.0       41.0
42.521301
26218                       33.673836         90.0       48.0
40.608002
26219                       12.661944         30.0       14.0
16.018499
26220                       40.546738        233.0       42.0
52.530300
26221                       25.534794         42.0       26.0
28.048401

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                    728.0              534.0             670.620483

1                    820.0              474.0             649.852783
```

```
2                        46.0                 26.0                28.199501

3                        95.0                 39.0                55.989899

4                       608.0                231.0               317.740784

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

26217                    49.0                 42.0                42.143101

26218                    89.0                 77.0                78.586899

26219                    29.0                 14.0                16.018400

26220                   233.0                 42.0                52.530300

26221                    41.0                 25.0                28.048401


       segment_actual_time_sum  segment_osrm_time_sum  \
0                        728.0                  534.0
1                        820.0                  474.0
2                         46.0                   26.0
3                         95.0                   39.0
4                        608.0                  231.0
...                        ...                    ...
26217                     49.0                   42.0
26218                     89.0                   77.0
26219                     29.0                   14.0
26220                    233.0                   42.0
26221                     41.0                   25.0

       segment_osrm_distance_sum          od_total_time
od_time_diff_hour  \
0                     670.620483 0 days 21:00:36.265275
21.010074
1                     649.852783 0 days 16:39:30.322728
16.658423
2                      28.199501 0 days 00:58:49.943264
0.980540
3                      55.989899 0 days 02:02:46.769161
2.046325
4                     317.740784 0 days 13:54:38.335721
13.910649
...                          ...                    ...
...
26217                  42.143101 0 days 01:02:06.911603
1.035253
26218                  78.586899 0 days 01:31:05.267810
1.518130
```

```
26219                 16.018400 0 days 00:44:10.464194
0.736240
26220                 52.530300 0 days 04:47:28.440393
4.791233
26221                 28.048401 0 days 01:06:56.013891
1.115559

      source_city source_place    source_state destination_city  \
0          Kanpur  Central_H_6   Uttar Pradesh          Gurgaon
1          Bhopal   Trnsport_H  Madhya Pradesh           Kanpur
2      Doddablpur   ChikaDPP_D       Karnataka       Chikblapur
3          Tumkur   Veersagr_I       Karnataka       Doddablpur
4         Gurgaon  Bilaspur_HB         Haryana       Chandigarh
...           ...          ...             ...              ...
26217  Tirchchndr   Shnmgprm_D      Tamil Nadu    Thisayanvilai
26218    Peikulam  SriVnktpm_D      Tamil Nadu      Tirunelveli
26219        Eral   Busstand_D      Tamil Nadu       Tirchchndr
26220      Sandur   WrdN1DPP_D       Karnataka          Bellary
26221      Hospet                    Karnataka           Sandur

      destination_place destination_state
0           Bilaspur_HB           Haryana
1           Central_H_6     Uttar Pradesh
2            ShntiSgr_D         Karnataka
3            ChikaDPP_D         Karnataka
4            Mehmdpur_H            Punjab
...                 ...               ...
26217        UdnkdiRD_D        Tamil Nadu
26218        VdkkuSrt_I        Tamil Nadu
26219        Shnmgprm_D        Tamil Nadu
26220                Dc         Karnataka
26221        WrdN1DPP_D         Karnataka

[26222 rows x 28 columns]
```

```
de[(de['source_place']=='') | (de['destination_place']=='')]
```

```
                                                        segment_key  \
7      trip-153671052974046625+IND583101AAA+IND583201AAA
9      trip-153671052974046625+IND583201AAA+IND583119AAA
19     trip-153671110078355292+IND121004AAB+IND121001AAA
33     trip-153671173668736946+IND110043AAA+IND110078AAA
80     trip-153671320807895983+IND121004AAB+IND121102AAA
...                                                  ...
26118  trip-153860849934816308+IND110078AAA+IND110043AAA
26153  trip-153860958923357924+IND842003AAB+IND482002AAA
26180  trip-153861007249500192+IND842001AAA+IND846004AAA
26181  trip-153861007249500192+IND846004AAA+IND847103AAA
26221  trip-153861118270144424+IND583201AAA+IND583119AAA
```

```
                       trip_uuid      data route_type  \
7      trip-153671052974046625  training        FTL
9      trip-153671052974046625  training        FTL
19     trip-153671110078355292  training    Carting
33     trip-153671173668736946  training    Carting
80     trip-153671320807895983  training    Carting
...                        ...       ...        ...
26118  trip-153860849934816308      test    Carting
26153  trip-153860958923357924      test    Carting
26180  trip-153861007249500192      test        FTL
26181  trip-153861007249500192      test        FTL
26221  trip-153861118270144424      test        FTL

              trip_creation_time
source_name  \
7     2018-09-12 00:02:09.740725                 Bellary_Dc
(Karnataka)
9     2018-09-12 00:02:09.740725                     Hospet
(Karnataka)
19    2018-09-12 00:11:40.783923           FBD_Balabhgarh_DPC
(Haryana)
33    2018-09-12 00:22:16.687619                Delhi_Nangli_IP
(Delhi)
80    2018-09-12 00:46:48.079257           FBD_Balabhgarh_DPC
(Haryana)
...                          ...                                   ..
.
26118 2018-10-03 23:14:59.348414                      Janakpuri
(Delhi)
26153 2018-10-03 23:33:09.233829  Jabalpur_Adhartal_IP (Madhya
Pradesh)
26180 2018-10-03 23:41:12.495257            Muzaffrpur_Bbganj_I
(Bihar)
26181 2018-10-03 23:41:12.495257                      Darbhanga
(Bihar)
26221 2018-10-03 23:59:42.701692                     Hospet
(Karnataka)

                    destination_name              od_start_time  \
7                 Hospet (Karnataka) 2018-09-12 00:02:09.740725
9      Sandur_WrdN1DPP_D (Karnataka) 2018-09-12 02:34:10.515593
19                Faridabad (Haryana) 2018-09-12 00:11:40.783923
33                 Janakpuri (Delhi) 2018-09-12 00:22:16.687619
80                  Palwal (Haryana) 2018-09-12 00:46:48.079257
...                              ...                        ...
26118       Delhi_Nangli_IP (Delhi) 2018-10-04 01:32:14.530264
26153     Jabalpur (Madhya Pradesh) 2018-10-03 23:33:09.233829
26180            Darbhanga (Bihar) 2018-10-03 23:41:12.495257
26181     Benipur_Javahar_D (Bihar) 2018-10-04 02:17:56.235080
```

```
26221  Sandur_WrdN1DPP_D (Karnataka) 2018-10-04 02:51:44.712656

                     od_end_time  start_scan_to_end_scan  \
7     2018-09-12 02:34:10.515593                   152.0
9     2018-09-12 03:54:43.114421                    80.0
19    2018-09-12 00:50:10.814399                    38.0
33    2018-09-12 01:29:19.277412                    67.0
80    2018-09-12 01:53:32.471405                    66.0
...                          ...                     ...
26118 2018-10-04 03:05:32.479193                    93.0
26153 2018-10-04 07:48:23.711056                   495.0
26180 2018-10-04 02:17:56.235080                   156.0
26181 2018-10-04 04:20:42.531207                   122.0
26221 2018-10-04 03:58:40.726547                    66.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
7                           59.530350        147.0       46.0
63.646099
9                           26.600536         63.0       27.0
29.569599
19                           9.396525         17.0        9.0
10.815900
33                          12.756768         44.0       21.0
18.766800
80                          37.859165         45.0       28.0
39.724499
...                               ...          ...        ...
...
26118                       12.207495         37.0       20.0
19.151501
26153                        9.065360        226.0        8.0
10.552100
26180                       53.236195         96.0       50.0
68.275101
26181                       24.323849         45.0       23.0
25.596600
26221                       25.534794         42.0       26.0
28.048401

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
7                    147.0               45.0              63.646099

9                     63.0               26.0              29.569698

19                    17.0                9.0              10.815900

33                    43.0               25.0              22.654800
```

```
80                     44.0               27.0                39.724400

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

26118                  37.0               24.0                18.512800

26153                 226.0                8.0                10.552100

26180                  95.0               49.0                68.275101

26181                  45.0               23.0                25.596600

26221                  41.0               25.0                28.048401


       segment_actual_time_sum  segment_osrm_time_sum  \
7                        147.0                   45.0
9                         63.0                   26.0
19                        17.0                    9.0
33                        43.0                   25.0
80                        44.0                   27.0
...                        ...                    ...
26118                     37.0                   24.0
26153                    226.0                    8.0
26180                     95.0                   49.0
26181                     45.0                   23.0
26221                     41.0                   25.0

       segment_osrm_distance_sum          od_total_time
od_time_diff_hour  \
7                      63.646099 0 days 02:32:00.774868
2.533549
9                      29.569698 0 days 01:20:32.598828
1.342389
19                     10.815900 0 days 00:38:30.030476
0.641675
33                     22.654800 0 days 01:07:02.589793
1.117386
80                     39.724400 0 days 01:06:44.392148
1.112331
...                          ...                    ...
...
26118                  18.512800 0 days 01:33:17.948929
1.554986
26153                  10.552100 0 days 08:15:14.477227
8.254021
26180                  68.275101 0 days 02:36:43.739823
2.612150
26181                  25.596600 0 days 02:02:46.296127
2.046193
```

```
26221                  28.048401 0 days 01:06:56.013891
1.115559

      source_city    source_place    source_state destination_city  \
7         Bellary              Dc       Karnataka           Hospet
9          Hospet                       Karnataka           Sandur
19            FBD  Balabhgarh_DPC         Haryana        Faridabad
33          Delhi       Nangli_IP           Delhi        Janakpuri
80            FBD  Balabhgarh_DPC         Haryana           Palwal
...           ...             ...             ...              ...
26118   Janakpuri                           Delhi            Delhi
26153    Jabalpur     Adhartal_IP  Madhya Pradesh         Jabalpur
26180  Muzaffrpur        Bbganj_I           Bihar        Darbhanga
26181   Darbhanga                           Bihar          Benipur
26221      Hospet                       Karnataka           Sandur

      destination_place destination_state
7                               Karnataka
9             WrdN1DPP_D        Karnataka
19                                Haryana
33                                  Delhi
80                                Haryana
...                 ...               ...
26118         Nangli_IP             Delhi
26153                      Madhya Pradesh
26180                               Bihar
26181          Javahar_D            Bihar
26221         WrdN1DPP_D        Karnataka

[782 rows x 28 columns]
```

```
de.loc[de['source_place']=='','source_place']=de['source_city']
de.loc[de['destination_place']=='','destination_place']=de['destinatio
n_city']

de[de.source_place.isna()]
```

```
Empty DataFrame
Columns: [segment_key, trip_uuid, data, route_type,
trip_creation_time, source_name, destination_name, od_start_time,
od_end_time, start_scan_to_end_scan, actual_distance_to_destination,
actual_time, osrm_time, osrm_distance, segment_actual_time,
segment_osrm_time, segment_osrm_distance, segment_actual_time_sum,
segment_osrm_time_sum, segment_osrm_distance_sum, od_total_time,
od_time_diff_hour, source_city, source_place, source_state,
destination_city, destination_place, destination_state]
Index: []
```

```
de.isna().sum()
```

```
segment_key                          0
trip_uuid                            0
data                                 0
route_type                           0
trip_creation_time                   0
source_name                          0
destination_name                     0
od_start_time                        0
od_end_time                          0
start_scan_to_end_scan               0
actual_distance_to_destination       0
actual_time                          0
osrm_time                            0
osrm_distance                        0
segment_actual_time                  0
segment_osrm_time                    0
segment_osrm_distance                0
segment_actual_time_sum              0
segment_osrm_time_sum                0
segment_osrm_distance_sum            0
od_total_time                        0
od_time_diff_hour                    0
source_city                          0
source_place                         0
source_state                         0
destination_city                     0
destination_place                    0
destination_state                    0
dtype: int64
```

```
#de =
de.drop(columns=['source_city','source_state','source_place','destinat
ion_city', 'destination_place', 'destination_state'])

de.loc[de.source_city=='Bangalore','source_city']='Bengaluru'
de.loc[de.destination_city=='Bangalore','destination_city']='Bengaluru
'

np.set_printoptions(threshold=np.inf)

de['source_city'].unique()
```

```
array(['Kanpur', 'Bhopal', 'Doddablpur', 'Tumkur', 'Gurgaon',
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       'North_D_2', 'MROoffce_D', 'Athithnr_DC', 'RTOofice_D',
       'RjndraRd_D', 'Palani_D', 'DPC', 'ChowkDPP_D', 'Mthurard_L',
       'Mullanpr_DC', 'Mehmdpur_H', 'Mohali', 'Central_DPP_2',
       'RajCmplx_D', 'Vidyangr_D', 'Beliaghata_DPC', 'RjnaiDPP_D',
       'KaremDPP_D', 'AbbasNgr_I', 'Palwal', 'Mankoli_HB',
'Wardno3_D',
       'GreenVly_D', 'BhaRDDPP_D', 'Airport_H', 'Gateway_HB',
       'Tathawde_H', 'ChotiHvl_DC', 'PnjPiara_D', 'Kharar_DC',
       'Trmltmpl_D', 'AnugrDPP_D', 'Srirampt_D', 'GlbrgaRD_D',
       'DBRCmplx_D', 'Mainroad_D', 'OnkarDPP_D', 'KaranNGR_D',
       'Panchot_IP', 'Sohagpur_D', 'ChainDPP_D', 'Chrompet_L',
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       'Busstand_D', 'JirgeNgr_D', 'BnsllNgr_D', 'Aswningr_I',
       'SivjiCWK_D', 'Central_I_1', 'KeranDPP_D', 'IndEstat_I',
'Court_D',
       'JmnvadRd_DC', 'NSTRoad_I', 'HydRoad_DC', 'Ragvendr_D',
       'Krishna_D', 'Nagaram_D', 'Rynapadu_H', 'BsstdDPP_D',
       'HawaiPlr_DC', 'Adhartal_IP', 'DumDum_DPC', 'Bomsndra_HB',
       'SsnRdDPP_D', 'Mamlatdr_DC', 'NCplxDPP_D', 'Swamylyt_D',
       'Narasipr_D', 'BrDbleRd_D', 'SulthnRd_D', 'NarsipuraRd_D',
       'Yadvgiri_IP', 'RatnaDPP_D', 'BegurRD_D', 'Thomas_D',
       'Central_D_2', 'TirupDPP_D', 'Gajuwaka_L', 'AtoNgrRd_I',
       'LaxmiNgr_D', 'NrdawDPP_D', 'Old City', 'Kundli_H',
'UdhamNgr_H',
       'Patelfli_D', 'Central_I_3', 'Vasanthm_I', 'KtsiGrsm_D',
       'ARBNorth_DC', 'Pngktgudi_D', 'Thalthru_DC', 'Bypasrd_D',
       'Sttyapar_D', 'Poonamallee_HB', 'VUNagar_DC', 'MotvdDPP_D',
       'NlgaonRd_D', 'Srnwsngr_D', 'Dakor_DC', 'Vaghasi_IP',
'Bnnrghta_L',
       'Thirumtr_IP', 'SelamRd_D', 'EastmnRD_D', 'VkotRoad_D',
       'GandhiRd_D', 'NJVNgr_D', 'GariDPP_D', 'barkarRd_D',
'GMukrDPP_D',
       'MP Nagar', 'Central_D_3', 'Jogshwri_I', 'GModDPP_D',
'KoilStrt_D',
       'CotnGren_M', 'Nzbadrd_D', 'Haridwar', 'Dwaraka_D',
'Devenply_I',
       'JKRoad_D', 'SuryaDPP_D', 'Menagrdn_D', 'NvygRDPP_D',
'CrossRD_D',
       'Sector1A_IP', 'PhrmPlza_D', 'Banikatt_D', 'Gndhichk_D',
'Dhelu_D',
       'Sulgwan_D', 'Bulabeda_D', 'Chowk_D', 'PatelNGR_D', 'Maheva_D',
       'BkgnRoad_D', 'CharRsta_D', 'Kollgpra_D', 'Peenya_IP',
       'GndhiNgr_IP', 'Sanpada_I', 'WrdN4DPP_D', 'Sakinaka_RP',
       'CivilHPL_D', 'OstwlEmp_D', 'KetyDPP_D', 'Gajuwaka',
'BaljiDPP_D',
       'Mhbhirab_D', 'CTRoad_D', 'MGRoad_D', 'RSRoad_D',
'Balajicly_I',
       'Artmclny_D', 'SDKNgr_D', 'Bngisheb_D', 'TirupthiRd_D',
       'BljiMrkt_D', 'DataSagr_D', 'Govndsgr_D', 'Dankuni_HB',
'Rakhial',
       'East_H_1', 'Memnagar', 'East_I_21', 'Mithakal_D',
'TrnspNgr_D',
       'Pakrela_D', 'Bbganj_I', 'Bilaspur_RP', 'Lovely_D',
'PatelWrd_D',
       'DivrsnRd_D', 'Mataward_D', 'CottonGreen_DPC', 'Pawane_L',
'Karur',
       'JPNagar_Pc', 'Knrpati_D', 'Trchngrd_D', 'Kengeri_IP',
'KHRoad_I',
       'RicMilRd_D', 'MlnprDPP_D', 'MiraRd_IP', 'Pashan DPC',
       'KhirByps_I', 'Agraroad_I', 'Katrmira_D', 'Sudmpuri_D',
'Potheri',
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       'Kuslpram_I', 'SamathBv_D', 'VadaiDPP_D', 'ColegRd_D',
       'AmvdiDPP_D', 'HudcoDPP_D', 'Ward14_D', 'Nayapalli',
'Nirjanpur_L',
       'Uppal_I', 'Jalukbari', 'Sardala_D', 'RPC', 'Chndivli_PC',
       'AadiDPP_D', 'Banikhet_D', 'Bangotu_D', 'Chuanpur_I',
'RatanDPP_D',
       'Hoodi_IP', 'Kadugodi_D', 'MhpraRD_D', 'AstrdDPP_D',
'Shop3DPP_D',
       'Chikdply_I', 'Mayapuri_PC', 'Mylapore', 'GillChwk_DC',
'Anjur_C',
       'Kishangarh_DPC', 'Janakpuri', 'Rohini_DPC', 'Panvel_D',
       'MilrGanj_HB', 'Koliplm_I', 'Ghansoli_DC', 'Bhogal',
'KaaduRd_D',
       'Patparganj_DPC', 'Salem', 'Mhdhvpur_D', 'Hillcard_DC',
       'WardNo3_D', 'Tiruchi', 'Sec 02_DPC', 'Sec-83_DC', 'Kadipur',
       'Chukhndi_D', 'HosptlRd_D', 'Tetultol_D', 'Wardno5_D',
       'HplrdDPP_D', 'Sracmplx_D', 'FoySGRRD_I', 'Nayagaon_I',
'Basni_I',
       'SamitiRd_D', 'JawaharN_D', 'RoshnBgh_I', 'AmzonDev_V',
       'Mundhawa_L', 'Vadgaon Sheri DPC', 'Alwal_L', 'LVMColge_D',
       'GtRoad_D', 'HrihrNgr_I', 'Madaprum_D', 'Thmpulam_D',
'HnumnDPP_D',
       'Raghogrh_D', 'Bypassrd_D', 'Truptingr_D', 'Faridabad',
'Peenya_L',
       'Pandrnga_I', 'PunjabiB_L', 'Mdiclcly_D', 'CGRoad_D',
'Umalodge_D',
       'Hejunagr_D', 'Wardno13_D', 'MahmurGj_IP', 'Adargchi_IP',
       'NamoNagr_D', 'Bsavangr_D', 'Cdosclrd_D', 'GadagRD_D',
'Sector4_D',
       'GndhiNGR_D', 'MChwkDPP_D', 'Govind_D', 'Parasi_D',
'Waidhan_D',
       'Ward8DPP_D', 'PC', 'Central_I_2', 'SriDPP_D', 'SriRmNGR_D',
       'Raiprvlg_L', 'MathuraRD_D', 'Panipat', 'kankroli_D',
'Nimachrd_D',
       'Okhla_PC', 'Bownplly_C', 'Narynpur_C', 'Madhavaram_DPC',
'HUB',
       'Chikdply_C', 'Markndpr_D', 'Udyabata_D', 'Sector02_C',
       'Kuntikna_H', 'Kurduwdi_D', 'Kakdepot_D', 'Kothapet_D',
       'SubhVRTL_I', 'Tiglgndi_D', 'Kacheri_D', 'BgwriDPP_D', 'CP',
       'Vardhard_D', 'Vidygiri_D', 'Sanpada_CP', 'Egmore_C',
       'Begumpur_CP', 'Sodal Road', 'Ramvlg_D', 'Dehradun',
'MhmodNgr_D',
       'Beleghta_CP', 'MndiRoad_D', 'MohanNgr_C', 'Prbhunth_D',
       'Soghra_D', 'PnditNGR_D', 'Madarpur_D', 'ChndrNgr_D',
'Robinson_D',
       'Poothole_D', 'Peedika_H', 'Alandur_C', 'VaniThtr_D',
'BMRd_DC',
       'Bburynkpl_D', 'Karelibaug_DPC', 'MhimWest_C', 'Malahi_D',
       'Bgwtichk_D', 'Vasai_CP', 'Mdhavram_C', 'Sector63_L',
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'Karayam_H',
       'Sarubali_D', 'Sirjudin_D', 'YuktiDPP_D', 'IndstlAr_I',
'Nagar_DC',
       'ShivNgar_D', 'Katira_D', 'Sirikona_H', 'Jantaclg_D',
'Bankura_D',
       'Salanpur_D', 'Talkui_D', 'Jogeshwri_L', 'ZebaTWR_D',
'BhgyaNgr_D',
       'Mhdiptnm_C', 'North_R_8', 'Pratpngr_D', 'BSarani_D',
'NagarDPP_D',
       'MaxDPP_D', 'BtaiRoad_D', 'Kapshera_L', 'Chungam_D',
'HatRDDPP_D',
       'WdN14DPP_D', 'Egmore_DPC', 'Mangri_I', 'Atapaka_D',
'Agraharm_DC',
       'GvrCompx_D', 'ArhamDPP_D', 'DindiRD_D', 'PeroorRD_D',
       'VidyaNGR_D', 'GndhiDPP_D', 'Wazirpur_L', 'Alwal_I',
'SrifoDPP_D',
       'Kntgorya_D', 'DohalDPP_D', 'BoiDPP_D', 'NditaDPP_D',
       'Gajuwaka_IP', 'KrsprDPP_D', 'Sirjudol_D', 'GopalDPP_D',
       'UtBzrDPP_D', 'SavtaHTL_D', 'Hindcwk_D', 'MiraRoad_M',
       'GrmNgriya_D', 'ViksClny_D', 'kalibari_D', 'Konapara_D',
       'Indsarea_D', 'PlaceCol_D', 'Bhogpur_D', 'TahurDPP_D',
'Vijdurg_D',
       'Bardivan_D', 'Wardno6_D', 'Pinjore_DC', 'MohanPrk_D',
       'Thsil3PL_D', 'Gaurkshn_I', 'SChwkDPP_D', 'Mundhe_D',
'Shantanu_D',
       'LxmiNiws_D', 'ColctrOf_D', 'LSRoad_DC', 'SikriKla_DC',
'Meerut',
       'Krishnpr_D', 'SadrHsptl_D', 'Gangjala_D', 'Central_H_2',
       'Bazar_D', 'Wardn13_D', 'Durma_D', 'Ward9DPP_D', 'WardNo1_D',
       'IndraNgr_D', 'Enkndla_D', 'SrnvsNgr_D', 'RKComplx_D',
       'ShtDRDPP_D', 'VikrmMah_D', 'Rohtak', 'DvlalDPP_D',
'GainMrkt_L',
       'BsStdDPP_D', 'Darbhanga', 'Javahar_D', 'Nagar_D', 'patna_D',
       'Vijayght_D', 'Shyndco_D', 'AgrohDPP_D', 'Gokulam_D',
'GVManu_D',
       'SaiNgr_D', 'Madnpali_D', 'Ambala', 'Gurudwar_D', 'Jhilmil_L',
       'BhukrdPP_D', 'Mwalibad_D', 'AjmhwDPP_D', 'Tilknagr_DC',
'Kumud_D',
       'Sookhtal_D', 'SuzkiSrv_D', 'Subhash_D', 'Barmasia_D',
       'NraynDPP_D', 'Nangli_L', 'Matriprm_IP', 'CCRoad_D',
'Subshngr_D',
       'BawliDPPP_D', 'Banjaria_D', 'PchpkrRD_D', 'BypassRd_D',
       'TrengaRD_D', 'Panderia_D', 'Dudhani_D', 'D', 'Hatpada_D',
       'Bhaleti_D', 'SainkSCL_D', 'Ward6_D', 'Dayanand_D',
'Fathuluh_D',
       'NaginaRd_D', 'NaginaRD_D', 'KotdwrRD_D', 'HunterRd_I',
       'Nrsampt_D', 'Perkadrd_D', 'KdidmCLY_D', 'Khwssrai_D',
'Ganesh_D',
       'Trimurti_D', 'Harop_D', 'KrshDPP_D', 'Ward2DPP_D',
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'Vaishali_D',
       'BhwniGnj_D', 'BajprDPP_D', 'MubarDPP_D', 'BgnprDPP_D',
'RamNgr_D',
       'RajaBzr_D', 'Mohim_D', 'Datatrya_D', 'EBroad_D', 'Bidar',
       'RIICO_L', 'StatonRd_D', 'Shankrpa_D', 'Verpatem_D',
'RailGate_D',
       'Kalol_DC', 'PODPP_D', 'MheshNGR_D', 'ITDARd_D', 'AskNagar_D',
       'SrnprHwy_D', 'DmodrNGR_D', 'IndraCln_D', 'NWclyDPP_D',
       'Ward6DPP_D', 'MndwrRod_D', 'HnsChowk_D', 'FatehpRd_I',
       'NavldiDPP_D', 'JdswarRD_D', 'Kalyanpr_D', 'KlngrDPP_D',
'NH117_D',
       'Antop Hill', 'Pariplly_D', 'Rdiosttn_D', 'NrainaRD_D',
       'NarenaRD_D', 'ChomuRD_D', 'Sarswati_D', 'Nishangr_D',
       'NgrNigam_DC', 'Wardno4_D', 'Purbari_D', 'Pnjbiyon_D',
'SJRoad_D',
       'DcntCLY_D', 'Kanongyn_D', 'Pettah_D', 'Arlumodu_D',
'MhraChng_D',
       'AryaNagr_D', 'Virar_DC', 'JNPT_D', 'Pbroad_DC', 'Goa',
       'ZuariNgr_IP', 'Mohan_Nagar_DPC', 'Swargash_D', 'HapurRD_D',
       'WardNo4_D', 'MnBzrDPP_D', 'GvrdnDPP_D', 'Kalyan West _Dc',
       'Ambernath_Dc', 'ShivaDPP_D', 'GunjRDPP_D', 'Aravind_D',
       'Mumbra_DC', 'Hitech_D', 'KamnHbRD_I', 'UzanBazr_DC',
'TKRoad_D',
       'KeRoad_D', 'JatniDPP_D', 'Klskhrpt_D', 'PostofJN_D',
'Amankovl_D',
       'Town_D', 'MIDCAvdn_I', 'DhuleRoad_D', 'KakaCplx_D',
'Nandrbar_D',
       'DhuleRd_D', 'Dilliyan_D', 'Jaipur', 'Shahdara', 'DhnliRth_D',
       'Pdmavati_D', 'KhsmiDPP_D', 'Balaji Nagar', 'BhadgDPP_D',
       'RamaNgr_D', 'Parigi_D', 'StatinRD_D', 'AdrshSt_DC',
'keshod_DC',
       'JilRDDPP_D', 'GayatriN_D', 'Kotwali_D', 'NehruNGR_D',
       'Arulimod_D', 'Ajnari_D', 'Madhavaram_L', 'GndhiNgr_D',
'Bokule_H',
       'JyotiNgr_D', 'BrlwgDPP_D', 'Selakui_D', 'Ward19_D',
'PalikDPP_D',
       'Nehru3PL_D', 'SttinDPP_D', 'FulbaDPP_D', 'Padra_D',
'CikhliRD_D',
       'StnRdDPP_D', 'Itachnda_D', 'WebelDPP_D', 'MilpaDPP_D',
       'Pshimpra_D', 'Uppal_L', 'BOB_D', 'Samarth_D', 'StRoad_D',
       'Tolichwk_I', 'Chndivli_D', 'Vadodara', 'Sholinganallur_Dc',
       'Sixmile', 'LB-Nagar_Dc', 'Panchkula', 'Bhgtpura_D',
'VishnuVhr_D',
       'ArkonmRD_D', 'MBTRd_DC', 'Sadras_D', 'Central_DPP_4',
'Chakan_D',
       'ColageRD_D', 'Srikot_D', 'Khajuria_I', 'ChrliDPP_D',
'SashPhkn_D',
       'ZoomCDPP_D', 'Shillong', 'ShanthiS_D', 'ShsmlDPP_D',
'KotwaliN_D',
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       'PBRDDPP_D', 'MduraiRD_D', 'LICOffce_D', 'Kaithwal_D',
       'SmClyDPP_D', 'LXngrDPP_D', 'TrtllaRD_L', 'Blockrd_D',
       'ManhrBld_D', 'Blmrgnst_D', 'StationRD_D', 'KrthiKyn_D',
       'Satara_D', 'Idgah_P', 'Udupi', 'Kakrmath_D', 'KmkshBul_D',
       'Prbhtngr_D', 'MarketRd_D', 'MrdiVlge_D', 'Ameenpur_I',
       'Pazhvedu_D', 'Kumrpurm_D', 'Feroke_H', 'Mandodi_D',
'Pshrikvu_D',
       'ZamQuatr_D', 'Mettu_DC', 'Thiruviz_D', 'Vadasari_D',
       'Kdthdstrt_D', 'VaiklSRT_D', 'MukkuRD_D', 'Davisdle_D',
'nagar_D',
       'Badeplly_D', 'anthniyr_D', 'HsptlRod_D', 'SH71_D',
'Puduvalvu_D',
       'Sbrmnprm_D', 'Alngjuri_D', 'Sishumdr_D', 'PriyrNGR_D',
       'Mthrapuri_D', 'ThryrRD_D', 'goplpurm_D', 'Kmrajngr_D',
       'Chithbrm_D', 'AmtlaDPP_D', 'JhumanCk_D', 'Kappalur_H',
       'AshkTalk_D', 'Msstreet_DC', 'Krsnakcl_D', 'Kovil_D',
'Mlydpthr_D',
       'Ward25_D', 'TherSRT_D', 'Kovaipudur_Dc', 'West_Dc',
'Khjurwli_DC',
       'RtlamNka_D', 'Patiala', 'Sahni_D', 'MrutiNGR_D', 'Palikval_D',
       'Talaiya_D', 'AshkngRd_D', 'Ward17_D', 'BhogdDPP_D', 'BMRd_D',
       'MuruPost_D', 'MandyaRD_D', 'MuthpTmp_D', 'TilakNgr_D',
'YTRd_D',
       'HsnRdDPP_D', 'Anaipeta_D', 'GodamDPP_D', 'Ambedkar_D',
'Sunku_D',
       'FshryOFC_D', 'KolarRd_D', 'Venkatsa_DC', 'Artclgrd_D',
       'GuttalRD_D', 'War5DPP_D', 'HoliCDPP_D', 'KairiyaT_D',
       'Wardno10_D', 'Techrcly_D', 'Thvlrsrt_D', 'Palladam_DC',
       'Bhabua_D', 'Torwa_DC', 'HousngBd_D', 'New Alipore_DPC',
       'Mutyvila_D', 'Chnglptu_DC', 'Achipkam_D', 'Yellanda_D',
       'Sudimala_D', 'VdkkuSrt_I', 'Radhaprm_D', 'Nallur_D',
       'ChtrGIDC_IP', 'MrktYrd_DC', 'UdnkdiRD_D', 'Shnmgprm_D',
       'SriVnktpm_D', 'SKRoad_D', 'VidyaNgr_D', 'PushPlza_D',
       'Kalynpur_I', 'Kataram_D', 'JwahrNGR_D', 'LaxmiNGR_D',
'Darbe_DC',
       'ConduDPP_D', 'JrjolDPP_D', 'Chandkheda_Dc', 'Chaitnya_D',
       'MohnVRTL_D', 'JydevNGR_D', 'CivlLine_D', 'ChngiDPP_D',
       'Mlkpura_D', 'RjndrNgr_DC', 'EtwahDPP_D', 'TBCross_D',
       'ShntiSgr_D', 'Kalyan', 'GwhRDDPP_D', 'Vepmpttu_DC',
'TmpleSrt_D',
       'Vllyaprm_D', 'RamnadRD_D', 'Raiprkln_C', 'Rawlgaon_D',
       'Malegaon_D', 'Varachha_DC', 'South_D_4', 'VasaviNg_D',
       'SnkunDPP_D', 'Shahapur_D', 'HBColny_D', 'Mangol_DC',
       'KrisnKunj_D', 'Lake Avenue_DPC', 'NaturDPP_D', 'Kolar
Mandakni',
       'Kadtmpty_H', 'krshnPly_DC', 'EragnDPP_D', 'Tejpal_I',
'BjbNgr_DC',
       'PndrgNgr_DC', 'Chandigarh', 'Mangalam_D', 'ShantiNg_D',
'Erode',
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        'DKLogDPP_D', 'Samrvrni_D', 'BaliaMod_D', 'Ganeshwr_D',
        'NagplDPP_D', 'KisanCo_D', 'Palakrty_D', 'Hanmkond_D',
        'BodomBzr_DC', 'RadhaCpx_D', 'MaladWest_CP', 'Mohnprwa_D',
        'Mnanthla_D', 'ShjnprRD_D', 'Mainrd_D', 'Eaglvari_D',
'Kelasahi_D',
        'GhtimDPP_D', 'VallaDPP_D', 'TnhbBlkC_D', 'VagaiNgr_D',
        'LxmntDPP_D', 'KdrShrRd_D', 'Veluthur_D', 'AlathurRD_D',
        'KKndrDPP_D', 'SagarDPP_D', 'WamanDPP_D', 'SchdvDPP_D',
'LFRoad_D',
        'Rathnam_D', 'RgvdrDPP_D', 'HesglDPP_D', 'CroslySRT_D',
        'HajiprRD_D', 'Haripur_D', 'Srvdycwk_D', 'Tuminkte_D',
        'NharuExt_D', 'NngrgnRd_D', 'Valluvar_D', 'Banshkri_DC',
        'Mahindra_D', 'MrenTirh_D', 'NorprRD_D', 'Sitarmrd_D',
        'BaraLoha_D', 'Rajula_DC', 'KrantiNgr_D', 'ICDCant_D',
        'Greenmkt_D', 'Chandanagar_Dc', 'Mnanthla_H', 'BndhuTRH_D',
        'Chandmari', 'APMCYard_D', 'Barwala', 'Katora_IP',
'BasthDPP_D',
        'AsnsdhRD_D', 'MahuGDPP_D', 'SourvDPP_D', 'RPRoad_D',
'NagpurRd_D',
        'DelRdDPP_D', 'ward9_D', 'Central_D_5', 'Shekhpur_D',
'BypassRD_D',
        'MngalDPP_D', 'BhwanDPP_D', 'HghsclRD_D', 'Blbgarh_DC',
        'Chpaguri_D', 'ShivBari_D', 'PigonDPP_D', 'Samyaprm_D',
        'PreetDPP_D', 'Oilmilrd_D', 'MSRClgRd_D', 'ITICollg_L',
        'KatlaDPP_D', 'South_R_11', 'Shivangr_D', 'KnsgraRD_D',
        'PuranDPP_D', 'Domlur', 'AnprnDPP_D', 'Chndrlpd_D',
'RmNyrDPP_D',
        'GMndiDPP_D', 'Kooriyad_D', 'Munduprm_D', 'ByePass_D',
        'SngihiRD_D', 'Sabalpur_D', 'Karnal', 'Shivalya_D',
'PnchmDPP_D',
        'Bahreya_I', 'JiswlDPP_D', 'Gobindgarh_DC', 'KarnalRd_D',
        'Bargawan_DC', 'Mughlpra_D', 'GutmgrCl_D', 'Perungudi_DPC',
        'BhemuDPP_D', 'Central_D_7', 'Patel Nagar', 'SidculRd_D',
        'Kothuru_D', 'Wardno8_D', 'ThthiCwk_D', 'VidyaDPP_D',
'BaruaRd_D',
        'Babupaty_D', 'Bhankrot_DC', 'Trimulgherry_Dc', 'Surajpur_DC',
        'TrnptNgr_L', 'MissonRd_D', 'MJRDPP_D', 'AzmrdDPP_D',
'Jamalpur_D',
        'LNBRoad_D', 'Shop2DPP_D', 'DeVDPP_D', 'KSClny_DC',
'GagiDPP_D',
        'HotelPrk_D', 'SnthiNGR_D', 'BypRDDPP_D', 'BhmrdDPP_D',
        'Vijayawada', 'Kidwai_D', 'Mharajpr_D', 'GrudwrRd_D',
'Adrshngr_D',
        'Krvnkuzy_D', 'PhdofDPP_D', 'CtyLgDPP_D', 'Pilani',
'StnRoad_DC',
        'Solaiprm_D', 'RailwyRd_D', 'Diakkawn_D', 'PiliKoti_D',
        'VislkNgr_DC', 'SaiTempl_D', 'NcsRd_DC', 'Arangadi_D',
        'LohiaDPP_D', 'PakriDPP_D', 'BisnolDPP_D', 'PrmNrDPP_D',
        'BsnoiHPL_D', 'Gopa3PL_D', 'ShrprDPP_D', 'MnRDDPP_D',
```

```
'BllvMarg_D',
       'Farmnala_D', 'Katghara_D', 'KhandDPP_D', 'JngidDPP_D',
       'Tolichwk_L', 'Pringla_D', 'SurbhiTh_D', 'Greens_D',
'CivilStn_D',
       'Shivprsad_D', 'KirtiNgr_D', 'ModelTwn_P', 'Fairybnk_D',
       'Cnsrvila_D', 'BhunaDPP_D', 'Ukkadam_D', 'BChwkDPP_D',
'Jharia_DC',
       'Chrwpaty_D', 'CollgeRD_D', 'Pthrgoan_D', 'HelipadRD_D',
       'DltprDPP_D', 'Ranakant_D', 'Vandalur_Dc', 'Airport',
       'Rahatani_DPC', 'Bhrnikvu_D', 'HunthrVg_I', 'AwmpiVng_D',
       'PmthuKlm_D', 'PanditRd_D', 'Chtrpuza_D', 'SantaNGR_D',
       'JalnaRd_D', 'Bazarrd_D', 'UmarDPP_D', 'CmtNgRod_D',
'KasyaDPP_D',
       'StteHW28_D', 'VijywdRD_D', 'Dehrird_D', 'Wardno7_D',
'NatunDPP_D',
       'Enayetpr_D', 'East_I_20', 'KtnRdDPP_D', 'Mapusa',
'Kothriya_DC',
       'Ymunpurm_D', 'TonkRoad_D', 'East_D_8', 'SmbjiCwk_D',
'Jabalpur',
       'Indrapri_DC', 'YashDPP_D', 'AchneraRD_D', 'DibngVly_D',
       'BnglorRd_D', 'PcrrdDPP_D', 'Murtingr_D', 'Central_D_15',
       'JmpuCntr_D', 'Rajpura_D', 'Mulapali_D', 'LdnunDPP_D',
'PngnrRd_D',
       'Tejpal_M', 'RjghatRd_D', 'Pnchlght_D', 'KDRoad_D',
'farukngr_D',
       'SingCLNY_D', 'Jagrata_D', 'ThaneDPP_D', 'MdhsnDPP_D',
'Margao_Dc',
       'Nijgan_D', 'Rawatpur_D', 'Gurukrpa_D', 'JivanDPP_D',
       'AshokNagar_DC', 'BhmprDPP_D', 'KarjuDPP_D', 'Pothredy_D',
'_NAD',
       'ShbdnDPP_D', 'ClgRDDPP_D', 'Brpc', 'ShubsNGR_D', 'Beltngdi_D',
       'Ldthlabh_D', 'KamalDPP_D', 'IndEstat_L', 'HnmntNgr_D',
       'ShivmDPP_D', 'BstndDPP_D', 'Cherukole_D', 'EmsPnmbi_D',
       'KaimgnjRD_D', 'Bhainpura_D', 'FatprDPP_D', 'RajRdDPP_D',
       'Mahad_D', 'MsjidDPP_D', 'PaikjNGR_D', 'BalibDPP_D',
'KcharaRD_D',
       'ChtwrDPP_D', 'MsmcyDPP_D', 'ElngoNgr_C', 'Rcocmplx_D',
       'PunjbiPd_D', 'Shanthi_D', 'Ponda_Dc', 'SirsaDPP_D', 'Mahim',
       'Paldi_D', 'SubrtDPP_D', 'Santalpr_D', 'TiloiDPP_D', 'Idgah_L',
       'KoralDPP_D', 'Nerul_D', 'Uppal_Dc', 'MhliaDPP_D',
'Bomsndra_L',
       'SukntDPP_D', 'Arsprmbu_D', 'MnimlaRd_D', 'UttarDPP_D',
       'ChatiDPP_D', 'MdnprDPP_D', 'Kanakpur_D', 'East', 'MdothdRD_D',
       'CroadDPP_D', 'Sarjapur_D', 'SbhRDDPP_D', 'Central_D_4',
       'Thiruvlr_DC', 'Sangetha_D', 'NadthiCx_D', 'Naraynpr_D',
'Hathras',
       'AkkolRD_D', 'AnnaNGR_D', 'LamtiDPP_D', 'DiyoDPP_D',
'MunplDPP_D',
       'RoopNgr_D', 'RwStnDPP_D', 'BhrolDPP_D', 'Umargaon_DC',
```

```
       'Ramnagar_D', 'Majoor_D', 'BageDPP_D', 'MnbzrDPP_D',
'AkhraBzr_D',
       'MemariRD_D', 'ArickDPP_D', 'kalmpuza_D', 'BnkrGate_D',
       'ColnyDPP_D', 'Muktsar_D', 'Patia', 'Rjndpara_D', 'BrezeDPP_D',
       'GurpdDPP_D', 'Kothanur_L', 'Ricco_D', 'Palam', 'Prjapati_D',
       'Gondkhry_H', 'South_D_20', 'Central_H_4', 'KalikDPP_D',
       'Bareilly', 'STRdDPP_D', 'RatuaDPP_D', 'BazarDPP_D',
'lalaNGR_D',
       'GndhiChk_D', 'Mirapati_L', 'RhmgjDPP_D', 'Central_L_8',
'Kaura_D',
       'Khndyusn_D', 'AmbkaDPP_D', 'Nelmngla_L', 'IOTCEncl_L',
       'AnadiDPP_D', 'JJCpxDPP_D', 'IdstrlAr_D', 'Mehsouri_D',
       'HanumDPP_D', 'GovndNgr_DC', 'JthriDPP_DC', 'Karelibaug_DC',
       'Bnsibtla_D', 'MjlprDPP_D', 'Sardhnrd_D', 'MbRoad_D',
       'Central_D_10', 'Old', 'SliprDPP_DC', 'Kapleswr_D',
'Kdvantra_D',
       'SadulDPP_D', 'Pulgaon_DC', 'AkhirDPP_D', 'KrshnNgr_D',
'Parai_D',
       'Selaiyur_DC', 'Chinchwad DC', 'NavdaCln_D', 'CBRoad_D',
'Sidrd_D',
       'ThanaDPP_D', 'Krusphrma_D', 'Mahuva_DC', 'Manchar_D',
       'BargaDPP_D', 'NapitDPP_D', 'RgstrOFC_D', 'Bhaluahi_D',
       'Thikiri_D', 'RajpurRD_D'], dtype=object)
```

```
de['source_state'].unique()
```

```
array(['Uttar Pradesh', 'Madhya Pradesh', 'Karnataka', 'Haryana',
       'Maharashtra', 'Tamil Nadu', 'Gujarat', 'Delhi', 'Telangana',
       'Andhra Pradesh', 'Rajasthan', 'Assam', 'West Bengal',
'Punjab',
       'Chandigarh', 'Goa', 'Uttarakhand', 'Jharkhand', 'Pondicherry',
       'Orissa', 'Himachal Pradesh', 'Kerala', 'Arunachal Pradesh',
       'Bihar', 'Meghalaya', 'Chhattisgarh', 'Jammu & Kashmir',
       'Dadra and Nagar Haveli', 'Mizoram', 'Tripura', 'Nagaland'],
      dtype=object)
```

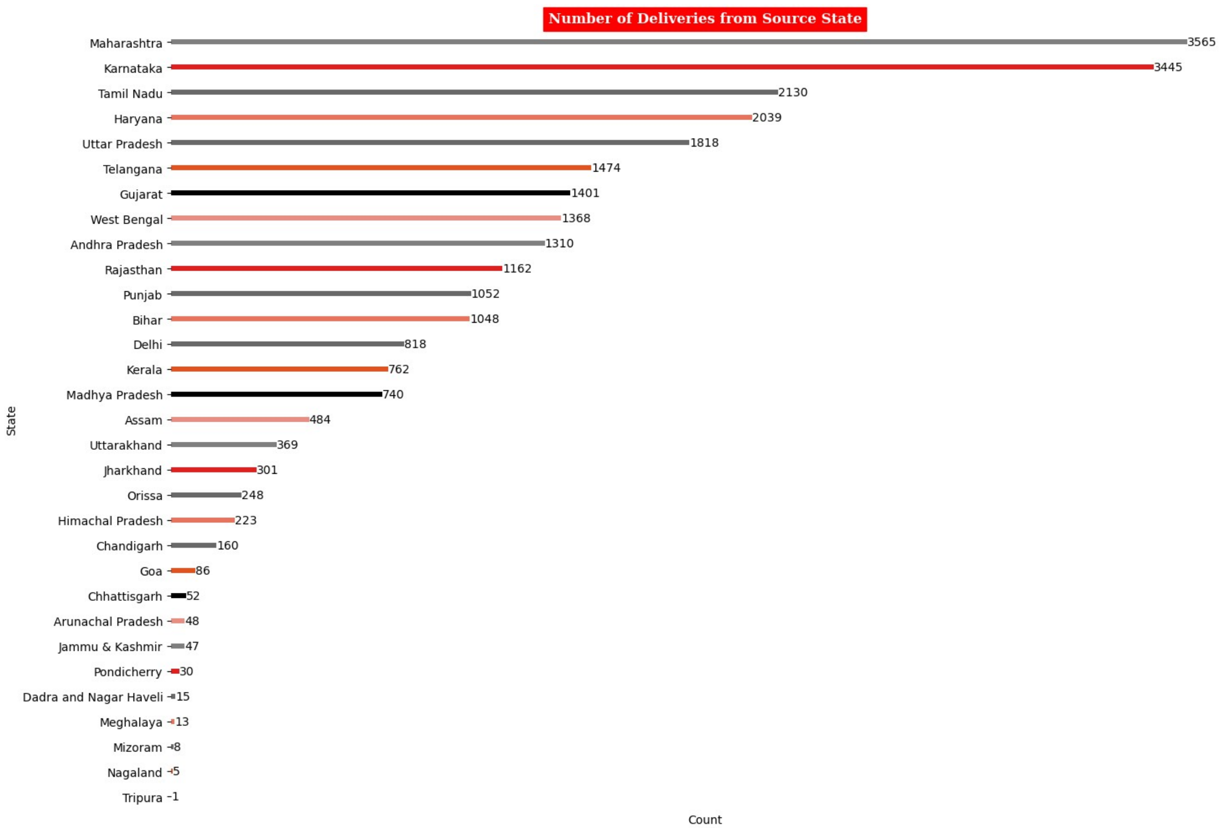
```
de['source_state'].value_counts().to_frame().style.background_gradient
(cmap='Reds')
```

```
<pandas.io.formats.style.Styler at 0x20e66549110>
```

```
state_counts =
de['source_state'].value_counts().to_frame().reset_index()
state_counts.columns = ['State', 'Count']

plt.figure(figsize=(15,10))
a = sns.barplot(y='State', x='Count',
data=state_counts,palette=cp,width=0.2)
a.bar_label(a.containers[0], label_type='edge')
plt.xticks([])
```

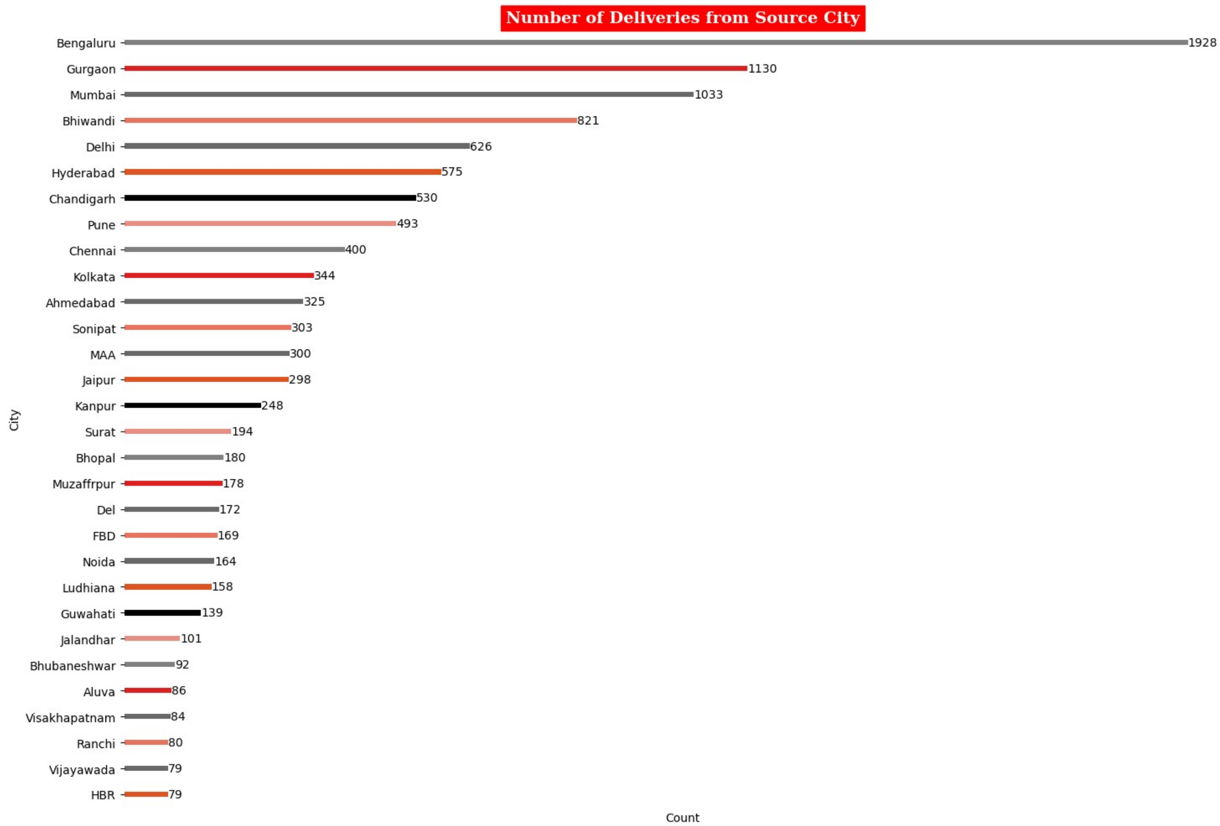
```
plt.ylabel('State')
plt.xlabel('Count')
plt.title('Number of Deliveries from Source
State',fontsize=12,fontfamily='serif',fontweight='bold',backgroundcolo
r='r',color='w')
plt.tight_layout()
sns.despine(bottom=True,left=True)
plt.show()
```




```
city_counts =
de['source_city'].value_counts().to_frame().reset_index()[:30]
city_counts.columns = ['City', 'Count']

plt.figure(figsize=(15,10))
a = sns.barplot(y='City', x='Count',
data=city_counts,palette=cp,width=0.2)
a.bar_label(a.containers[0], label_type='edge')
plt.xticks([])
plt.ylabel('City')
plt.xlabel('Count')
plt.title('Number of Deliveries from Source
City',fontsize=14,fontfamily='serif',fontweight='bold',backgroundcolor
='r',color='w')
plt.tight_layout()
```

```
sns.despine(bottom=True,left=True)
plt.show()
```



Insights:

`Source State contributors`

- **Maharashtra**, **Karnataka** ,**Tamil Nadu**, **Haryana**, and **Uttar Pradesh** are the top contributors where maximum bookings are recorded in this month indicating significant engagement.

`Source City contributors`

- Cities like **Bengaluru**, **Gurgaon**, **Mumbai**, **Bhiwandi**, **Delhi**, **Hyderabad** where the major no.of booking are recorded.

```
de.describe().T
```

```
                                  count                           mean  \
trip_creation_time                26222  2018-09-22 13:58:56.740969728

od_start_time                     26222  2018-09-22 17:49:54.012840448

od_end_time                       26222  2018-09-22 22:49:00.449498112

start_scan_to_end_scan          26222.0                     298.553375
```

```
actual_distance_to_destination  26222.0                      92.533051
actual_time                     26222.0                      200.92659
osrm_time                       26222.0                      90.785332
osrm_distance                   26222.0                     114.975334
segment_actual_time             26222.0                     199.095642
segment_osrm_time               26222.0                     101.793343
segment_osrm_distance           26222.0                     125.587128
segment_actual_time_sum         26222.0                     199.095642
segment_osrm_time_sum           26222.0                     101.793343
segment_osrm_distance_sum       26222.0                     125.587128
od_total_time                     26222      0 days 04:59:06.436657725
od_time_diff_hour               26222.0                       4.985121

                                                       min  \
trip_creation_time              2018-09-12 00:00:16.535741
od_start_time                   2018-09-12 00:00:16.535741
od_end_time                     2018-09-12 00:50:10.814399
start_scan_to_end_scan                                20.0
actual_distance_to_destination                    9.001351
actual_time                                            9.0
osrm_time                                              6.0
osrm_distance                                       9.0729
segment_actual_time                                    9.0
segment_osrm_time                                      6.0
segment_osrm_distance                               9.0729
segment_actual_time_sum                                9.0
segment_osrm_time_sum                                  6.0
segment_osrm_distance_sum                           9.0729
od_total_time                       0 days 00:20:42.168787
od_time_diff_hour                                 0.345047

                                                          25%  \
trip_creation_time              2018-09-17 03:57:50.900417024
od_start_time                   2018-09-17 07:43:36.525784320
od_end_time                     2018-09-17 15:10:35.615369472
start_scan_to_end_scan                                   90.0
actual_distance_to_destination                       21.65415
actual_time                                              51.0
```

```
osrm_time                                                 25.0
osrm_distance                                         27.71915
segment_actual_time                                       50.0
segment_osrm_time                                         25.0
segment_osrm_distance                                28.429099
segment_actual_time_sum                                   50.0
segment_osrm_time_sum                                     25.0
segment_osrm_distance_sum                            28.429099
od_total_time                        0 days 01:30:58.665517750
od_time_diff_hour                                     1.516296

                                                           50%  \
trip_creation_time               2018-09-22 03:33:30.255023104
od_start_time                    2018-09-22 07:17:15.379571712
od_end_time                      2018-09-22 14:46:05.410478848
start_scan_to_end_scan                                   152.0
actual_distance_to_destination                       35.044329
actual_time                                               84.0
osrm_time                                                 39.0
osrm_distance                                         43.54355
segment_actual_time                                       83.0
segment_osrm_time                                         42.0
segment_osrm_distance                                45.797649
segment_actual_time_sum                                   83.0
segment_osrm_time_sum                                     42.0
segment_osrm_distance_sum                            45.797649
od_total_time                        0 days 02:32:20.203949500
od_time_diff_hour                                     2.538946

                                                           75%  \
trip_creation_time               2018-09-27 19:55:17.273207040
od_start_time                    2018-09-27 23:22:20.105725952
od_end_time                      2018-09-28 03:19:50.211971840
start_scan_to_end_scan                                   307.0
actual_distance_to_destination                       65.557392
actual_time                                              167.0
osrm_time                                                 72.0
osrm_distance                                        85.443949
segment_actual_time                                      166.0
segment_osrm_time                                         79.0
segment_osrm_distance                                91.023573
segment_actual_time_sum                                  166.0
segment_osrm_time_sum                                     79.0
segment_osrm_distance_sum                            91.023573
od_total_time                           0 days 05:07:17.158769
od_time_diff_hour                                     5.121433

                                                        max  \
trip_creation_time               2018-10-03 23:59:42.701692
od_start_time                    2018-10-06 04:27:23.392375
```

```
od_end_time                               2018-10-08 03:00:24.353479
start_scan_to_end_scan                                        7898.0
actual_distance_to_destination                           1927.447754
actual_time                                                   4532.0
osrm_time                                                     1686.0
osrm_distance                                            2326.199219
segment_actual_time                                           4504.0
segment_osrm_time                                             1938.0
segment_osrm_distance                                    2640.924805
segment_actual_time_sum                                       4504.0
segment_osrm_time_sum                                         1938.0
segment_osrm_distance_sum                                2640.924805
od_total_time                                 5 days 11:38:33.117274
od_time_diff_hour                                         131.642533

                                                                std
trip_creation_time                                              NaN
od_start_time                                                   NaN
od_end_time                                                     NaN
start_scan_to_end_scan                                   441.116974
actual_distance_to_destination                           209.952652
actual_time                                              385.728271
osrm_time                                                185.558731
osrm_distance                                            254.426529
segment_actual_time                                      382.145752
segment_osrm_time                                        216.205933
segment_osrm_distance                                      286.6698
segment_actual_time_sum                                  382.145752
segment_osrm_time_sum                                    216.205933
segment_osrm_distance_sum                                  286.6698
od_total_time                             0 days 07:21:14.957234047
od_time_diff_hour                                          7.354155
```

```python
de.describe(include='object').T
```

```
                   count unique  \
segment_key        26222  26222
trip_uuid          26222  14787
source_name        26222   1496
destination_name   26222   1466
source_city        26222   1239
source_place       26222   1246
source_state       26222     31
destination_city   26222   1236
destination_place  26222   1217
destination_state  26222     32

                                                                 top
freq
segment_key        trip-153671041653548748+IND209304AAA+IND000000ACB
```

```
1
trip_uuid                                    trip-153717306559016761
8
source_name                           Gurgaon_Bilaspur_HB (Haryana)
1052
destination_name                      Gurgaon_Bilaspur_HB (Haryana)
928
source_city                                                Bengaluru
1928
source_place                                             Bilaspur_HB
1052
source_state                                             Maharashtra
3565
destination_city                                           Bengaluru
1863
destination_place                                        Bilaspur_HB
928
destination_state                                          Karnataka
3497
```

```
de['destination_city'].unique()
```

```
array(['Gurgaon', 'Kanpur', 'Chikblapur', 'Doddablpur', 'Chandigarh',
       'Mumbai', 'Hospet', 'Bellary', 'Sandur', 'Chennai',
'Bengaluru',
       'HBR', 'Surat', 'Delhi', 'PNQ', 'Faridabad', 'Kolhapur',
'Shirala',
       'Ratnagiri', 'Anantapur', 'Hyderabad', 'Sindagi', 'Gulbarga',
       'Indi', 'Aland', 'Jaipur', 'Satna', 'Janakpuri', 'Guwahati',
       'Unnao', 'Gadarwara', 'Bareli', 'Shirdi', 'Sinnar',
'Sangamner',
       'Shrirampur', 'Kopargaon', 'Vaijiapur', 'Nashik', 'Kolkata',
       'Hoogly', 'Hooghly', 'Pavagada', 'Puttaprthi', 'Sivasagar',
       'Medchal', 'Oddnchtram', 'Batlagundu', 'Vadipatti',
'Kodaikanal',
       'Palani', 'Nakodar', 'Kapurthala', 'Jalandhar', 'Yavatmal',
       'Atapadi', 'Sangola', 'Bhandara', 'Savner', 'Kurnool',
'Palwal',
       'FBD', 'TalwandiSabo', 'Mansa', 'Jhunir', 'Bhatinda',
'Bhiwandi',
       'Barnala', 'Murbad', 'AnandprShb', 'RoopNagar', 'Puttur',
'Kadaba',
       'Chittapur', 'Sedam', 'Chincholi', 'Naraingarh', 'Ludhiana',
       'Ahmedabad', 'Kadi', 'Dola', 'Jabalpur', 'MAA', 'Parli',
       'Ambajogai', 'Pune', 'Loha', 'Gangakher', 'Barjora',
'Bishnupur',
       'Bankura', 'Silvassa', 'Junagadh', 'Bhanvad', 'Porbandar',
       'Dhoraji', 'Upleta', 'Jetpur', 'Choutuppal', 'Suryapet',
       'Vijayawada', 'Nalgonda', 'Miryalguda', 'Khammam', 'Vadnagar',
       'Palanpur', 'Deesa', 'Mehsana', 'Katni', 'Kodinar', 'Talala',
```

```
       'Una', 'Chamarjngr', 'Mysore', 'Kollegala', 'Tirumakudalu',
       'Malavalli', 'Krishnarajngr', 'Gonikoppal', 'HDKote', 'Unjha',
       'Bhabhar', 'Radhanpur', 'Rajamundry', 'Visakhapatnam',
       'Sawantwadi', 'Kankavali', 'Bhopal', 'Bhubaneshwar',
'Allahabad',
       'Moradabad', 'Rudrapur', 'Sonipat', 'Modasa', 'Khedbrahma',
       'Himmatnagar', 'Sasaram', 'Ranchi', 'Cuddalore', 'Chidambaram',
       'Sirkazhi', 'Karaikal', 'Nagapttinm', 'Pondicherry',
'Thiruvarur',
       'GZB', 'Khambhat', 'Anand', 'Degloor', 'Udgir', 'Latur',
'Nanded',
       'Noida', 'Umreth', 'Nadiad', 'Panruti', 'Pennadam',
'Chinnasalem',
       'Villupuram', 'Neyveli', 'Virudhchlm', 'Jhalda', 'Purulia',
'Hura',
       'Durgapur', 'Bhadrak', 'Goa', 'Balurghat', 'Meham', 'Hisar',
       'Ambur', 'Tiruppattur', 'Haridwar', 'Kotdwara', 'Narsapur',
       'Kamareddy', 'Bodhan', 'Medak', 'Banswada', 'Yellareddy',
       'Dhrangadhra', 'Halvad', 'Gangavathi', 'Koppal', 'Jahu',
       'BilaspurHP', 'JognderNgr', 'Kharagpur', 'Jhargram',
       'ChandroknaRD', 'Kirauli', 'BLR', 'Lakhimpur', 'Sitapur',
'Gola',
       'Dhaurahara', 'Mangalore', 'Canacona', 'Vansda',
'Mananthavady',
       'Lucknow', 'Silchar', 'Nakhatrana', 'Bhuj', 'Pundibari',
       'LowerParel', 'Changlang', 'Dahanu', 'Boisar', 'Chodavaram',
       'Bhalukpong', 'Tezpur', 'Rajampet', 'Tirupati', 'Koduru',
'GGN',
       'Sriklahsti', 'Venktagiri', 'Gudur', 'Roha', 'Mahad', 'Pen',
'CCU',
       'Amdavad', 'AMD', 'Gosainganj', 'Akbarpur', 'Muzaffrpur',
'Purnia',
       'Aurangabad', 'KN', 'Phagwara', 'Pandhurna', 'Betul', 'Sausar',
       'Tamluk', 'Panskura', 'Haldia', 'Madurai', 'Dindigul',
'Namakkal',
       'Erode', 'Aligarh', 'Mainpuri', 'Shikohabad', 'Firozabad',
'Rajam',
       'Salur', 'Srikakulam', 'Palakonda', 'Parvathipuram',
'Narasnpeta',
       'Palasa', 'Paralakhemundi', 'Tekkali', 'Nalasopara', 'Hajo',
'NOI',
       'Dalhousie', 'Chamba', 'Pathankot', 'Baharampur', 'Dhulian',
       'Malda', 'Malvan', 'Hoskote', 'Shujalpur', 'Shajapur',
'Ambabadi',
       'OK', 'Amritsar', 'Coimbatore', 'Jasai', 'Tirchngode',
'Mettur',
       'Kurseong', 'Darjeeling', 'Tiruchi', 'Dadri', 'Del', 'Rangia',
       'Nalbari', 'Bilasipara', 'Lakhipur', 'Dhubri', 'Vellore',
'Ajmer',
```

```
        'Pali', 'Jodhpur', 'Gotan', 'Gajraula', 'Rampur', 'Amroha',
        'Dholpur', 'Lalitpur', 'Gwalior', 'Datia', 'Thirthurpondi',
        'Pushpavanam', 'Dhanbad', 'Ashokngr', 'Guna', 'Burhanpur',
        'Hassan', 'Margherita', 'SrinagarUK', 'Chamoli', 'Gohpur',
        'Itanagar', 'Silapathar', 'Pasighat', 'Mirzapur', 'Ghazipur',
        'Dharwad', 'Gokak', 'Hubli', 'Ramdurg', 'Gadag', 'Rona',
        'Bagalkot', 'Renukoot', 'Anpara', 'Singrauli', 'Robertsganj',
        'Panipat', 'Berhampur', 'Ranebennur', 'Haveri', 'Alwar',
        'Bhilwara', 'Udaipur', 'Gandhidham', 'Solapur', 'Belgaum',
        'Muktsar', 'Moga', 'Jagatsghpr', 'Paradip', 'Kendrpara',
        'Osmanabad', 'Barshi', 'Addanki', 'Kanigiri', 'Kandukur',
'Ongole',
        'Bokaro', 'Sirsi', 'Sagara', 'Muzaffrngr', 'Dehradun',
'Deoband',
        'Chhatarpur', 'Siwan', 'Nawada', 'Chandi', 'BiharSarif',
'Rajgir',
        'Pallakad', 'Vadakkencherry', 'Thrissur', 'Kanakapura',
        'Chanapatna', 'Mandya', 'Roorkee', 'Rishikesh', 'Manjeshwar',
        'Surathkal', 'Jamshedpur', 'Vadodara', 'Sheikhpura',
'Bakhtiarpur',
        'Godhra', 'Dahod', 'Tirupur', 'Kendujhar', 'Barbil',
'Karanjia',
        'Rewari', 'Dharuhera', 'Neemrana', 'Hanumangarh', 'Sirsa',
'Ganga',
        'Arrah', 'Arwal', 'Jhajjar', 'Bhiwani', 'Kabuganj', 'Kolasib',
        'Bardhaman', 'Asansol', 'Rupnarayanpur', 'Midnapore', 'Jalna',
        'Sillod', 'Nellore', 'Chapra', 'Nakashipara', 'Plassey',
        'SultnBthry', 'Rawatsar', 'Kurukshetra', 'Assandh', 'Pehowa',
        'Kaithal', 'Nuzvid', 'Kaikaluru', 'Gudivada', 'Machilipatnam',
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       'MROoffce_D', 'Alwal_I', 'Palani_D', 'RTOofice_D', 'lalaNGR_D',
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       'Pandrnga_I', 'CivilHPL_D', 'Srikot_D', 'CGRoad_D',
'WageDPP_D',
       'Hejunagr_D', 'MissonRd_D', 'JangiRd_D', 'Kaithwal_D',
       'Bsavangr_D', 'Adargchi_IP', 'Jogshwri_I', 'GndhiNGR_D',
       'Cdosclrd_D', 'GadagRD_D', 'Sector4_D', 'Govind_D', 'Parasi_D',
       'Waidhan_D', 'Ward8DPP_D', 'ArtoDPP_D', 'Panipat',
```

```
'Khajuria_I',
       'SriRmNGR_D', 'GuttalRD_D', 'Mangri_I', 'Sector1A_IP',
       'Shamshbd_P', 'Dankuni_P', 'Markndpr_D', 'Udyabata_D',
       'Kapleswr_D', 'Okhla_PC', 'Nangli_L', 'Kakdepot_D',
'Kurduwdi_D',
       'Oilmilrd_D', 'Tiglgndi_D', 'LICOffce_D', 'SubhVRTL_I', 'HUB',
       'Patparganj_DPC', 'Chndivli_PC', 'KSClny_DC', 'Vidygiri_D',
       'Vardhard_D', 'Mankoli_GW', 'Chrompet_PC', 'Bilaspur_P',
       'Pandesra_Gateway', 'MhmodNgr_D', 'Dehradun', 'Ramvlg_D',
       'HnmntNgr_D', 'SH78_D', 'Soghra_D', 'PnditNGR_D', 'ChndrNgr_D',
       'Robinson_D', 'Poothole_D', 'VaniThtr_D', 'IOTCEncl_L',
       'Tolichwk_I', 'Central_I_3', 'Karelibaug_DPC', 'Bgwtichk_D',
       'BypassRD_D', 'Kapshera_L', 'RIICO_L', 'Koliplm_I',
'Sirjudin_D',
       'PunjbiPd_D', 'Sarubali_D', 'YuktiDPP_D', 'Rcocmplx_D',
       'AnprnDPP_D', 'Nagar_DC', 'Katira_D', 'Rozapar_D',
'Jantaclg_D',
       'Diakkawn_D', 'Bankura_D', 'Salanpur_D', 'Talkui_D',
'BhgyaNgr_D',
       'ZebaTWR_D', 'North_R_8', 'Aurangabad', 'NagarDPP_D',
'MaxDPP_D',
       'BtaiRoad_D', 'Kollgpra_D', 'ShivmDPP_D', 'MhrjaDPP_D',
       'WdN14DPP_D', 'Ward17_D', 'Atapaka_D', 'GvrCompx_D',
'ArhamDPP_D',
       'GndhiDPP_D', 'PeroorRD_D', 'DindiRD_D', 'VidyaNGR_D',
       'Mundhawa_L', 'BoiDPP_D', 'SrifoDPP_D', 'Kntgorya_D',
'NditaDPP_D',
       'DohalDPP_D', 'GopalDPP_D', 'KrsprDPP_D', 'UtBzrDPP_D',
       'SavtaHTL_D', 'Hindcwk_D', 'GrmNgriya_D', 'HoliCDPP_D',
       'MdothdRD_D', 'kalibari_D', 'Alngjuri_D', 'RicMilRd_D',
       'Bhogpur_D', 'AkhraBzr_D', 'PlaceCol_D', 'TahurDPP_D',
       'Anaipeta_D', 'Bardivan_D', 'Wardno6_D', 'ByePass_D',
'MohanPrk_D',
       'SChwkDPP_D', 'SagarDPP_D', 'Gaurkshn_I', 'LxmiNiws_D',
'Mundhe_D',
       'Mahad_D', 'Shantanu_D', 'LSRoad_DC', 'VallaDPP_D',
'ColctrOf_D',
       'SikriKla_DC', 'Meerut', 'Wazirpur_L', 'Gangjala_D',
'SadrHsptl_D',
       'Krishnpr_D', 'Wardn13_D', 'Bazar_D', 'Ward9DPP_D',
'SngihiRD_D',
       'Durma_D', 'Sishumdr_D', 'SrnvsNgr_D', 'Enkndla_D', 'YTRd_D',
       'ShtDRDPP_D', 'RKComplx_D', 'VikrmMah_D', 'KirtiNgr_D',
       'DvlalDPP_D', 'Rohtak', 'Patiala', 'GainMrkt_L', 'Darbhanga',
       'Javahar_D', 'Nagar_D', 'MuruPost_D', 'patna_D', 'GodamDPP_D',
       'Vijayght_D', 'Shyndco_D', 'AgrohDPP_D', 'SchdvDPP_D',
'SaiNgr_D',
       'GVManu_D', 'Madnpali_D', 'RTCStand_D', 'Gurudwar_D',
'AjmhwDPP_D',
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        'BhukrdPP_D', 'Mwalibad_D', 'MithmdRd_D', 'Subhash_D',
        'Sookhtal_D', 'Kumud_D', 'SuzkiSrv_D', 'PushPlza_D',
'NraynDPP_D',
        'LalBagh_D', 'CCRoad_D', 'Banjaria_D', 'Matriprm_IP',
'Subshngr_D',
        'KasyaDPP_D', 'East_I_21', 'BypassRd_D', 'PchpkrRD_D',
        'Panderia_D', 'TrnsptNGR_D', 'Hatpada_D', 'Dudhani_D',
'Bhaleti_D',
        'BpassDPP_D', 'Ward6_D', 'Fathuluh_D', 'KotdwrRD_D',
'Dayanand_D',
        'NaginaRD_D', 'Nrsampt_D', 'Yellanda_D', 'HunterRd_I',
'Ganesh_D',
        'KdidmCLY_D', 'Khwssrai_D', 'Khjurwli_DC', 'Harop_D',
'OnkarDPP_D',
        'BajprDPP_D', 'Vaishali_D', 'BhwniGnj_D', 'MubarDPP_D',
        'PnchmDPP_D', 'Kosmi_D', 'RajaBzr_D', 'KairiyaT_D', 'Mohim_D',
        'EBroad_D', 'Bidar', 'Datatrya_D', 'StatonRd_D', 'Verpatem_D',
        'RailGate_D', 'Shankrpa_D', 'Kalol_DC', 'Chandkheda_Dc',
        'MheshNGR_D', 'PODPP_D', 'AskNagar_D', 'KarnalRd_D',
'DmodrNGR_D',
        'IndraCln_D', 'MndwrRod_D', 'NWclyDPP_D', 'HnsChowk_D',
        'Ward6DPP_D', 'NavldiDPP_D', 'Pilani', 'JdswarRD_D',
'Kalyanpr_D',
        'StnRoad_DC', 'KlngrDPP_D', 'MrenTirh_D', 'Tejpal_I',
'Krvnkuzy_D',
        'Pariplly_D', 'NrainaRD_D', 'NarenaRD_D', 'ChomuRD_D',
        'Nishangr_D', 'Wardno13_D', 'Sarswati_D', 'Wardno4_D',
'Purbari_D',
        'GTRoad_D', 'SJRoad_D', 'Kanongyn_D', 'DcntCLY_D',
'Arlumodu_D',
        'Mutyvila_D', 'MhraChng_D', 'AryaNagr_D', 'Kharghar_D',
        'NdiaTola_D', 'Pbroad_DC', 'ZuariNgr_IP', 'Goa', 'HapurRD_D',
        'Swargash_D', 'WardNo4_D', 'Haripur_D', 'KamnHbRD_I',
'GunjRDPP_D',
        'Aravind_D', 'HanumDPP_D', 'Hitech_D', 'TKRoad_D',
'Kumrpurm_D',
        'MunplDPP_D', 'Gobindgarh_DC', 'Town_D', 'Amankovl_D',
        'Klskhrpt_D', 'PostofJN_D', 'KrantiNgr_D', 'MIDCAvdn_I',
        'DhuleRd_D', 'DhuleRoad_D', 'Nandrbar_D', 'Mahindra_D',
        'Khar West _Dc', 'RajCmplx_D', 'Balaji Nagar', 'Peedika_H',
        'BhadgDPP_D', 'KolheDPP_D', 'BChwkDPP_D', 'Parigi_D',
'KanpurRd_D',
        'StatinRD_D', 'Rawatpur_D', 'JilRDDPP_D', 'Kotwali_D',
'Mlkpura_D',
        'GayatriN_D', 'Arulimod_D', 'Ajnari_D', 'NehruNGR_D',
'Court_D',
        'GovndNgr_DC', 'barkarRd_D', 'Bokule_H', 'JyotiNgr_D',
        'BrlwgDPP_D', 'Chikdply_I', 'Naraynpr_D', 'ModelTwn_P',
'Ward19_D',
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       'SttinDPP_D', 'PalikDPP_D', 'Padra_D', 'WebelDPP_D',
'Itachnda_D',
       'Pshimpra_D', 'Psthrjhr_D', 'BOB_D', 'Truptingr_D', 'Virar_DC',
       'Skynet_INT', 'Shop3DPP_D', 'Vepmpttu_DC', 'IndEstat_I',
       'Paschim_DC', 'LB-Nagar_Dc', 'CotnGren_M', 'MiraRoad_M',
       'ShivBari_D', 'Vadodara', 'ArkonmRD_D', 'Central_DPP_4',
       'Chakan_D', 'Mdiclcly_D', 'ColageRD_D', 'Umalodge_D',
'SriDPP_D',
       'WardNo3_D', 'Shillong', 'NamoNagr_D', 'ShsmlDPP_D',
'FatehpRd_I',
       'PBRDDPP_D', 'KotwaliN_D', 'MduraiRD_D', 'Kacheri_D',
'KhandDPP_D',
       'Jamalpur_D', 'BgwriDPP_D', 'SmClyDPP_D', 'Madarpur_D',
       'Nirjanpur_L', 'PonaniRD_D', 'ManhrBld_D', 'DumDum_DPC',
       'KaaduRd_D', 'Blmrgnst_D', 'KrthiKyn_D', 'StationRD_D',
'Satara_D',
       'BstndDPP_D', 'KmkshBul_D', 'Prbhtngr_D', 'Kakrmath_D',
       'Beltngdi_D', 'MarketRd_D', 'Veersagr_I', 'Pazhvedu_D',
       'Pshrikvu_D', 'ZamQuatr_D', 'Mandodi_D', 'IdstrlAr_D',
       'Thiruviz_D', 'Vadasari_D', 'Poondi_D', 'VaiklSRT_D',
'MukkuRD_D',
       'Fairybnk_D', 'kalmpuza_D', 'nagar_D', 'Badeplly_D', 'SH71_D',
       'Sbrmnprm_D', 'HsptlRod_D', 'Mrthndpr_D', 'Puduvalvu_D',
       'Konapara_D', 'CmtNgRod_D', 'AnnaNGR_D', 'goplpurm_D',
       'Mthrapuri_D', 'Kmrajngr_D', 'Chithbrm_D', 'PriyrNGR_D',
       'Pinjore_DC', 'AmtlaDPP_D', 'JhumanCk_D', 'Msstreet_DC',
       'Krsnakcl_D', 'Kovil_D', 'AshkTalk_D', 'Ward25_D', 'TherSRT_D',
       'Ukkadam_D', 'RtlamNka_D', 'Sahni_D', 'Palikval_D',
'Ward7DPP_D',
       'Srvdycwk_D', 'VijywdRD_D', 'BhogdDPP_D', 'MuthpTmp_D',
'BMRd_D',
       'Shanthi_D', 'Vijdurg_D', 'Ambedkar_D', 'Sunku_D', 'KolarRd_D',
       'FshryOFC_D', 'Artclgrd_D', 'Venkatsa_DC', 'Tuminkte_D',
       'PlsrdDPP_D', 'ViksClny_D', 'Barout_D', 'Wardno10_D',
'Thvlrsrt_D',
       'Palladam_DC', 'Techrcly_D', 'Wardno7_D', 'Brplicwk_D',
       'GangDPP_D', 'Banshkri_DC', 'HousngBd_D', 'NH117_D',
'Arsprmbu_D',
       'Chnglptu_DC', 'Achipkam_D', 'Sudimala_D', 'Perkadrd_D',
       'Radhaprm_D', 'AsrplmRd_DC', 'VdkkuSrt_I', 'MrktYrd_DC',
       'Rajula_DC', 'SriVnktpm_D', 'UdnkdiRD_D', 'Shnmgprm_D',
       'VidyaNgr_D', 'SKRoad_D', 'Uppal_L', 'BaraLoha_D',
'Barmasia_D',
       'D', 'AmbedDPP_D', 'LaxmiNGR_D', 'Kataram_D', 'JwahrNGR_D',
       'Srirampt_D', 'BnglorRd_D', 'Greenmkt_D', 'KndliDPP_D',
       'Pdmavati_D', 'JydevNGR_D', 'CivlLine_D', 'ChngiDPP_D',
       'RjndrNgr_DC', 'PiliKoti_D', 'Gurukrpa_D', 'TBCross_D',
       'CollgeRD_D', 'North', 'GwhRDDPP_D', 'Thiruvlr_DC',
'TmpleSrt_D',
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       'Vllyaprm_D', 'RamnadRD_D', 'ThrbadRD_D', 'Rawlgaon_D',
       'Malegaon_D', 'South_D_12', 'Central_D_7', 'Wrd12DPP_D',
       'Shahapur_D', 'HBColny_D', 'Ponda_Dc', 'RajpurRD_D',
'NorprRD_D',
       'ThanaDPP_D', 'Salem', 'PC', 'EragnDPP_D', 'Antop Hill',
       'AadiDPP_D', 'TrnptNgr_L', 'Trimulgherry_Dc', 'Panvel_D',
       'Mangalam_D', 'ShantiNg_D', 'Viveka_DC', 'MJRDPP_D',
'Samarth_D',
       'BaliaMod_D', 'MhliaDPP_D', 'Ganeshwr_D', 'KatlaDPP_D',
       'Trmltmpl_D', 'kankroli_D', 'Mehmdpur_P', 'Hanmkond_D',
       'RadhaCpx_D', 'MndiRoad_D', 'Mohnprwa_D', 'Ward11_D',
'Mnanthla_H',
       'ShjnprRD_D', 'Eaglvari_D', 'PhdofDPP_D', 'Kelasahi_D',
       'Kdthdstrt_D', 'TnhbBlkC_D', 'VagaiNgr_D', 'LxmntDPP_D',
       'BhmrdDPP_D', 'Ameenpur_I', 'KdrShrRd_D', 'AlathurRD_D',
       'Thsil3PL_D', 'KKndrDPP_D', 'BhunaDPP_D', 'LFRoad_D',
'RgvdrDPP_D',
       'MandyaRD_D', 'Mlydpthr_D', 'Davisdle_D', 'HajiprRD_D',
       'MnBzrDPP_D', 'Talaiya_D', 'NharuExt_D', 'NngrgnRd_D',
       'SrnprHwy_D', 'Margao_Dc', 'Tejpal_M', 'Valluvar_D',
'RLSTNDPP_D',
       'War5DPP_D', 'Dilliyan_D', 'BhrolDPP_D', 'NaginaRd_D',
       'Sitarmrd_D', 'Kadugodi_D', 'Mahuva_DC', 'Shahdara',
'KakaCplx_D',
       'ConduDPP_D', 'Pothredy_D', 'APMCYard_D', 'VasaviNg_D',
'Kalyan',
       'Barwala', 'Central_D_5', 'PaikjNGR_D', 'Chaitnya_D',
'AsnsdhRD_D',
       'GndhiNgr_D', 'KhdimDPP_D', 'RPRoad_D', 'Swamylyt_D',
'Kidwai_D',
       'NagpurRd_D', 'DelRdDPP_D', 'ColegRd_D', 'Shekhpur_D',
       'MngalDPP_D', 'PrmNrDPP_D', 'BhwanDPP_D', 'MohnVRTL_D',
       'MohanNgr_C', 'PigonDPP_D', 'Chpaguri_D', 'Manikndm_H',
       'Palakrty_D', 'PreetDPP_D', 'Kothapet_D', 'ChtrGIDC_IP',
'Delhi',
       'ITICollg_L', 'KisanCo_D', 'LdnunDPP_D', 'Mhdiptnm_C',
       'Shivangr_D', 'KnsgraRD_D', 'Udupi', 'Sector02_C',
'Bomsndra_PC',
       'Vijayawada', 'Chndrlpd_D', 'AkkolRD_D', 'MnbzrDPP_D',
       'Munduprm_D', 'EmsPnmbi_D', 'BSarani_D', 'Bareilly',
'WardNo1_D',
       'SadarHPL_D', 'Karnal', 'BgnprDPP_D', 'Mughlpra_D',
'SainkSCL_D',
       'Sohagpur_D', 'Sholinganallur_Dc', 'MdhsnDPP_D', 'Kadipur',
       'Kothuru_D', 'Wardno8_D', 'BaruaRd_D', 'Potheri', 'ChrliDPP_D',
       'Chatrpr_DC', 'MBTRd_DC', 'Sadras_D', 'AzmrdDPP_D',
'LNBRoad_D',
       'Shop2DPP_D', 'DeVDPP_D', 'GagiDPP_D', 'BodomBzr_DC',
'HotelPrk_D',
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        'Mainrd_D', 'Pandriba_L', 'SnthiNGR_D', 'CroslySRT_D',
        'BypRDDPP_D', 'JrjolDPP_D', 'UmarDPP_D', 'Mharajpr_D',
        'Cnsrvila_D', 'Gurkhari_D', 'East_L_23', 'JthriDPP_DC',
        'CtyLgDPP_D', 'SadulDPP_D', 'PedakRd_P', 'RailwyRd_D',
        'Solaiprm_D', 'Bhabua_D', 'Chukhndi_D', 'Todapur_DC',
        'VislkNgr_DC', 'SaiTempl_D', 'NcsRd_DC', 'Nullipad_D',
        'NapitDPP_D', 'MrdiVlge_D', 'LohiaDPP_D', 'PakriDPP_D',
        'BisnolDPP_D', 'Gopa3PL_D', 'Nehru3PL_D', 'MnRDDPP_D',
'Bahreya_I',
        'ThthiCwk_D', 'HSR_Layout_PC', 'Sracmplx_D', 'Katghara_D',
        'Mhimapur_D', 'Nimachrd_D', 'Kdvantra_D', 'Chtrpuza_D',
        'Veluthur_D', 'Greens_D', 'SurbhiTh_D', 'Shivprsad_D',
        'BawliDPPP_D', 'Rathnam_D', 'HesglDPP_D', 'TonkRoad_D',
        'MSRClgRd_D', 'Shivalya_D', 'JatniDPP_D', 'Mangol_DC',
        'Pthrgoan_D', 'Chrwpaty_D', 'HelipadRD_D', 'Farmnala_D',
        'ShbdnDPP_D', 'Ranakant_D', 'Chmpmura_I', 'North_D_3',
        'ShubsNGR_D', 'Mrtrklgr_D', 'AwmpiVng_D', 'HunthrVg_I',
'Feroke_H',
        'Pringla_D', 'SantaNGR_D', 'Bazarrd_D', 'JalnaRd_D',
'GhtimDPP_D',
        'IndraNgr_D', 'RmNyrDPP_D', 'HsnRdDPP_D', 'Puthalam_D',
        'Agraharm_DC', 'Dehrird_D', 'BasthDPP_D', 'SubrtDPP_D',
        'FatprDPP_D', 'Nijgan_D', 'East_I_20', 'KtnRdDPP_D', 'Mapusa',
        'Pnjbiyon_D', 'Patel Nagar', 'East_D_8', 'Rjndrngr_D', 'Old
City',
        'YashDPP_D', 'Aliganj', 'Agra', 'Nerul_D', 'Murtingr_D',
        'PcrrdDPP_D', 'BsStdDPP_D', 'SashPhkn_D', 'KalikDPP_D',
        'Lakshmi_D', 'Whitefld_L', 'Lngrguda_D', 'DMComDPP_D',
        'Pnchlght_D', 'KDRoad_D', 'NavdaCln_D', 'KaimgnjRD_D',
        'farukngr_D', 'CroadDPP_D', 'RatuaDPP_D', 'JivanDPP_D',
        'BhmprDPP_D', 'Vishakhapatnam', 'GoalpDPP_D', 'MlnprDPP_D',
        'TiloiDPP_D', 'Wardnor4_D', 'Ldthlabh_D', 'MahmurGj_IP',
        'KamalDPP_D', 'PuranDPP_D', 'Cherukole_D', 'Bhainpura_D',
        'MnimlaRd_D', 'KeRoad_D', 'MsjidDPP_D', 'KarjuDPP_D',
'VidyaDPP_D',
        'KoralDPP_D', 'Majoor_D', 'Bhaluahi_D', 'MsmcyDPP_D',
'KcharaRD_D',
        'Cochin_L', 'CourtDPP_D', 'SirsaDPP_D', 'PtrlBunk_D',
'NatunDPP_D',
        'Enayetpr_D', 'BsnoiHPL_D', 'Idgah_P', 'Chandigarh',
'ColnyDPP_D',
        'Pettah_D', 'Mylapore', 'NaturDPP_D', 'UttarDPP_D',
'MdnprDPP_D',
        'Kanakpur_D', 'Salap_DC', 'Idgah_L', 'Kolar Mandakni',
'SohnaRd_D',
        'NagplDPP_D', 'KeranDPP_D', 'BnkrGate_D', 'SndbrDPP_D',
        'RoopNgr_D', 'Jharia_DC', 'Jabalpur', 'NadthiCx_D',
'Sangetha_D',
        'Ramnagar_D', 'WamanDPP_D', 'DiyoDPP_D', 'JJCpxDPP_D',
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       'RwStnDPP_D', 'Ricco_D', 'Poonamallee_L', 'Umargaon_DC',
       'BalibDPP_D', 'Kadtmpty_D', 'KotyamRD_D', 'MemariRD_D',
       'Srirmpur_D', 'Central_L_8', 'FulbaDPP_D', 'SukntDPP_D',
       'Kondapur_D', 'VUNagar_DC', 'Prjapati_D', 'EtwahDPP_D',
       'UdaynDPP_D', 'DibngVly_D', 'GndhiChk_D', 'Muktsar_D',
       'Ghansoli_DC', 'Kovaipudur_Dc', 'Lajwanti', 'Central_H_4',
       'BrezeDPP_D', 'Rjndpara_D', 'BazarDPP_D', 'MotiDPP_D',
       'MrgnjDPP_D', 'Jaripatk_DC', 'Sarjapur_D', 'Kothanur_L',
       'AshkngRd_D', 'JiswlDPP_D', 'West_Dc', 'BargaDPP_D',
'SbhRDDPP_D',
       'Parai_D', 'KhsmiDPP_D', 'ChatiDPP_D', 'Bulabeda_D',
'ChtwrDPP_D',
       'RhmgjDPP_D', 'Kooriyad_D', 'Bhandup West_Dc', 'GMndiDPP_D',
       'GurpdDPP_D', 'Kaura_D', 'Bnsibtla_D', 'MjlprDPP_D',
'Varanasi',
       'TilakNgr_D', 'Manchar_D', 'Old', 'ShantiDPP_D', 'Royapuram',
       'DivrsnRd_D', 'SliprDPP_DC', 'RajRdDPP_D', 'KrisnKunj_D',
       'ShivaDPP_D', 'East_D_7', 'Rajpura_D', 'SingCLNY_D',
'CBRoad_D',
       'Sidrd_D', 'Krusphrma_D', 'Karelibaug_DC', 'RgstrOFC_D',
       'Sanpada_CP', 'Bhilai_DC', 'Nattukal_D', 'AnadiDPP_D',
       'ArickDPP_D', 'VrdhriRD_D'], dtype=object)
```
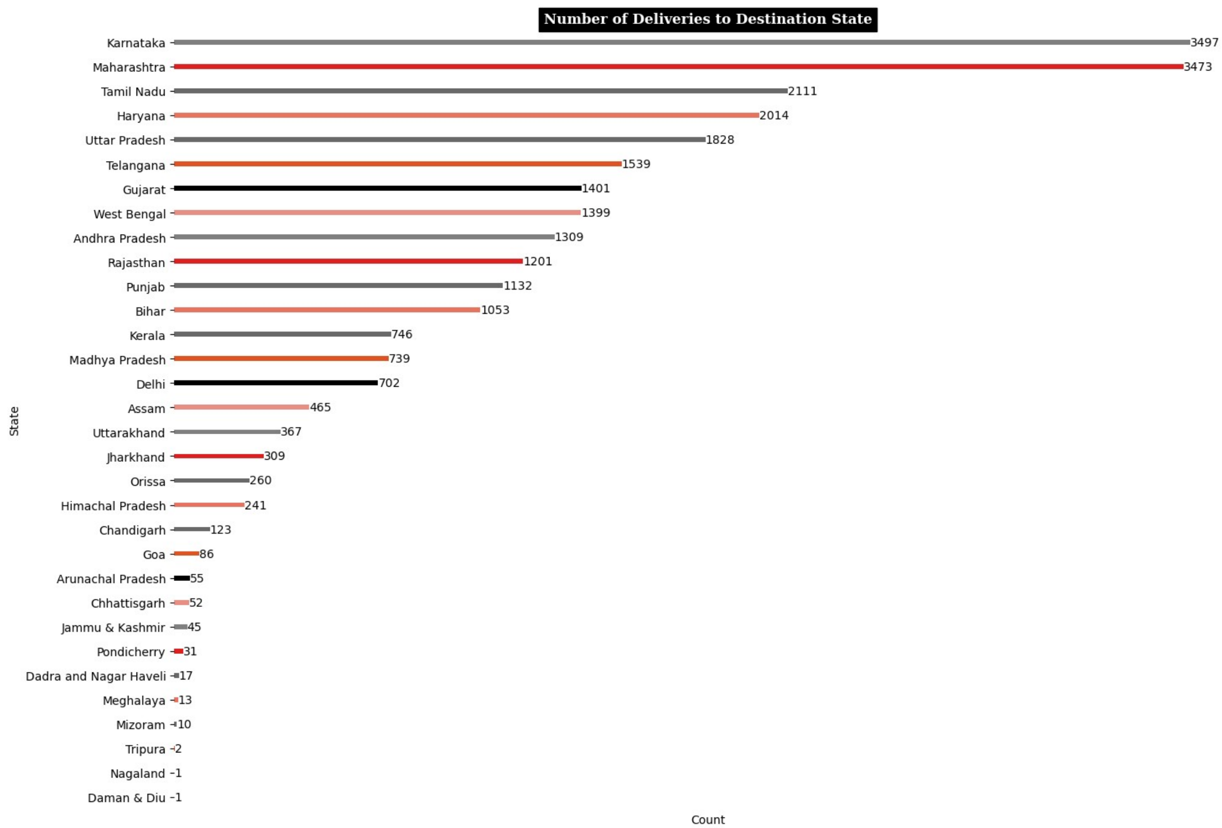

```
de['destination_state'].unique()
```

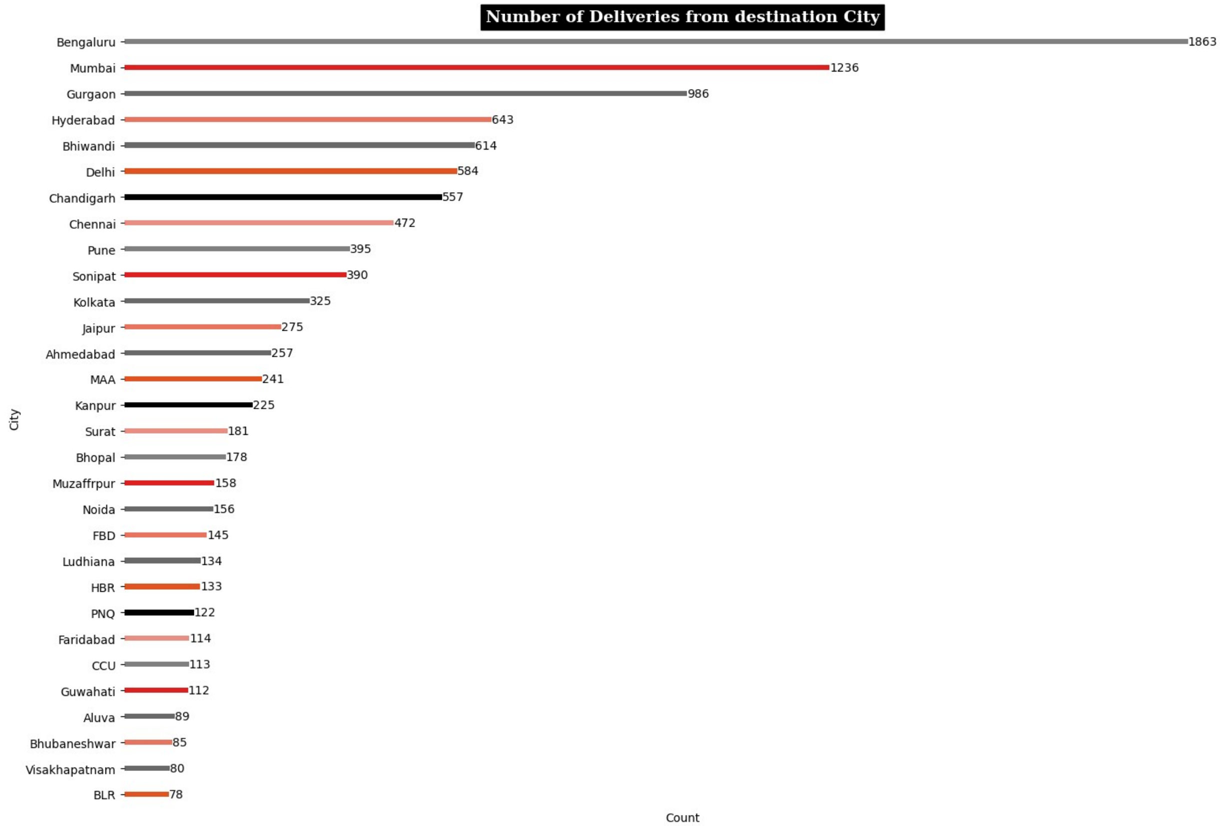
```
array(['Haryana', 'Uttar Pradesh', 'Karnataka', 'Punjab',
'Maharashtra',
       'Tamil Nadu', 'Gujarat', 'Delhi', 'Andhra Pradesh',
'Telangana',
       'Rajasthan', 'Madhya Pradesh', 'Assam', 'West Bengal',
       'Chandigarh', 'Dadra and Nagar Haveli', 'Orissa',
'Uttarakhand',
       'Bihar', 'Jharkhand', 'Pondicherry', 'Goa', 'Himachal Pradesh',
       'Kerala', 'Arunachal Pradesh', 'Mizoram', 'Chhattisgarh',
       'Jammu & Kashmir', 'Meghalaya', 'Nagaland', 'Tripura',
       'Daman & Diu'], dtype=object)
```

```
state_counts =
de['destination_state'].value_counts().to_frame().reset_index()
state_counts.columns = ['State', 'Count']

plt.figure(figsize=(15,10))
a = sns.barplot(y='State', x='Count',
data=state_counts,palette=cp,width=0.2)
a.bar_label(a.containers[0], label_type='edge')
plt.xticks([])
plt.ylabel('State')
plt.xlabel('Count')
plt.title('Number of Deliveries to Destination
State',fontsize=12,fontfamily='serif',fontweight='bold',backgroundcolo
```

```
r='k',color='w')
plt.tight_layout()
sns.despine(bottom=True,left=True)
plt.show()
```




```
city_counts =
de['destination_city'].value_counts().to_frame().reset_index()[:30]
city_counts.columns = ['City', 'Count']

plt.figure(figsize=(15,10))
a = sns.barplot(y='City', x='Count',
data=city_counts,palette=cp,width=0.2)
a.bar_label(a.containers[0], label_type='edge')
plt.xticks([])
plt.ylabel('City')
plt.xlabel('Count')
plt.title('Number of Deliveries from destination
City',fontsize=14,fontfamily='serif',fontweight='bold',backgroundcolor
='k',color='w')
plt.tight_layout()
sns.despine(bottom=True,left=True)
plt.show()
```



Insights:

`Destination State`

- States like **Karnataka**, **Maharashtra**, **Tamil Nadu**, **Haryana**, and **Uttar Pradesh** where maximum packages are received in this month indicating significant engagement.

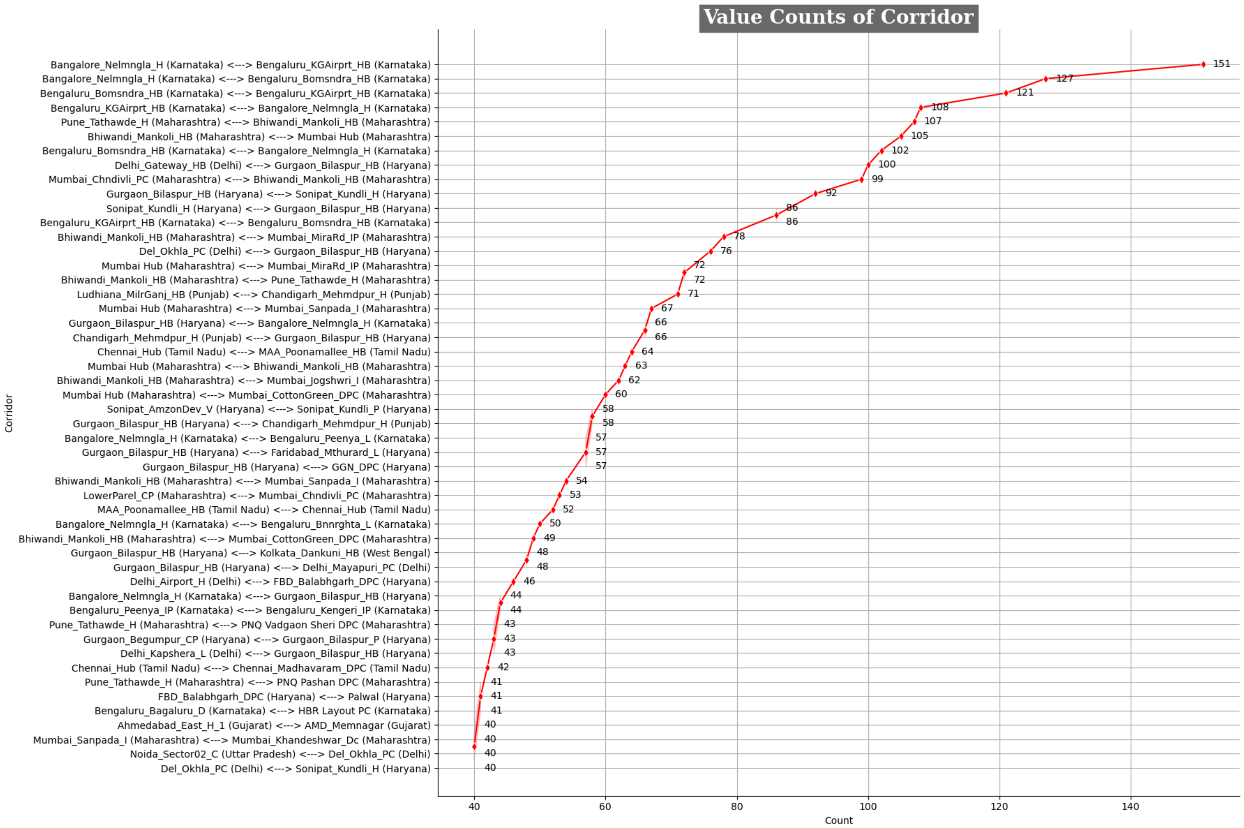
`Destination City`

- Cities like **Bengaluru**, **Mumbai**, **Gurgaon**, **Bhiwandi**, **Hyderabad**, **Delhi** where the major no.of booking are received.

```
np.set_printoptions(threshold=np.inf)

de['corridor'] = de['source_name'] +' <---> '+ de['destination_name']
de['corridor'].value_counts()
```

```
corridor
Bangalore_Nelmngla_H (Karnataka) <---> Bengaluru_KGAirprt_HB
(Karnataka)             151
Bangalore_Nelmngla_H (Karnataka) <---> Bengaluru_Bomsndra_HB
(Karnataka)             127
Bengaluru_Bomsndra_HB (Karnataka) <---> Bengaluru_KGAirprt_HB
(Karnataka)            121
Bengaluru_KGAirprt_HB (Karnataka) <---> Bangalore_Nelmngla_H
(Karnataka)             108
Pune_Tathawde_H (Maharashtra) <---> Bhiwandi_Mankoli_HB (Maharashtra)
107
```

```
...
Ongole_SubhVRTL_I (Andhra Pradesh) <---> Kandukur_LICOffce_D (Andhra
Pradesh)         1
Madnapalle_PngnrRd_D (Andhra Pradesh) <---> Palamaner_Lakshmi_D
(Andhra Pradesh)      1
Dharmavram_SaiNgr_D (Andhra Pradesh) <---> Kadiri_GVManu_D (Andhra
Pradesh)           1
Baharampur_Chuanpur_I (West Bengal) <---> Chapra_NagarDPP_D (West
Bengal)             1
Jaipur_NgrNigam_DC (Rajasthan) <---> Jaipur_Central_D_1 (Rajasthan)
1
Name: count, Length: 2741, dtype: int64

corridor_counts = de['corridor'].value_counts()[:50]

plt.figure(figsize=(18,12))
#corridor_counts.plot(kind='line', marker='d', color='r')
sns.lineplot(y=corridor_counts.index, x=corridor_counts.values,
marker='d', color='r')
plt.title('Value Counts of
Corridor',fontsize=20,fontfamily='serif',fontweight='bold',backgroundc
olor='dimgrey',color='w')
plt.ylabel('Corridor')
plt.xlabel('Count')
plt.tight_layout()
sns.despine()
plt.grid(True)

for i, count in enumerate(corridor_counts.values):
    plt.text(count+1.5, corridor_counts.index[i], str(count),
ha='left', va='center')

plt.show()
```



Insights:

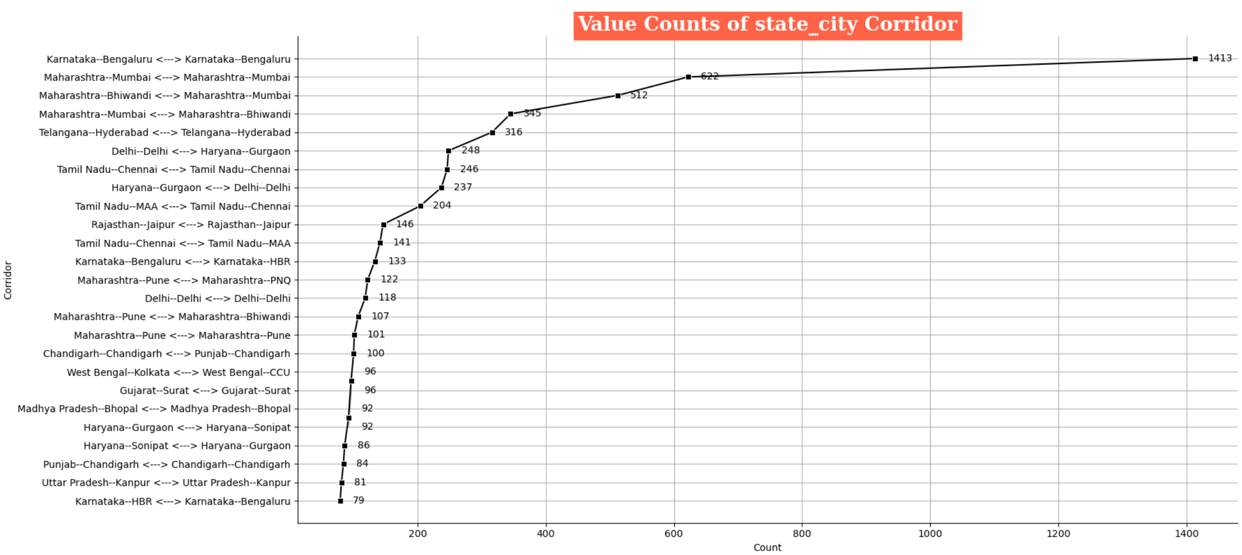
- The route between **Bangalore_Nelamangala_H** to **Bengaluru_KGAirport_HB**,**Bengaluru_Bomsndra_HB** sees the highest package volume, with 151 and 127 packages sent respectively.
- **Bengaluru_Bommasandra_HB** to **Bengaluru_KGAirport_HB** is also popular, with 121 packages sent.
- **Bengaluru_KGAirport_HB** to **Bangalore_Nelamangala_H** has moderate activity, with 108 packages sent.

1. The data indicates Bengaluru's importance as a transportation hub `Corridor` within ***Karnataka***, handling significant package traffic.

```
de['state_corridor'] = de['source_state']+'--'+de['source_city'] +'
<---> '+ de['destination_state']+'--'+de['destination_city']
de['state_corridor'].value_counts()

state_corridor
Karnataka--Bengaluru <---> Karnataka--Bengaluru                    1413
Maharashtra--Mumbai <---> Maharashtra--Mumbai                       622
Maharashtra--Bhiwandi <---> Maharashtra--Mumbai                     512
Maharashtra--Mumbai <---> Maharashtra--Bhiwandi                     345
Telangana--Hyderabad <---> Telangana--Hyderabad                     316
                                                                   ...
Gujarat--Jetpur <---> Gujarat--Dhoraji                                1
Andhra Pradesh--Anakapalle <---> Andhra Pradesh--Visakhapatnam        1
```

```
Andhra Pradesh--Narsiptnm <---> Andhra Pradesh--Anakapalle          1
West Bengal--MirzapurWB <---> West Bengal--Kolkata                  1
Uttar Pradesh--Anandnagar <---> Uttar Pradesh--Gorakhpur            1
Name: count, Length: 2302, dtype: int64
```

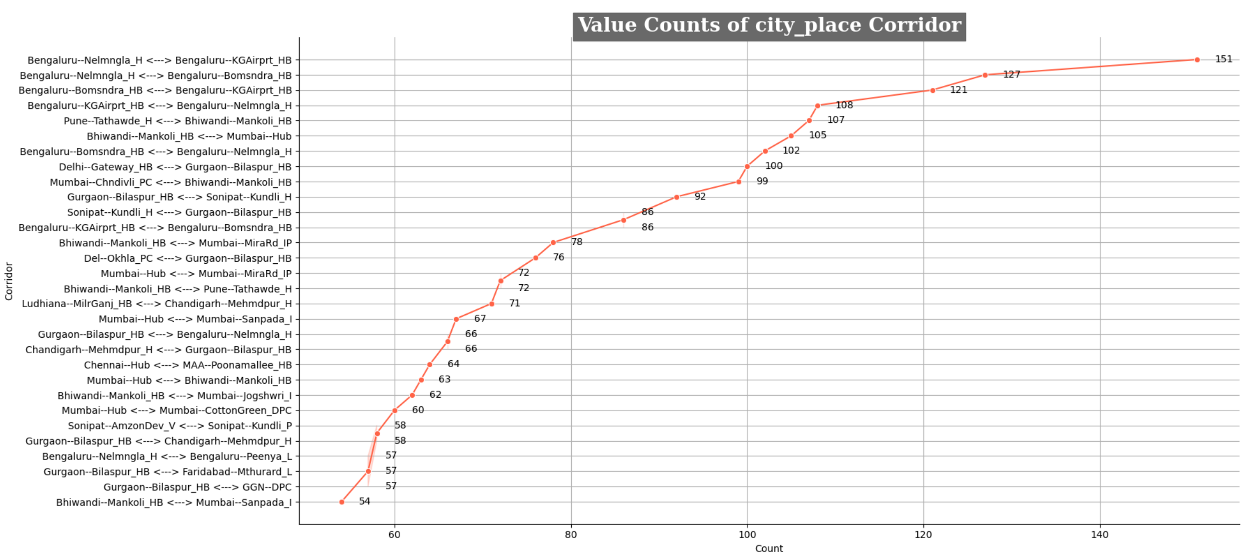
```
state_corridor_counts = de['state_corridor'].value_counts()[:25]

plt.figure(figsize=(18,8))
sns.lineplot(y=state_corridor_counts.index,
x=state_corridor_counts.values, marker='s', color='k')
plt.title('Value Counts of state_city
Corridor',fontsize=20,fontfamily='serif',fontweight='bold',backgroundc
olor='tomato',color='w')
plt.ylabel('Corridor')
plt.xlabel('Count')
plt.tight_layout()
sns.despine()
plt.grid(True)

for i, count in enumerate(state_corridor_counts.values):
    plt.text(count+20, state_corridor_counts.index[i], str(count),
ha='left', va='center')

plt.show()
```




```
de['city_corridor'] = de['source_city']+'--'+de['source_place'] +'
<---> '+ de['destination_city']+'--'+de['destination_place']
display(de['city_corridor'].value_counts())
```

```
city_corridor
Bengaluru--Nelmngla_H <---> Bengaluru--KGAirprt_HB     151
Bengaluru--Nelmngla_H <---> Bengaluru--Bomsndra_HB     127
Bengaluru--Bomsndra_HB <---> Bengaluru--KGAirprt_HB    121
```

```
Bengaluru--KGAirprt_HB <---> Bengaluru--Nelmngla_H     108
Pune--Tathawde_H <---> Bhiwandi--Mankoli_HB            107
                                                      ...
Ongole--SubhVRTL_I <---> Kandukur--LICOffce_D            1
Madnapalle--PngnrRd_D <---> Palamaner--Lakshmi_D         1
Dharmavram--SaiNgr_D <---> Kadiri--GVManu_D              1
Baharampur--Chuanpur_I <---> Chapra--NagarDPP_D          1
Jaipur--NgrNigam_DC <---> Jaipur--Central_D_1            1
Name: count, Length: 2741, dtype: int64

city_corridor_counts = de['city_corridor'].value_counts()[:30]

plt.figure(figsize=(18,8))
sns.lineplot(y=city_corridor_counts.index,
x=city_corridor_counts.values, marker='o', color='tomato')
plt.title('Value Counts of city_place
Corridor',fontsize=20,fontfamily='serif',fontweight='bold',backgroundc
olor='dimgray',color='w')
plt.ylabel('Corridor')
plt.xlabel('Count')
plt.tight_layout()
sns.despine()
plt.grid(True)

for i, count in enumerate(city_corridor_counts.values):
    plt.text(count+2, city_corridor_counts.index[i], str(count),
ha='left', va='center')

plt.show()
```



Insights:

- Maharashtra, Karnataka, Haryana, and Tamil Nadu serve as key starting and ending locations for delivery services.

- Mumbai, Gurgaon, Delhi, and Bengaluru are major metropolitan centers from where many deliveries originate.
- A large proportion of nationwide deliveries are destined for Mumbai, Bengaluru, Gurgaon, and Delhi.

```
# 4. Extracting features like month, year, day, etc. from
Trip_creation_time
de['trip_creation_month'] = de['trip_creation_time'].dt.month
de['trip_creation_year'] = de['trip_creation_time'].dt.year
de['trip_creation_day'] = de['trip_creation_time'].dt.day
de['trip_creation_hour'] = de['trip_creation_time'].dt.hour
de['trip_creation_weekday'] = de['trip_creation_time'].dt.weekday
de['trip_creation_week'] =
de['trip_creation_time'].dt.isocalendar().week
de

                                              segment_key  \
0      trip-153671041653548748+IND209304AAA+IND000000ACB
1      trip-153671041653548748+IND462022AAA+IND209304AAA
2      trip-153671042288605164+IND561203AAB+IND562101AAA
3      trip-153671042288605164+IND572101AAA+IND561203AAB
4      trip-153671043369099517+IND000000ACB+IND160002AAC
...                                                   ...
26217  trip-153861115439069069+IND628204AAA+IND627657AAA
26218  trip-153861115439069069+IND628613AAA+IND627005AAA
26219  trip-153861115439069069+IND628801AAA+IND628204AAA
26220  trip-153861118270144424+IND583119AAA+IND583101AAA
26221  trip-153861118270144424+IND583201AAA+IND583119AAA

                     trip_uuid      data route_type  \
0      trip-153671041653548748  training        FTL
1      trip-153671041653548748  training        FTL
2      trip-153671042288605164  training    Carting
3      trip-153671042288605164  training    Carting
4      trip-153671043369099517  training        FTL
...                        ...       ...        ...
26217  trip-153861115439069069      test    Carting
26218  trip-153861115439069069      test    Carting
26219  trip-153861115439069069      test    Carting
26220  trip-153861118270144424      test        FTL
26221  trip-153861118270144424      test        FTL

              trip_creation_time
source_name  \
0     2018-09-12 00:00:16.535741  Kanpur_Central_H_6 (Uttar Pradesh)

1     2018-09-12 00:00:16.535741  Bhopal_Trnsport_H (Madhya Pradesh)

2     2018-09-12 00:00:22.886430   Doddablpur_ChikaDPP_D (Karnataka)

3     2018-09-12 00:00:22.886430       Tumkur_Veersagr_I (Karnataka)
```

```
4     2018-09-12 00:00:33.691250      Gurgaon_Bilaspur_HB (Haryana)

...                          ...                                ...

26217 2018-10-03 23:59:14.390954  Tirchchndr_Shnmgprm_D (Tamil Nadu)

26218 2018-10-03 23:59:14.390954   Peikulam_SriVnktpm_D (Tamil Nadu)

26219 2018-10-03 23:59:14.390954        Eral_Busstand_D (Tamil Nadu)

26220 2018-10-03 23:59:42.701692      Sandur_WrdN1DPP_D (Karnataka)

26221 2018-10-03 23:59:42.701692                 Hospet (Karnataka)


                            destination_name
od_start_time  \
0              Gurgaon_Bilaspur_HB (Haryana) 2018-09-12
16:39:46.858469
1         Kanpur_Central_H_6 (Uttar Pradesh) 2018-09-12
00:00:16.535741
2          Chikblapur_ShntiSgr_D (Karnataka) 2018-09-12
02:03:09.655591
3          Doddablpur_ChikaDPP_D (Karnataka) 2018-09-12
00:00:22.886430
4             Chandigarh_Mehmdpur_H (Punjab) 2018-09-14
03:40:17.106733
...                                      ...                           ..
.
26217  Thisayanvilai_UdnkdiRD_D (Tamil Nadu) 2018-10-04
02:29:04.272194
26218    Tirunelveli_VdkkuSrt_I (Tamil Nadu) 2018-10-04
04:16:39.894872
26219     Tirchchndr_Shnmgprm_D (Tamil Nadu) 2018-10-04
01:44:53.808000
26220                Bellary_Dc (Karnataka) 2018-10-04
03:58:40.726547
26221         Sandur_WrdN1DPP_D (Karnataka) 2018-10-04
02:51:44.712656

                     od_end_time  start_scan_to_end_scan  \
0     2018-09-13 13:40:23.123744                  1260.0
1     2018-09-12 16:39:46.858469                   999.0
2     2018-09-12 03:01:59.598855                    58.0
3     2018-09-12 02:03:09.655591                   122.0
4     2018-09-14 17:34:55.442454                   834.0
...                          ...                     ...
26217 2018-10-04 03:31:11.183797                    62.0
26218 2018-10-04 05:47:45.162682                    91.0
```

```
26219 2018-10-04 02:29:04.272194                      44.0
26220 2018-10-04 08:46:09.166940                     287.0
26221 2018-10-04 03:58:40.726547                      66.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                          383.759155        732.0      329.0
446.549591
1                          440.973694        830.0      388.0
544.802673
2                           24.644020         47.0       26.0
28.199400
3                           48.542889         96.0       42.0
56.911598
4                          237.439606        611.0      212.0
281.210907
...                               ...          ...        ...
...
26217                       33.627182         51.0       41.0
42.521301
26218                       33.673836         90.0       48.0
40.608002
26219                       12.661944         30.0       14.0
16.018499
26220                       40.546738        233.0       42.0
52.530300
26221                       25.534794         42.0       26.0
28.048401

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                    728.0              534.0             670.620483

1                    820.0              474.0             649.852783

2                     46.0               26.0              28.199501

3                     95.0               39.0              55.989899

4                    608.0              231.0             317.740784

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

26217                 49.0               42.0              42.143101

26218                 89.0               77.0              78.586899

26219                 29.0               14.0              16.018400

26220                233.0               42.0              52.530300
```

```
26221                  41.0                 25.0              28.048401

       segment_actual_time_sum  segment_osrm_time_sum  \
0                        728.0                  534.0
1                        820.0                  474.0
2                         46.0                   26.0
3                         95.0                   39.0
4                        608.0                  231.0
...                        ...                    ...
26217                     49.0                   42.0
26218                     89.0                   77.0
26219                     29.0                   14.0
26220                    233.0                   42.0
26221                     41.0                   25.0

       segment_osrm_distance_sum          od_total_time
od_time_diff_hour  \
0                     670.620483 0 days 21:00:36.265275
21.010074
1                     649.852783 0 days 16:39:30.322728
16.658423
2                      28.199501 0 days 00:58:49.943264
0.980540
3                      55.989899 0 days 02:02:46.769161
2.046325
4                     317.740784 0 days 13:54:38.335721
13.910649
...                          ...                    ...
...
26217                  42.143101 0 days 01:02:06.911603
1.035253
26218                  78.586899 0 days 01:31:05.267810
1.518130
26219                  16.018400 0 days 00:44:10.464194
0.736240
26220                  52.530300 0 days 04:47:28.440393
4.791233
26221                  28.048401 0 days 01:06:56.013891
1.115559

      source_city source_place    source_state destination_city  \
0          Kanpur  Central_H_6   Uttar Pradesh          Gurgaon
1          Bhopal   Trnsport_H  Madhya Pradesh           Kanpur
2      Doddablpur   ChikaDPP_D       Karnataka       Chikblapur
3          Tumkur   Veersagr_I       Karnataka       Doddablpur
4         Gurgaon  Bilaspur_HB         Haryana       Chandigarh
...           ...          ...             ...              ...
26217  Tirchchndr   Shnmgprm_D      Tamil Nadu    Thisayanvilai
```

```
26218    Peikulam  SriVnktpm_D      Tamil Nadu      Tirunelveli
26219        Eral   Busstand_D      Tamil Nadu       Tirchchndr
26220      Sandur   WrdN1DPP_D       Karnataka          Bellary
26221      Hospet       Hospet       Karnataka           Sandur

      destination_place destination_state  \
0           Bilaspur_HB           Haryana
1           Central_H_6     Uttar Pradesh
2            ShntiSgr_D         Karnataka
3            ChikaDPP_D         Karnataka
4            Mehmdpur_H            Punjab
...                 ...               ...
26217        UdnkdiRD_D        Tamil Nadu
26218        VdkkuSrt_I        Tamil Nadu
26219        Shnmgprm_D        Tamil Nadu
26220                Dc         Karnataka
26221        WrdN1DPP_D         Karnataka

                                                corridor  \
0      Kanpur_Central_H_6 (Uttar Pradesh) <---> Gurga...
1      Bhopal_Trnsport_H (Madhya Pradesh) <---> Kanpu...
2      Doddablpur_ChikaDPP_D (Karnataka) <---> Chikbl...
3      Tumkur_Veersagr_I (Karnataka) <---> Doddablpur...
4      Gurgaon_Bilaspur_HB (Haryana) <---> Chandigarh...
...                                                  ...
26217  Tirchchndr_Shnmgprm_D (Tamil Nadu) <---> Thisa...
26218  Peikulam_SriVnktpm_D (Tamil Nadu) <---> Tirune...
26219  Eral_Busstand_D (Tamil Nadu) <---> Tirchchndr_...
26220  Sandur_WrdN1DPP_D (Karnataka) <---> Bellary_Dc...
26221  Hospet (Karnataka) <---> Sandur_WrdN1DPP_D (Ka...

                                          state_corridor  \
0           Uttar Pradesh--Kanpur <---> Haryana--Gurgaon
1      Madhya Pradesh--Bhopal <---> Uttar Pradesh--Ka...
2      Karnataka--Doddablpur <---> Karnataka--Chikblapur
3          Karnataka--Tumkur <---> Karnataka--Doddablpur
4              Haryana--Gurgaon <---> Punjab--Chandigarh
...                                                  ...
26217  Tamil Nadu--Tirchchndr <---> Tamil Nadu--Thisa...
26218  Tamil Nadu--Peikulam <---> Tamil Nadu--Tirunel...
26219      Tamil Nadu--Eral <---> Tamil Nadu--Tirchchndr
26220         Karnataka--Sandur <---> Karnataka--Bellary
26221          Karnataka--Hospet <---> Karnataka--Sandur

                                           city_corridor
trip_creation_month  \
0        Kanpur--Central_H_6 <---> Gurgaon--Bilaspur_HB
9
1           Bhopal--Trnsport_H <---> Kanpur--Central_H_6
9
```

```
2      Doddablpur--ChikaDPP_D <---> Chikblapur--Shnti...
9
3        Tumkur--Veersagr_I <---> Doddablpur--ChikaDPP_D
9
4      Gurgaon--Bilaspur_HB <---> Chandigarh--Mehmdpur_H
9
...                                                  ...
...
26217  Tirchchndr--Shnmgprm_D <---> Thisayanvilai--Ud...
10
26218  Peikulam--SriVnktpm_D <---> Tirunelveli--Vdkku...
10
26219      Eral--Busstand_D <---> Tirchchndr--Shnmgprm_D
10
26220              Sandur--WrdN1DPP_D <---> Bellary--Dc
10
26221            Hospet--Hospet <---> Sandur--WrdN1DPP_D
10

       trip_creation_year  trip_creation_day  trip_creation_hour  \
0                    2018                 12                   0
1                    2018                 12                   0
2                    2018                 12                   0
3                    2018                 12                   0
4                    2018                 12                   0
...                   ...                ...                 ...
26217                2018                  3                  23
26218                2018                  3                  23
26219                2018                  3                  23
26220                2018                  3                  23
26221                2018                  3                  23

       trip_creation_weekday  trip_creation_week
0                          2                  37
1                          2                  37
2                          2                  37
3                          2                  37
4                          2                  37
...                      ...                 ...
26217                      2                  40
26218                      2                  40
26219                      2                  40
26220                      2                  40
26221                      2                  40

[26222 rows x 37 columns]
```

In-Depth Analysis

```
new_df = de.copy()

new_df.columns

Index(['segment_key', 'trip_uuid', 'data', 'route_type',
'trip_creation_time',
       'source_name', 'destination_name', 'od_start_time',
'od_end_time',
       'start_scan_to_end_scan', 'actual_distance_to_destination',
       'actual_time', 'osrm_time', 'osrm_distance',
'segment_actual_time',
       'segment_osrm_time', 'segment_osrm_distance',
'segment_actual_time_sum',
       'segment_osrm_time_sum', 'segment_osrm_distance_sum',
'od_total_time',
       'od_time_diff_hour', 'source_city', 'source_place',
'source_state',
       'destination_city', 'destination_place', 'destination_state',
       'corridor', 'state_corridor', 'city_corridor',
'trip_creation_month',
       'trip_creation_year', 'trip_creation_day',
'trip_creation_hour',
       'trip_creation_weekday', 'trip_creation_week'],
      dtype='object')

new_df.sample(2)

                                            segment_key  \
3330  trip-153694740553026744+IND574104AAA+IND574216AAA
3755  trip-153696604384005633+IND507117AAB+IND507303AAA

                    trip_uuid      data route_type
trip_creation_time  \
3330  trip-153694740553026744  training    Carting 2018-09-14
17:50:05.530477
3755  trip-153696604384005633  training        FTL 2018-09-14
23:00:43.840397

                          source_name
destination_name  \
3330   Karkala_MarketRd_D (Karnataka)  Dhrmsthala_Beltngdi_D
(Karnataka)
3755  Manuguru_AskNagar_D (Telangana)  Sathupally_VidyaNGR_D
(Telangana)

                  od_start_time                od_end_time  \
3330 2018-09-15 02:48:16.030062 2018-09-15 04:38:56.729715
3755 2018-09-15 04:15:30.426079 2018-09-15 07:28:59.609574
```

```
      start_scan_to_end_scan  actual_distance_to_destination
actual_time  \
3330                   110.0                       43.015263
88.0
3755                   193.0                       79.276848
177.0

      osrm_time  osrm_distance  segment_actual_time  segment_osrm_time
\
3330       47.0      54.231701                 86.0               45.0

3755       92.0     121.918297                176.0              139.0


      segment_osrm_distance  segment_actual_time_sum
segment_osrm_time_sum  \
3330              54.231598                     86.0
45.0
3755             114.664200                    176.0
139.0

      segment_osrm_distance_sum          od_total_time
od_time_diff_hour  \
3330                  54.231598 0 days 01:50:40.699653
1.844639
3755                 114.664200 0 days 03:13:29.183495
3.224773

     source_city source_place source_state destination_city
destination_place  \
3330     Karkala   MarketRd_D    Karnataka       Dhrmsthala
Beltngdi_D
3755    Manuguru   AskNagar_D    Telangana       Sathupally
VidyaNGR_D

     destination_state
corridor  \
3330         Karnataka  Karkala_MarketRd_D (Karnataka) <--->
Dhrmsthal...
3755         Telangana  Manuguru_AskNagar_D (Telangana) <--->
Sathupal...

                                       state_corridor  \
3330   Karnataka--Karkala <---> Karnataka--Dhrmsthala
3755  Telangana--Manuguru <---> Telangana--Sathupally

                                          city_corridor
trip_creation_month  \
3330   Karkala--MarketRd_D <---> Dhrmsthala--Beltngdi_D
9
```

```
3755  Manuguru--AskNagar_D <---> Sathupally--VidyaNGR_D
9

      trip_creation_year  trip_creation_day  trip_creation_hour  \
3330                2018                 14                  17
3755                2018                 14                  23

      trip_creation_weekday  trip_creation_week
3330                      4                  37
3755                      4                  37

create_trip_dict={
  'data' : 'first',
  'route_type' : 'first',
  'od_start_time':'first',
  'od_end_time':'last',
  'od_time_diff_hour' : 'sum',
  'trip_creation_time' : 'first',
  'trip_creation_month' : 'first',
  'trip_creation_year' : 'first',
  'trip_creation_day' : 'first',
  'trip_creation_hour' : 'first',
  'trip_creation_weekday' : 'first',
  'trip_creation_week' : 'first',
  'start_scan_to_end_scan' : 'sum',
  'actual_distance_to_destination' : 'sum',
  'actual_time' : 'sum',
  'osrm_time' : 'sum',
  'osrm_distance' : 'sum',
  'segment_actual_time': 'sum',
  'segment_osrm_time': 'sum',
  'segment_osrm_distance': 'sum',
  'segment_actual_time_sum': 'sum',
  'segment_osrm_time_sum': 'sum',
  'segment_osrm_distance_sum': 'sum',
  'source_name': 'first',
  'source_city':'first',
  'source_state':'first',
  'source_place':'first',
  'destination_name': 'first',
  'destination_city':'first',
  'destination_state':'first',
  'destination_place':'first',
  'corridor':'first',
  'state_corridor':'first',
  'city_corridor':'first'
  }

trip_agg_df =
```

```
new_df.groupby('trip_uuid').agg(create_trip_dict).reset_index()
trip_agg_df

                    trip_uuid      data route_type  \
0      trip-153671041653548748  training        FTL
1      trip-153671042288605164  training    Carting
2      trip-153671043369099517  training        FTL
3      trip-153671046011330457  training    Carting
4      trip-153671052974046625  training        FTL
...                        ...       ...        ...
14782  trip-153861095625827784      test    Carting
14783  trip-153861104386292051      test    Carting
14784  trip-153861106442901555      test    Carting
14785  trip-153861115439069069      test    Carting
14786  trip-153861118270144424      test        FTL

                  od_start_time                od_end_time  \
0     2018-09-12 16:39:46.858469 2018-09-12 16:39:46.858469
1     2018-09-12 02:03:09.655591 2018-09-12 02:03:09.655591
2     2018-09-14 03:40:17.106733 2018-09-14 03:40:17.106733
3     2018-09-12 00:01:00.113710 2018-09-12 01:41:29.809822
4     2018-09-12 00:02:09.740725 2018-09-12 03:54:43.114421
...                         ...                        ...
14782 2018-10-03 23:55:56.258533 2018-10-04 06:41:25.409035
14783 2018-10-03 23:57:23.863155 2018-10-04 00:57:59.294434
14784 2018-10-04 02:51:27.075797 2018-10-04 02:51:27.075797
14785 2018-10-03 23:59:14.390954 2018-10-04 02:29:04.272194
14786 2018-10-04 03:58:40.726547 2018-10-04 03:58:40.726547

       od_time_diff_hour         trip_creation_time
trip_creation_month  \
0              37.668497 2018-09-12 00:00:16.535741
9
1               3.026865 2018-09-12 00:00:22.886430
9
2              65.572709 2018-09-12 00:00:33.691250
9
3               1.674916 2018-09-12 00:01:00.113710
9
4              11.972484 2018-09-12 00:02:09.740725
9
...                  ...                        ...                  .
..
14782           4.300482 2018-10-03 23:55:56.258533
10
14783           1.009842 2018-10-03 23:57:23.863155
10
14784           7.035331 2018-10-03 23:57:44.429324
10
14785           5.808548 2018-10-03 23:59:14.390954
```

```
10
14786          5.906793 2018-10-03 23:59:42.701692
10

       trip_creation_year  trip_creation_day  trip_creation_hour  \
0                    2018                 12                   0
1                    2018                 12                   0
2                    2018                 12                   0
3                    2018                 12                   0
4                    2018                 12                   0
...                   ...                ...                 ...
14782                2018                  3                  23
14783                2018                  3                  23
14784                2018                  3                  23
14785                2018                  3                  23
14786                2018                  3                  23

       trip_creation_weekday  trip_creation_week
start_scan_to_end_scan  \
0                          2                  37
2259.0
1                          2                  37
180.0
2                          2                  37
3933.0
3                          2                  37
100.0
4                          2                  37
717.0
...                      ...                 ...                       .
..
14782                      2                  40
257.0
14783                      2                  40
60.0
14784                      2                  40
421.0
14785                      2                  40
347.0
14786                      2                  40
353.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                          824.732849       1562.0      717.0
991.352295
1                           73.186905        143.0       68.0
85.111000
2                         1927.404297       3347.0     1740.0
2354.066650
```

```
3                                17.175274         59.0        15.0
19.680000
4                               127.448502        341.0       117.0
146.791794
...                                    ...          ...         ...
...
14782                            57.762333         83.0        62.0
73.462997
14783                            15.513784         21.0        12.0
16.088200
14784                            38.684837        282.0        48.0
58.903702
14785                           134.723831        264.0       179.0
171.110306
14786                            66.081528        275.0        68.0
80.578705

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                   1548.0             1008.0             1320.473267

1                    141.0               65.0               84.189400

2                   3308.0             1941.0             2545.267822

3                     59.0               16.0               19.876600

4                    340.0              115.0              146.791901

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

14782                 82.0               62.0               64.855103

14783                 21.0               11.0               16.088299

14784                281.0               88.0              104.886597

14785                258.0              221.0              223.532394

14786                274.0               67.0               80.578705


       segment_actual_time_sum  segment_osrm_time_sum  \
0                       1548.0                 1008.0
1                        141.0                   65.0
2                       3308.0                 1941.0
3                         59.0                   16.0
4                        340.0                  115.0
...                        ...                    ...
14782                     82.0                   62.0
```

```
14783                   21.0                      11.0
14784                  281.0                      88.0
14785                  258.0                     221.0
14786                  274.0                      67.0

       segment_osrm_distance_sum                          source_name
\
0                    1320.473267   Kanpur_Central_H_6 (Uttar Pradesh)

1                      84.189400    Doddablpur_ChikaDPP_D (Karnataka)

2                    2545.267822        Gurgaon_Bilaspur_HB (Haryana)

3                      19.876600             Mumbai Hub (Maharashtra)

4                     146.791901                Bellary_Dc (Karnataka)

...                          ...                                  ...

14782                  64.855103       Chandigarh_Mehmdpur_H (Punjab)

14783                  16.088299         FBD_Balabhgarh_DPC (Haryana)

14784                 104.886597   Kanpur_GovndNgr_DC (Uttar Pradesh)

14785                 223.532394  Tirunelveli_VdkkuSrt_I (Tamil Nadu)

14786                  80.578705        Sandur_WrdN1DPP_D (Karnataka)


       source_city   source_state    source_place  \
0           Kanpur  Uttar Pradesh      Central_H_6
1       Doddablpur      Karnataka       ChikaDPP_D
2          Gurgaon        Haryana      Bilaspur_HB
3           Mumbai    Maharashtra              Hub
4          Bellary      Karnataka               Dc
...            ...            ...              ...
14782   Chandigarh         Punjab       Mehmdpur_H
14783          FBD        Haryana   Balabhgarh_DPC
14784       Kanpur  Uttar Pradesh      GovndNgr_DC
14785  Tirunelveli     Tamil Nadu       VdkkuSrt_I
14786       Sandur      Karnataka       WrdN1DPP_D

                                destination_name destination_city
destination_state  \
0           Gurgaon_Bilaspur_HB (Haryana)           Gurgaon
Haryana
1       Chikblapur_ShntiSgr_D (Karnataka)        Chikblapur
Karnataka
2          Chandigarh_Mehmdpur_H (Punjab)        Chandigarh
Punjab
```

```
3          Mumbai_MiraRd_IP (Maharashtra)          Mumbai
Maharashtra
4                      Hospet (Karnataka)          Hospet
Karnataka
...                                   ...             ...
...
14782                Zirakpur_DC (Punjab)        Zirakpur
Punjab
14783      Faridabad_Blbgarh_DC (Haryana)       Faridabad
Haryana
14784  Kanpur_Central_H_6 (Uttar Pradesh)          Kanpur     Uttar
Pradesh
14785        Eral_Busstand_D (Tamil Nadu)            Eral
Tamil Nadu
14786                 Bellary_Dc (Karnataka)         Bellary
Karnataka

      destination_place
corridor  \
0           Bilaspur_HB  Kanpur_Central_H_6 (Uttar Pradesh) <--->
Gurga...
1            ShntiSgr_D  Doddablpur_ChikaDPP_D (Karnataka) <--->
Chikbl...
2            Mehmdpur_H  Gurgaon_Bilaspur_HB (Haryana) <--->
Chandigarh...
3             MiraRd_IP  Mumbai Hub (Maharashtra) <--->
Mumbai_MiraRd_I...
4                Hospet    Bellary_Dc (Karnataka) <---> Hospet
(Karnataka)
...                 ...
...
14782                DC  Chandigarh_Mehmdpur_H (Punjab) <--->
Zirakpur_...
14783        Blbgarh_DC  FBD_Balabhgarh_DPC (Haryana) <--->
Faridabad_B...
14784       Central_H_6  Kanpur_GovndNgr_DC (Uttar Pradesh) <--->
Kanpu...
14785        Busstand_D  Tirunelveli_VdkkuSrt_I (Tamil Nadu) <--->
Eral...
14786                Dc  Sandur_WrdN1DPP_D (Karnataka) <--->
Bellary_Dc...

                                          state_corridor  \
0           Uttar Pradesh--Kanpur <---> Haryana--Gurgaon
1      Karnataka--Doddablpur <---> Karnataka--Chikblapur
2             Haryana--Gurgaon <---> Punjab--Chandigarh
3          Maharashtra--Mumbai <---> Maharashtra--Mumbai
4            Karnataka--Bellary <---> Karnataka--Hospet
...                                                  ...
```

```
14782          Punjab--Chandigarh <---> Punjab--Zirakpur
14783              Haryana--FBD <---> Haryana--Faridabad
14784  Uttar Pradesh--Kanpur <---> Uttar Pradesh--Kanpur
14785     Tamil Nadu--Tirunelveli <---> Tamil Nadu--Eral
14786         Karnataka--Sandur <---> Karnataka--Bellary

                                           city_corridor
0         Kanpur--Central_H_6 <---> Gurgaon--Bilaspur_HB
1      Doddablpur--ChikaDPP_D <---> Chikblapur--Shnti...
2      Gurgaon--Bilaspur_HB <---> Chandigarh--Mehmdpur_H
3                   Mumbai--Hub <---> Mumbai--MiraRd_IP
4                      Bellary--Dc <---> Hospet--Hospet
...                                                  ...
14782          Chandigarh--Mehmdpur_H <---> Zirakpur--DC
14783    FBD--Balabhgarh_DPC <---> Faridabad--Blbgarh_DC
14784      Kanpur--GovndNgr_DC <---> Kanpur--Central_H_6
14785     Tirunelveli--VdkkuSrt_I <---> Eral--Busstand_D
14786                Sandur--WrdN1DPP_D <---> Bellary--Dc

[14787 rows x 35 columns]
```

```
numerical_columns = trip_agg_df.select_dtypes(include=[np.float32,
np.float64])
numerical_columns
```

```
       od_time_diff_hour  start_scan_to_end_scan  \
0              37.668497                  2259.0
1               3.026865                   180.0
2              65.572709                  3933.0
3               1.674916                   100.0
4              11.972484                   717.0
...                  ...                     ...
14782           4.300482                   257.0
14783           1.009842                    60.0
14784           7.035331                   421.0
14785           5.808548                   347.0
14786           5.906793                   353.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                          824.732849       1562.0      717.0
991.352295
1                           73.186905        143.0       68.0
85.111000
2                         1927.404297       3347.0     1740.0
2354.066650
3                           17.175274         59.0       15.0
19.680000
4                          127.448502        341.0      117.0
146.791794
```

```
...                                  ...          ...        ...
...
14782                          57.762333         83.0       62.0
73.462997
14783                          15.513784         21.0       12.0
16.088200
14784                          38.684837        282.0       48.0
58.903702
14785                         134.723831        264.0      179.0
171.110306
14786                          66.081528        275.0       68.0
80.578705

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                   1548.0             1008.0            1320.473267

1                    141.0               65.0              84.189400

2                   3308.0             1941.0            2545.267822

3                     59.0               16.0              19.876600

4                    340.0              115.0             146.791901

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

14782                 82.0               62.0              64.855103

14783                 21.0               11.0              16.088299

14784                281.0               88.0             104.886597

14785                258.0              221.0             223.532394

14786                274.0               67.0              80.578705


       segment_actual_time_sum  segment_osrm_time_sum  \
0                       1548.0                 1008.0
1                        141.0                   65.0
2                       3308.0                 1941.0
3                         59.0                   16.0
4                        340.0                  115.0
...                        ...                    ...
14782                     82.0                   62.0
14783                     21.0                   11.0
14784                    281.0                   88.0
14785                    258.0                  221.0
14786                    274.0                   67.0
```

```
       segment_osrm_distance_sum
0                    1320.473267
1                      84.189400
2                    2545.267822
3                      19.876600
4                     146.791901
...                          ...
14782                  64.855103
14783                  16.088299
14784                 104.886597
14785                 223.532394
14786                  80.578705

[14787 rows x 12 columns]
```

```
numerical_columns.describe().T
```

```
                                 count        mean         std
min  \
od_time_diff_hour              14787.0    8.840187   10.978880
0.391024
start_scan_to_end_scan         14787.0  529.429016  658.254395
23.000000
actual_distance_to_destination 14787.0  164.090195  305.502808
9.002461
actual_time                    14787.0  356.306000  561.517761
9.000000
osrm_time                      14787.0  160.990936  271.459229
6.000000
osrm_distance                  14787.0  203.887405  370.565460
9.072900
segment_actual_time            14787.0  353.059174  556.364441
9.000000
segment_osrm_time              14787.0  180.511597  314.678741
6.000000
segment_osrm_distance          14787.0  222.705444  416.845642
9.072900
segment_actual_time_sum        14787.0  353.059174  556.364441
9.000000
segment_osrm_time_sum          14787.0  180.511597  314.678741
6.000000
segment_osrm_distance_sum      14787.0  222.705444  416.845642
9.072900

                                      25%         50%         75%  \
od_time_diff_hour                2.494975    4.661846   10.558962
start_scan_to_end_scan         149.000000  279.000000  632.000000
actual_distance_to_destination  22.777099   48.287895  163.591255
actual_time                     67.000000  148.000000  367.000000
osrm_time                       29.000000   60.000000  168.000000
```

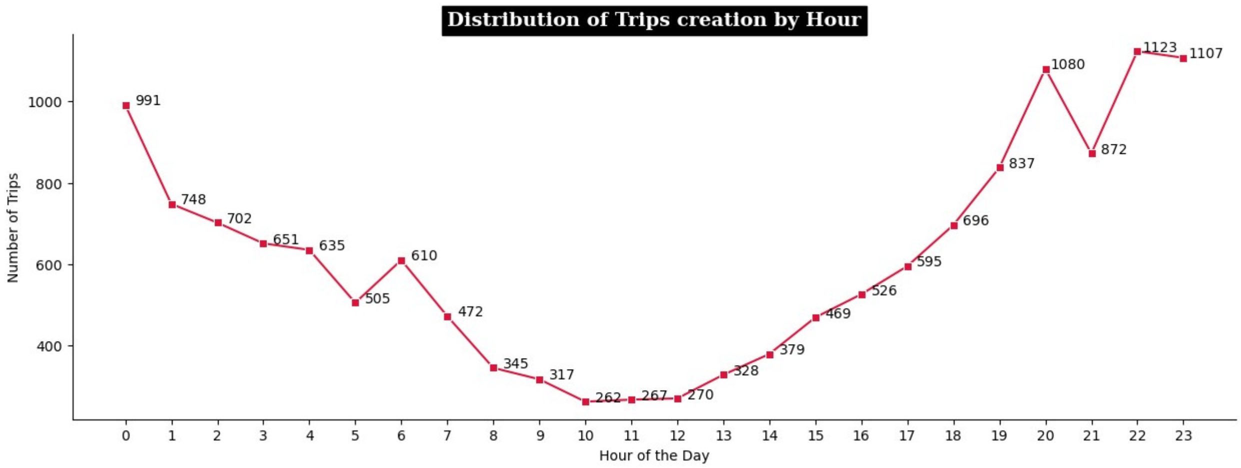
```
osrm_distance                    30.756900   65.302795  206.644203
segment_actual_time              66.000000  147.000000  364.000000
segment_osrm_time                30.000000   65.000000  184.000000
segment_osrm_distance            32.578850   69.784203  216.560608
segment_actual_time_sum          66.000000  147.000000  364.000000
segment_osrm_time_sum            30.000000   65.000000  184.000000
segment_osrm_distance_sum        32.578850   69.784203  216.560608

                                        max
od_time_diff_hour                131.642533
start_scan_to_end_scan          7898.000000
actual_distance_to_destination  2186.531738
actual_time                     6265.000000
osrm_time                       2032.000000
osrm_distance                   2840.081055
segment_actual_time             6230.000000
segment_osrm_time               2564.000000
segment_osrm_distance           3523.632324
segment_actual_time_sum         6230.000000
segment_osrm_time_sum           2564.000000
segment_osrm_distance_sum       3523.632324
```

```
trip_agg_df.describe(include = object).T
```

```
                   count unique  \
trip_uuid          14787  14787
source_name        14787    930
source_city        14787    713
source_state       14787     29
source_place       14787    788
destination_name   14787   1042
destination_city   14787    851
destination_state  14787     32
destination_place  14787    866
corridor           14787   1737
state_corridor     14787   1366
city_corridor      14787   1737

                                                                 top
freq
trip_uuid                                    trip-153671041653548748
1
source_name                           Gurgaon_Bilaspur_HB (Haryana)
1052
source_city                                                Bengaluru
1700
source_state                                             Maharashtra
2714
source_place                                             Bilaspur_HB
1052
```

```
destination_name                               Gurgaon_Bilaspur_HB (Haryana)
745
destination_city                                                    Bengaluru
1633
destination_state                                                 Maharashtra
2569
destination_place                                                 Bilaspur_HB
745
corridor            Bangalore_Nelmngla_H (Karnataka) <---> Bengalu...
151
state_corridor        Karnataka--Bengaluru <---> Karnataka--Bengaluru
1333
city_corridor       Bengaluru--Nelmngla_H <---> Bengaluru--KGAirpr...
151
```

```
trip_df = trip_agg_df.copy()

trip_creation_by_hour = trip_df.groupby(by='trip_creation_hour')
['trip_uuid'].count().reset_index()

plt.figure(figsize=(15,5))
sns.lineplot(data=trip_creation_by_hour, x='trip_creation_hour',
y='trip_uuid', marker='s', color='crimson')
plt.xticks(np.arange(0, 24))

for i, count in enumerate(trip_creation_by_hour['trip_uuid']):
    plt.text(trip_creation_by_hour['trip_creation_hour'][i]+0.5,
count, count, ha='center')

plt.title('Distribution of Trips creation by
Hour',fontsize=14,fontfamily='serif',fontweight='bold',backgroundcolor
='k',color='w')
plt.xlabel('Hour of the Day')
plt.ylabel('Number of Trips')
sns.despine()
plt.show()
```




```
trip_df.sample()

                       trip_uuid      data route_type
od_start_time  \
7917  trip-153765583943264913  training    Carting 2018-09-22
22:37:19.432896

                       od_end_time  od_time_diff_hour
trip_creation_time  \
7917 2018-09-22 23:19:42.965506           0.706537 2018-09-22
22:37:19.432896

      trip_creation_month  trip_creation_year  trip_creation_day  \
7917                    9                2018                 22

      trip_creation_hour  trip_creation_weekday  trip_creation_week  \
7917                  22                      5                  38

      start_scan_to_end_scan  actual_distance_to_destination
actual_time  \
7917                    42.0                       12.338054
14.0

      osrm_time  osrm_distance  segment_actual_time  segment_osrm_time
\
7917        9.0        12.3592                 13.0                9.0


      segment_osrm_distance  segment_actual_time_sum
segment_osrm_time_sum  \
7917              12.359099                     13.0
9.0

      segment_osrm_distance_sum                  source_name
source_city  \
7917                  12.359099  Sonipat_AmzonDev_V (Haryana)
```

```
Sonipat

     source_state source_place            destination_name
destination_city  \
7917      Haryana   AmzonDev_V  Sonipat_Kundli_P (Haryana)
Sonipat

     destination_state destination_place  \
7917           Haryana          Kundli_P

                                                   corridor  \
7917  Sonipat_AmzonDev_V (Haryana) <---> Sonipat_Kun...

                               state_corridor  \
7917  Haryana--Sonipat <---> Haryana--Sonipat

                                    city_corridor
7917  Sonipat--AmzonDev_V <---> Sonipat--Kundli_P
```

```
trip_df.trip_creation_year.value_counts()
```

```
trip_creation_year
2018    14787
Name: count, dtype: int64
```

```
trip_df.trip_creation_month.value_counts()
```

```
trip_creation_month
9     13011
10     1776
Name: count, dtype: int64
```

```
trip_df['trip_creation_month'].value_counts(normalize = True) * 100
```

```
trip_creation_month
9     87.98945
10    12.01055
Name: proportion, dtype: float64
```

```
trip_df.trip_creation_week.value_counts()
```

```
trip_creation_week
38    5001
39    4402
37    3608
40    1776
Name: count, dtype: Int64
```

```
trip_df.trip_creation_weekday.value_counts(ascending=True)
```

```
trip_creation_weekday
6    1753
```

```
0    1980
1    2035
4    2057
3    2103
5    2128
2    2731
Name: count, dtype: int64
```

```
trip_df['trip_creation_day_week'] =
trip_df['trip_creation_time'].dt.day_name()
```

```
trip_df.trip_creation_day.value_counts()
```

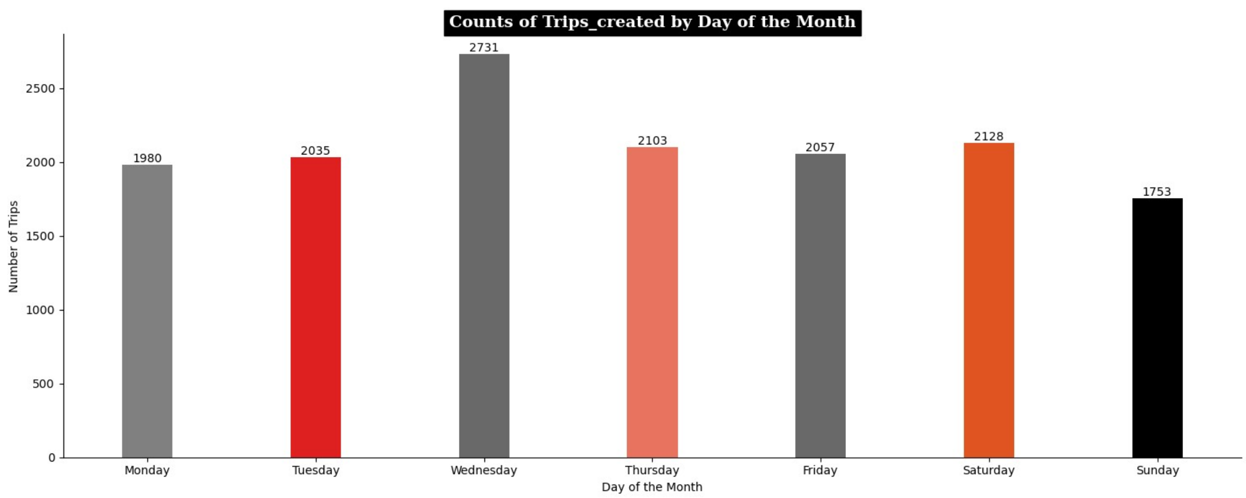
```
trip_creation_day
18    791
15    783
13    750
12    747
21    740
22    740
17    722
14    712
20    703
25    695
26    683
19    674
24    658
27    650
23    631
3     627
16    616
28    605
29    605
1     600
2     549
30    506
Name: count, dtype: int64
```

```
trip_df.sample()
```

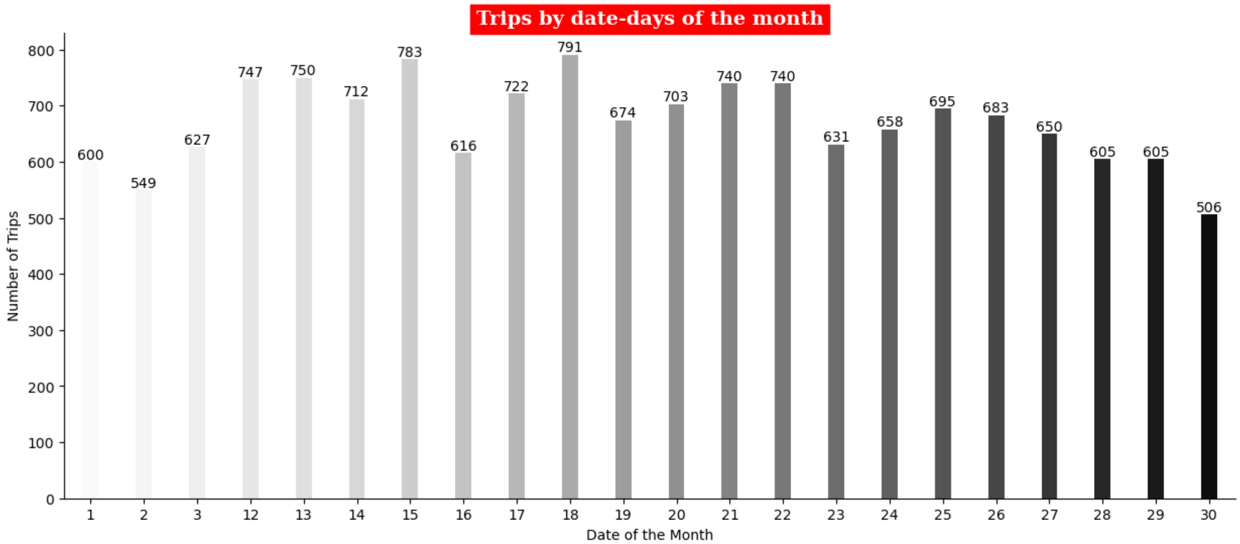
```
                    trip_uuid      data route_type
od_start_time  \
8403  trip-153772987770593762  training        FTL 2018-09-24
00:14:22.226774

                    od_end_time  od_time_diff_hour
trip_creation_time  \
8403 2018-09-24 02:42:00.976996           3.847563 2018-09-23
19:11:17.706293

      trip_creation_month  trip_creation_year  trip_creation_day  \
```

```
8403                        9                 2018                  23

      trip_creation_hour  trip_creation_weekday  trip_creation_week  \
8403                  19                      6                  38

      start_scan_to_end_scan  actual_distance_to_destination
actual_time  \
8403                   230.0                        69.34938
130.0

      osrm_time  osrm_distance  segment_actual_time  segment_osrm_time
\
8403       82.0      79.446396                129.0               86.0


      segment_osrm_distance  segment_actual_time_sum
segment_osrm_time_sum  \
8403              83.658005                    129.0
86.0

      segment_osrm_distance_sum                        source_name  \
8403                  83.658005  Pattukotai_anthniyr_D (Tamil Nadu)

     source_city source_state source_place
destination_name  \
8403  Pattukotai   Tamil Nadu   anthniyr_D  Peravurani_SH71_D (Tamil
Nadu)

     destination_city destination_state destination_place  \
8403       Peravurani        Tamil Nadu            SH71_D

                                               corridor  \
8403  Pattukotai_anthniyr_D (Tamil Nadu) <---> Perav...

                                         state_corridor  \
8403  Tamil Nadu--Pattukotai <---> Tamil Nadu--Perav...

                                        city_corridor
trip_creation_day_week  \
8403  Pattukotai--anthniyr_D <---> Peravurani--SH71_D
Sunday

      trip_creation_dayofdate
8403                       23

plt.figure(figsize=(15,6))

weekday_order = ['Monday', 'Tuesday', 'Wednesday', 'Thursday',
'Friday', 'Saturday', 'Sunday']
day_counts =
trip_df['trip_creation_day_week'].value_counts().reindex(weekday_order
```

```
)

sns.barplot(x=day_counts.index, y=day_counts.values,
palette=cp,width=0.3)
for i, count in enumerate(day_counts.values):
    plt.text(i, count, str(count), ha='center', va='bottom')
plt.title('Counts of Trips_created by Day of the
Month',fontsize=14,fontfamily='serif',fontweight='bold',backgroundcolo
r='k',color='w')
plt.xlabel('Day of the Month')
plt.ylabel('Number of Trips')
plt.tight_layout()
sns.despine()
plt.show()
```




```
trip_df['trip_creation_dayofdate'] =
trip_df['trip_creation_time'].dt.day

trips_by_dateday = trip_df.groupby(by = 'trip_creation_dayofdate')
['trip_uuid'].count().to_frame().reset_index()

plt.figure(figsize = (15, 6))
sns.barplot(data =trip_df,x =
trips_by_dateday['trip_creation_dayofdate'],y =
trips_by_dateday['trip_uuid'], palette='Greys',width=0.3)
for i, count in enumerate(trips_by_dateday['trip_uuid']):
    plt.text(i, count, str(count), ha='center', va='bottom')
plt.title('Trips by date-days of the
month',fontsize=14,fontfamily='serif',fontweight='bold',backgroundcolo
r='r',color='w')
plt.xlabel('Date of the Month')
plt.ylabel('Number of Trips')
sns.despine()
plt.show()
```

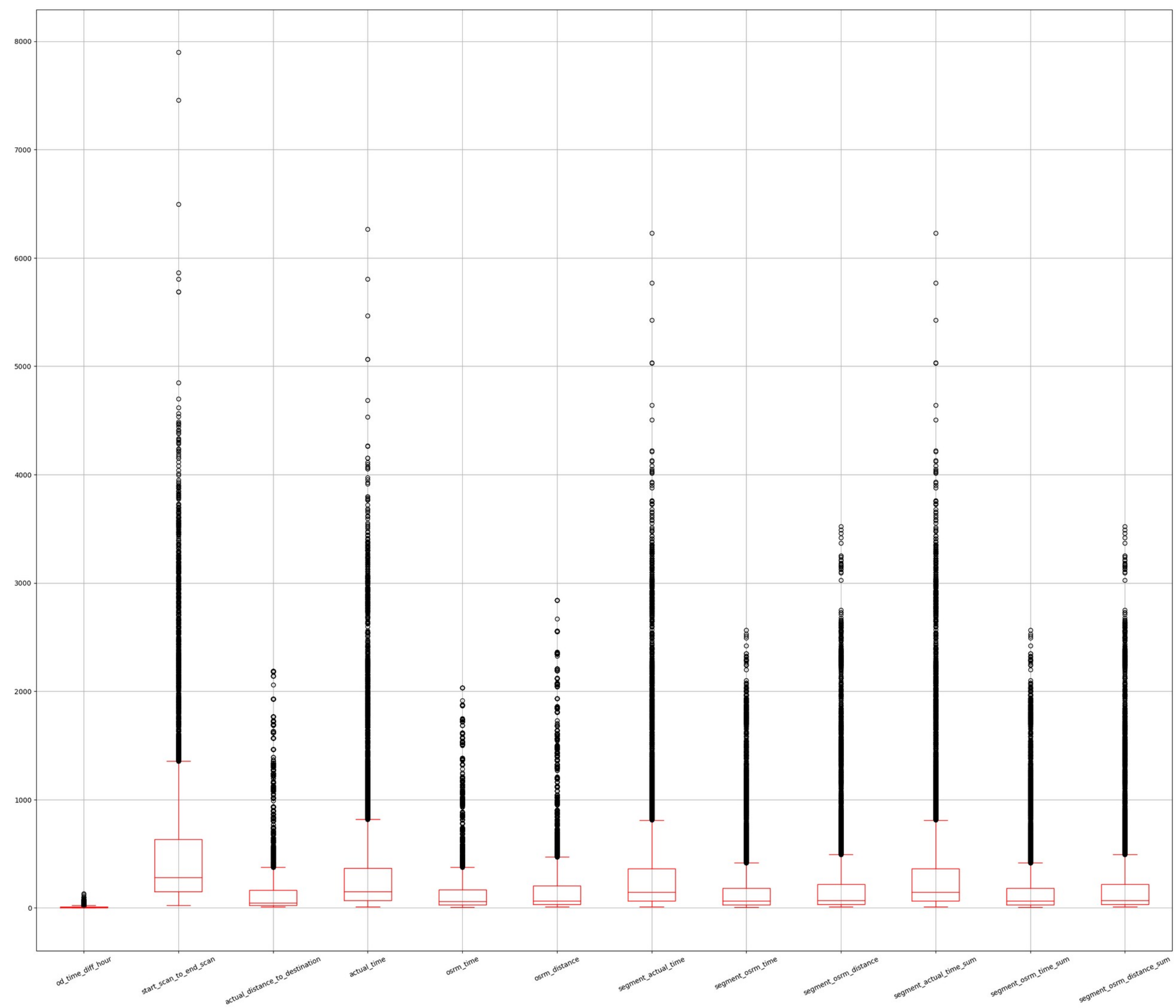


Outlier treatment

```
numerical_columns

       od_time_diff_hour  start_scan_to_end_scan  \
0              37.668497                  2259.0
1               3.026865                   180.0
2              65.572709                  3933.0
3               1.674916                   100.0
4              11.972484                   717.0
...                  ...                     ...
14782           4.300482                   257.0
14783           1.009842                    60.0
14784           7.035331                   421.0
14785           5.808548                   347.0
14786           5.906793                   353.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                          824.732849       1562.0      717.0
991.352295
1                           73.186905        143.0       68.0
85.111000
2                         1927.404297       3347.0     1740.0
2354.066650
3                           17.175274         59.0       15.0
19.680000
4                          127.448502        341.0      117.0
146.791794
...                               ...          ...        ...
...
14782                       57.762333         83.0       62.0
73.462997
```

```
14783                             15.513784         21.0        12.0
16.088200
14784                             38.684837        282.0        48.0
58.903702
14785                            134.723831        264.0       179.0
171.110306
14786                             66.081528        275.0        68.0
80.578705

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                   1548.0             1008.0            1320.473267

1                    141.0               65.0              84.189400

2                   3308.0             1941.0            2545.267822

3                     59.0               16.0              19.876600

4                    340.0              115.0             146.791901

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

14782                 82.0               62.0              64.855103

14783                 21.0               11.0              16.088299

14784                281.0               88.0             104.886597

14785                258.0              221.0             223.532394

14786                274.0               67.0              80.578705


       segment_actual_time_sum  segment_osrm_time_sum  \
0                       1548.0                 1008.0
1                        141.0                   65.0
2                       3308.0                 1941.0
3                         59.0                   16.0
4                        340.0                  115.0
...                        ...                    ...
14782                     82.0                   62.0
14783                     21.0                   11.0
14784                    281.0                   88.0
14785                    258.0                  221.0
14786                    274.0                   67.0

       segment_osrm_distance_sum
0                    1320.473267
1                      84.189400
2                    2545.267822
```

```
3                           19.876600
4                          146.791901
...                               ...
14782                       64.855103
14783                       16.088299
14784                      104.886597
14785                      223.532394
14786                       80.578705

[14787 rows x 12 columns]

plt.figure(figsize=(30, 25))
numerical_columns.boxplot(rot=25, figsize=(35,20), color = 'r')
plt.grid('off')
plt.show()
```




```
numerical_columns.columns
```

```
Index(['od_time_diff_hour', 'start_scan_to_end_scan',
       'actual_distance_to_destination', 'actual_time', 'osrm_time',
       'osrm_distance', 'segment_actual_time', 'segment_osrm_time',
       'segment_osrm_distance', 'segment_actual_time_sum',
       'segment_osrm_time_sum', 'segment_osrm_distance_sum'],
      dtype='object')
```

```
num_cols = numerical_columns.columns.tolist()
num_cols
```

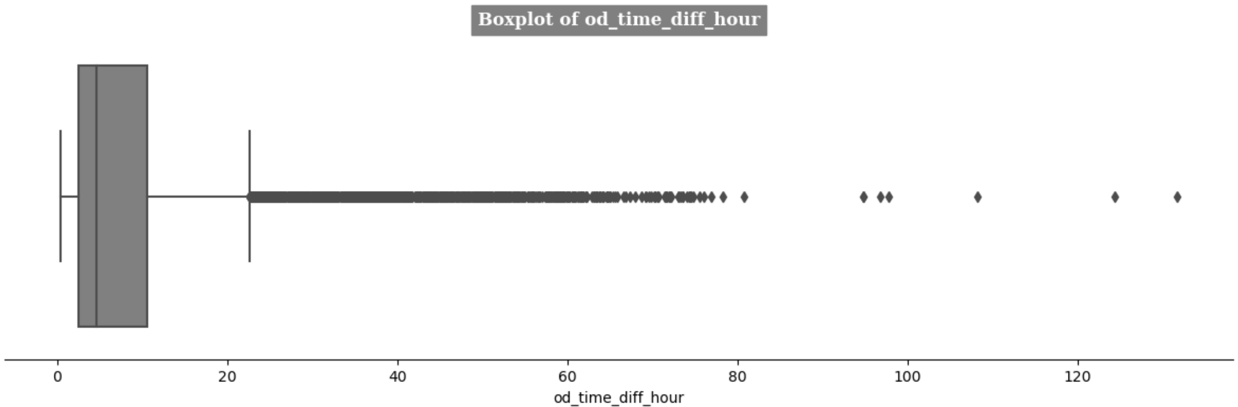
```
['od_time_diff_hour',
 'start_scan_to_end_scan',
 'actual_distance_to_destination',
 'actual_time',
 'osrm_time',
 'osrm_distance',
 'segment_actual_time',
 'segment_osrm_time',
 'segment_osrm_distance',
 'segment_actual_time_sum',
 'segment_osrm_time_sum',
 'segment_osrm_distance_sum']
```

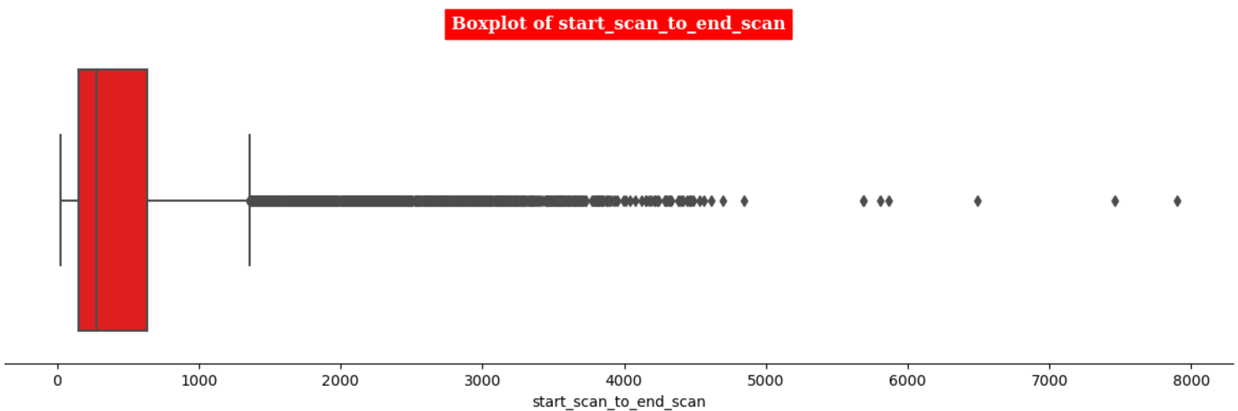
```
# obtain the first quartile
Q1 = numerical_columns.quantile(0.25)

# obtain the third quartile
Q3 = numerical_columns.quantile(0.75)

# obtain the IQR
IQR = Q3 - Q1

# print the IQR
print(IQR)
```

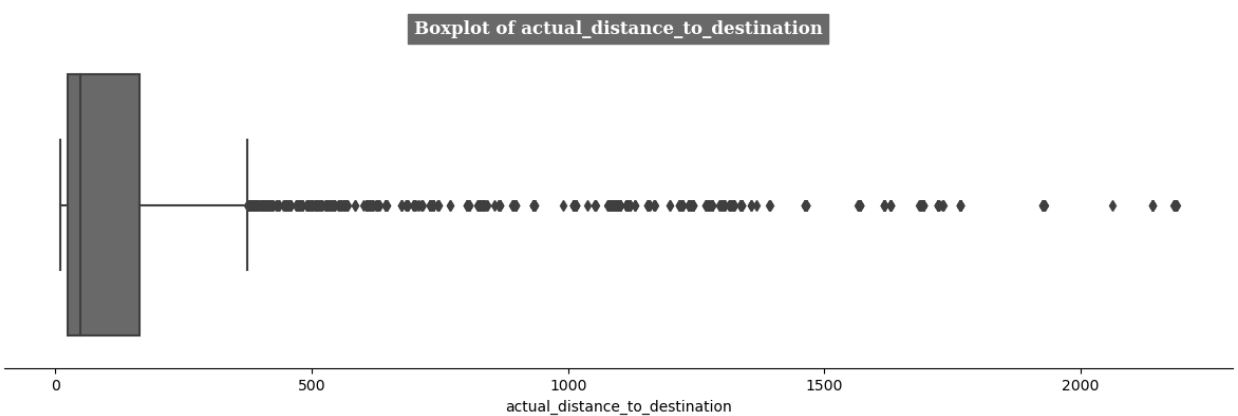
```
od_time_diff_hour                   8.063987
start_scan_to_end_scan            483.000000
actual_distance_to_destination    140.814157
actual_time                       300.000000
osrm_time                         139.000000
osrm_distance                     175.887303
segment_actual_time               298.000000
segment_osrm_time                 154.000000
segment_osrm_distance             183.981758
segment_actual_time_sum           298.000000
segment_osrm_time_sum             154.000000
segment_osrm_distance_sum         183.981758
dtype: float64
```

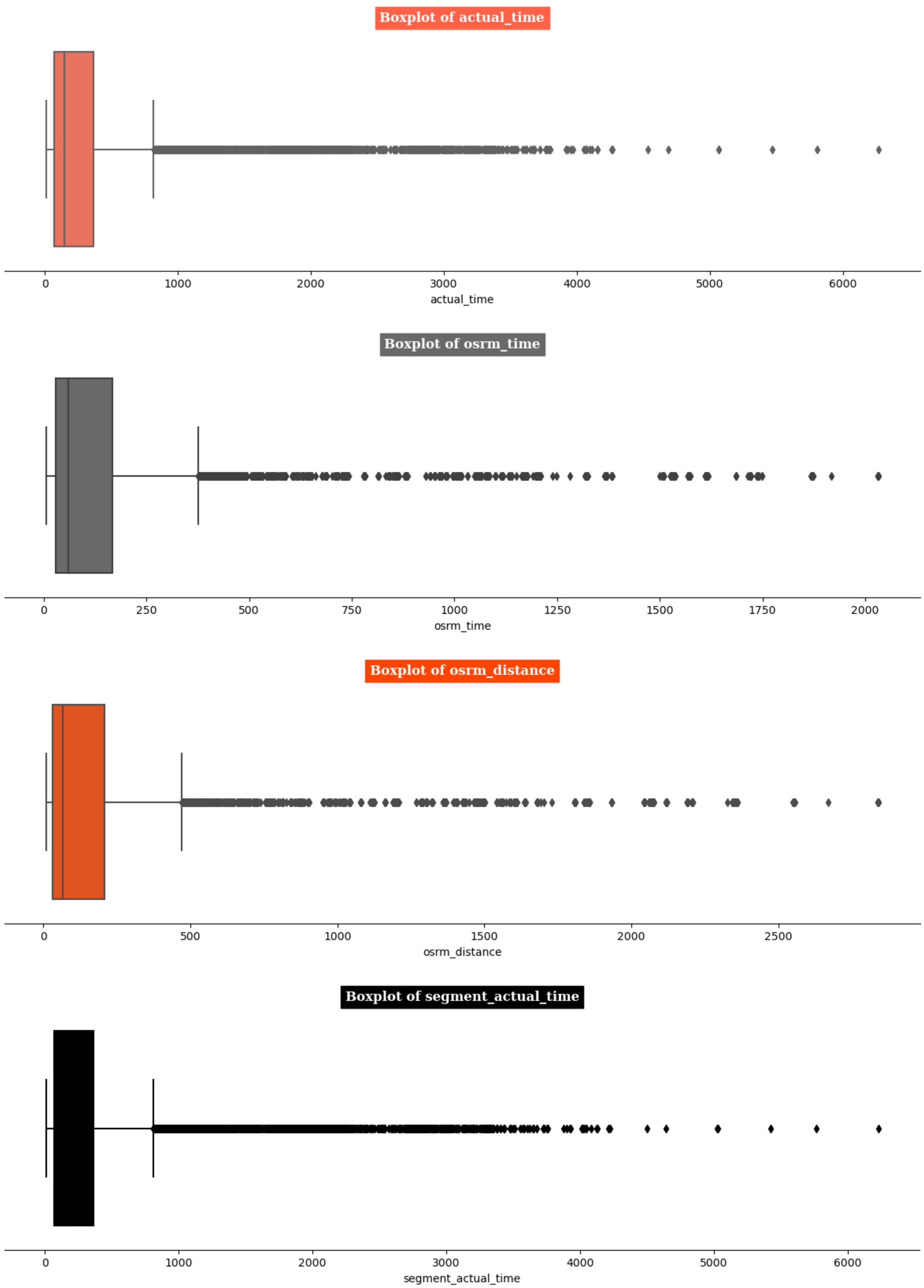
```
for i,col in enumerate(numerical_columns):
    plt.figure(figsize=(15,4))
```

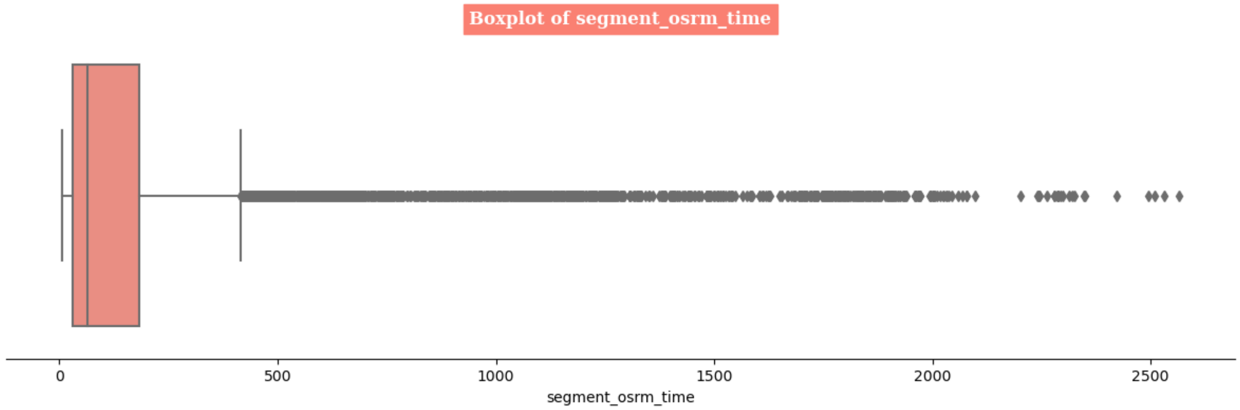
```
    sns.boxplot(x=col, data=numerical_columns,color=cp[i])
    sns.despine(left=True)
    plt.yticks([])
    plt.title(f'Boxplot of 
{col}',fontfamily='serif',fontweight='bold',fontsize=12,backgroundcolo
r=cp[i],color='w')
    plt.show()
```

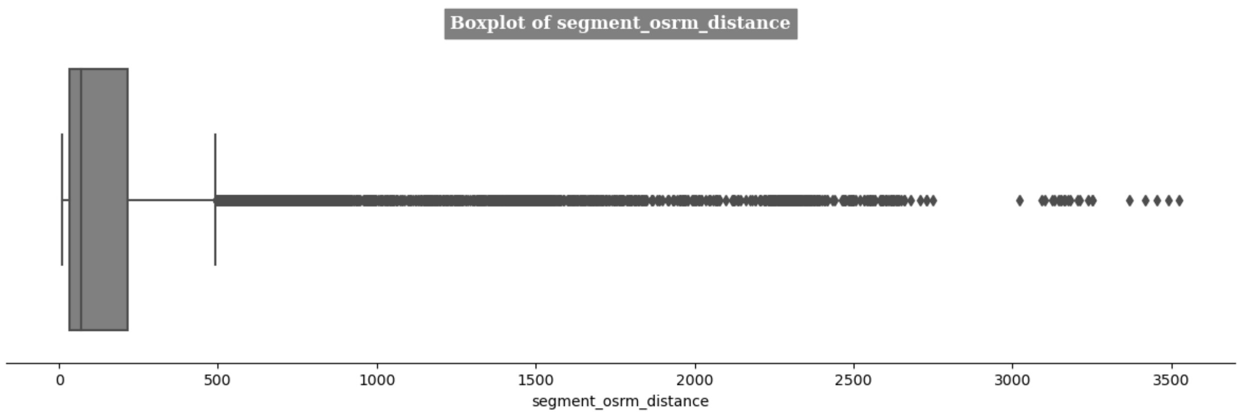


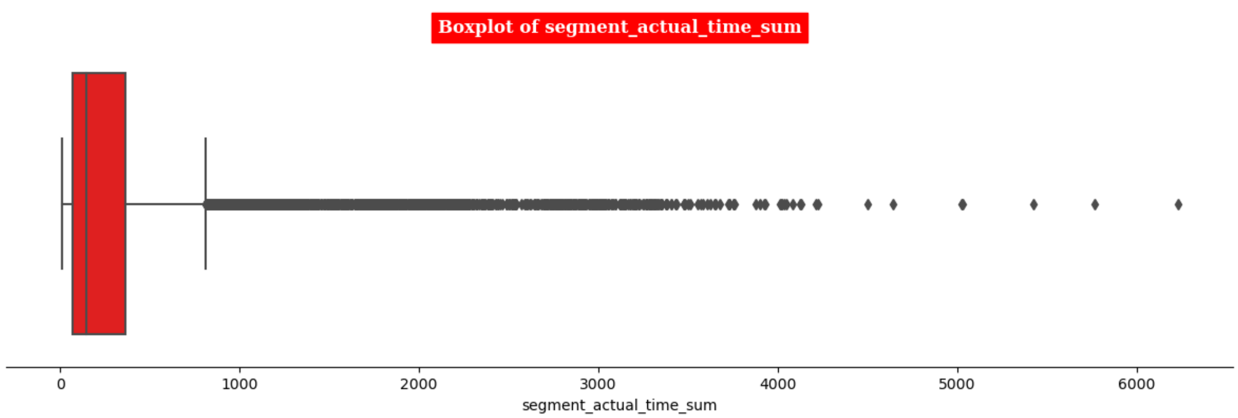


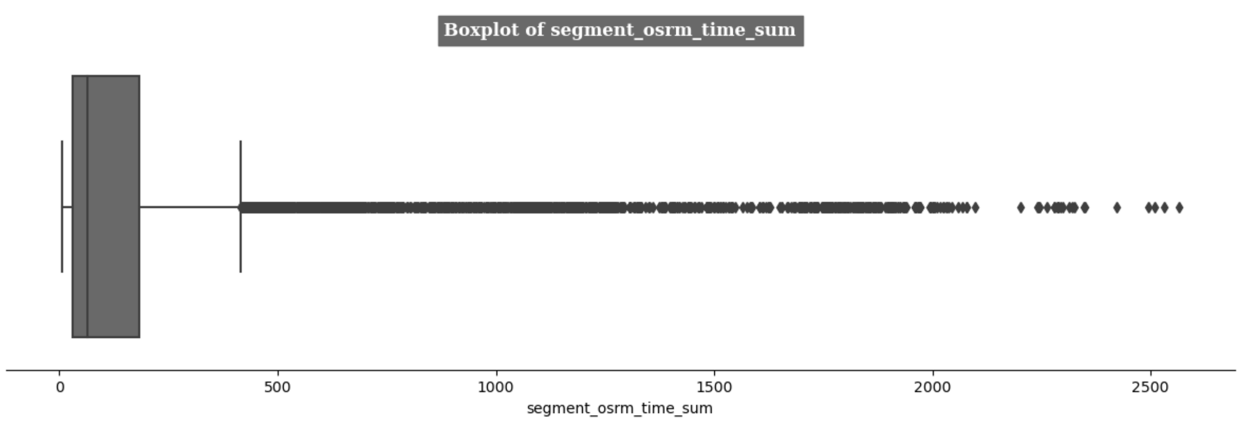


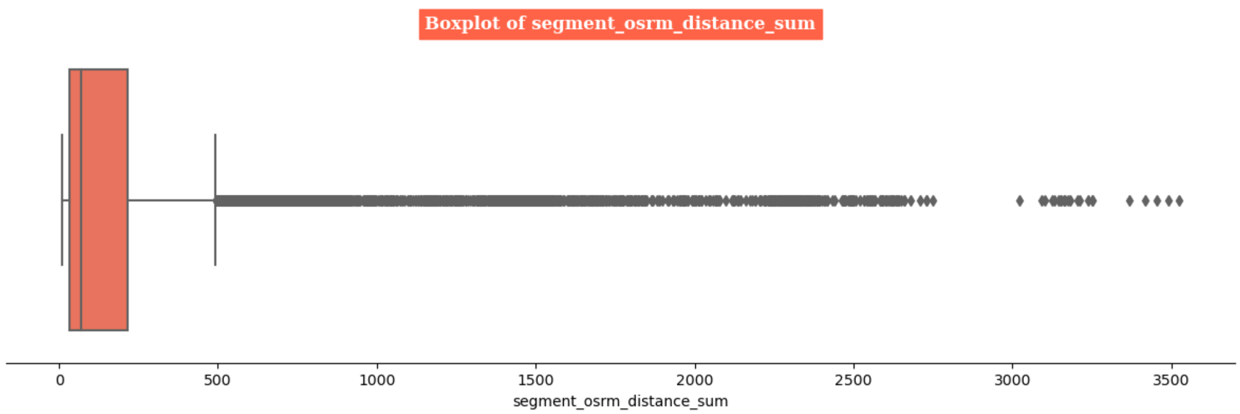

Boxplot of actual_time
0
1000
2000
3000
4000
5000
6000
actual_time
Boxplot of osrm_time
0
250
500
750
1000
1250
1500
1750
2000
osrm_time
Boxplot of osrm_distance
0
500
1000
1500
2000
2500
osrm_distance
Boxplot of segment_actual_time
0
1000
2000
3000
4000
5000
6000
segment_actual_time


Boxplot of segment_osrm_time
0
500
1000
1500
2000
2500
segment_osrm_time


Boxplot of segment_osrm_distance
0
500
1000
1500
2000
2500
3000
3500
segment_osrm_distance


Boxplot of segment_actual_time_sum
0
1000
2000
3000
4000
5000
6000
segment_actual_time_sum


Boxplot of segment_osrm_time_sum
0
500
1000
1500
2000
2500
segment_osrm_time_sum



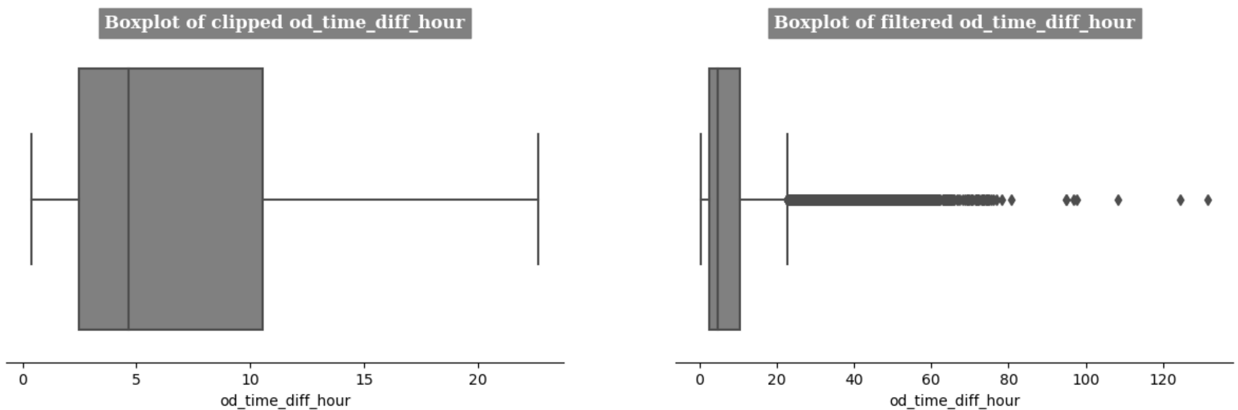
Outlier Removal

```
for i, col in enumerate(numerical_columns):

    data = trip_df[col]
    display(data.to_frame())


    Q1 = np.percentile(data, 25)
    Q3 = np.percentile(data, 75)
    IQR = Q3 - Q1


    lower_bound = Q1 - (1.5 * IQR)
    upper_bound = Q3 + (1.5 * IQR)

    clipped_data = np.clip(data, lower_bound, upper_bound)
    print(f'Clipped data of {col}')
    display(clipped_data.to_frame())
    print()

    # Plot boxplot of the clipped data
    plt.figure(figsize=(15, 4))
    plt.subplot(121)
    sns.boxplot(x=clipped_data, color=cp[i])
    sns.despine(left=True)
    plt.yticks([])
    plt.title(f'Boxplot of clipped {col}', fontfamily='serif',
fontweight='bold', fontsize=12, backgroundcolor=cp[i], color='w')

    filtered_data = data.loc[(data >= lower_bound) | (data <=
upper_bound)]
    print(f'Filtered data of {col}')
    display(filtered_data.to_frame())
    print()

    plt.subplot(122)
    sns.boxplot(x=filtered_data, color=cp[i])
```

```
    sns.despine(left=True)
    plt.yticks([])
    plt.title(f'Boxplot of filtered {col}', fontfamily='serif',
fontweight='bold', fontsize=12, backgroundcolor=cp[i], color='w')

    plt.show()
```

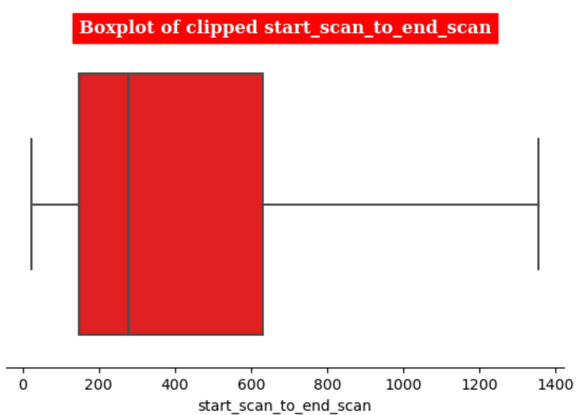
```
       od_time_diff_hour
0              37.668497
1               3.026865
2              65.572709
3               1.674916
4              11.972484
...                  ...
14782           4.300482
14783           1.009842
14784           7.035331
14785           5.808548
14786           5.906793

[14787 rows x 1 columns]

Clipped data of od_time_diff_hour

       od_time_diff_hour
0              22.654942
1               3.026865
2              22.654942
3               1.674916
4              11.972484
...                  ...
14782           4.300482
14783           1.009842
14784           7.035331
14785           5.808548
14786           5.906793

[14787 rows x 1 columns]


Filtered data of od_time_diff_hour

       od_time_diff_hour
0              37.668497
1               3.026865
2              65.572709
3               1.674916
4              11.972484
...                  ...
14782           4.300482
14783           1.009842
```

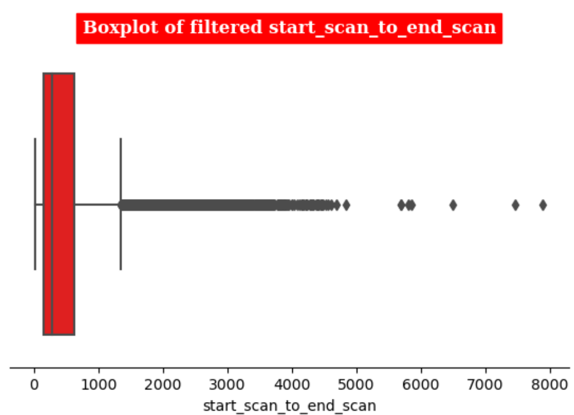
```
14784           7.035331
14785           5.808548
14786           5.906793

[14787 rows x 1 columns]
```




```
       start_scan_to_end_scan
0                      2259.0
1                       180.0
2                      3933.0
3                       100.0
4                       717.0
...                       ...
14782                   257.0
14783                    60.0
14784                   421.0
14785                   347.0
14786                   353.0

[14787 rows x 1 columns]

Clipped data of start_scan_to_end_scan

       start_scan_to_end_scan
0                      1356.5
1                       180.0
2                      1356.5
3                       100.0
4                       717.0
...                       ...
14782                   257.0
14783                    60.0
14784                   421.0
14785                   347.0
14786                   353.0
```

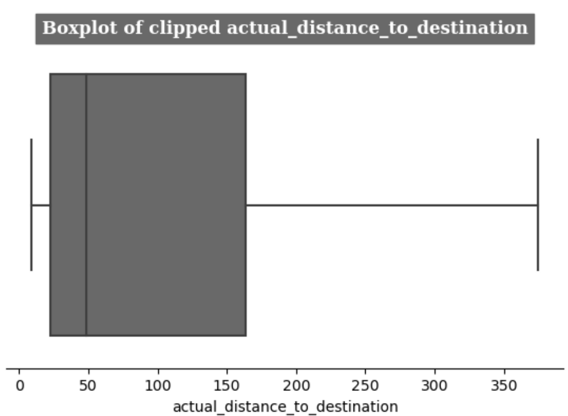
```
[14787 rows x 1 columns]


Filtered data of start_scan_to_end_scan

       start_scan_to_end_scan
0                      2259.0
1                       180.0
2                      3933.0
3                       100.0
4                       717.0
...                       ...
14782                   257.0
14783                    60.0
14784                   421.0
14785                   347.0
14786                   353.0

[14787 rows x 1 columns]
```

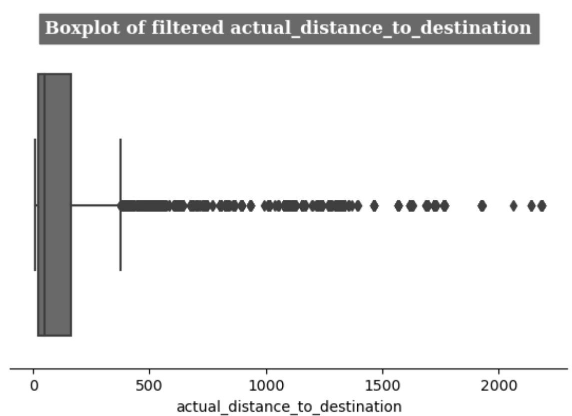




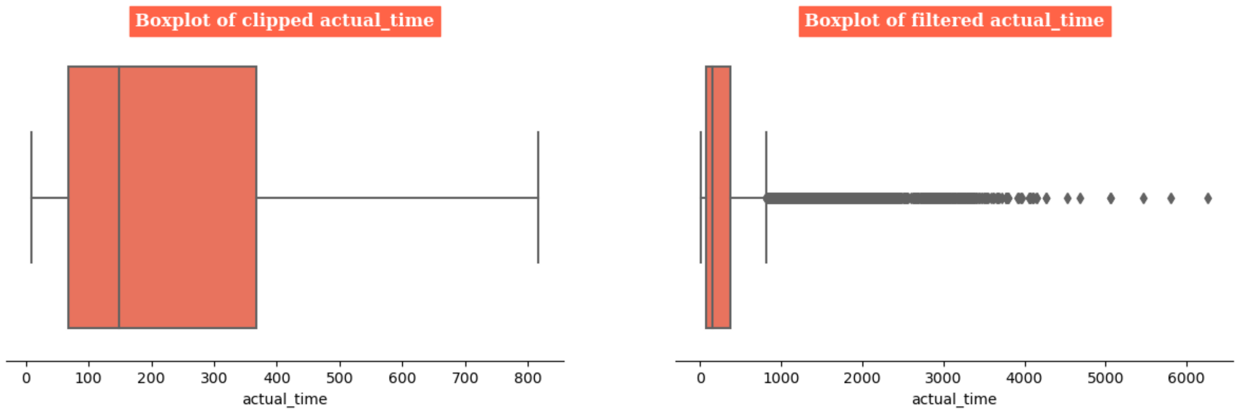

```
       actual_distance_to_destination
0                          824.732849
1                           73.186905
2                         1927.404297
3                           17.175274
4                          127.448502
...                               ...
14782                       57.762333
14783                       15.513784
14784                       38.684837
14785                      134.723831
14786                       66.081528

[14787 rows x 1 columns]
```

```
Clipped data of actual_distance_to_destination

       actual_distance_to_destination
0                          374.812490
1                           73.186905
2                          374.812490
3                           17.175274
4                          127.448502
...                               ...
14782                       57.762333
14783                       15.513784
14784                       38.684837
14785                      134.723831
14786                       66.081528

[14787 rows x 1 columns]


Filtered data of actual_distance_to_destination

       actual_distance_to_destination
0                          824.732849
1                           73.186905
2                         1927.404297
3                           17.175274
4                          127.448502
...                               ...
14782                       57.762333
14783                       15.513784
14784                       38.684837
14785                      134.723831
14786                       66.081528

[14787 rows x 1 columns]
```



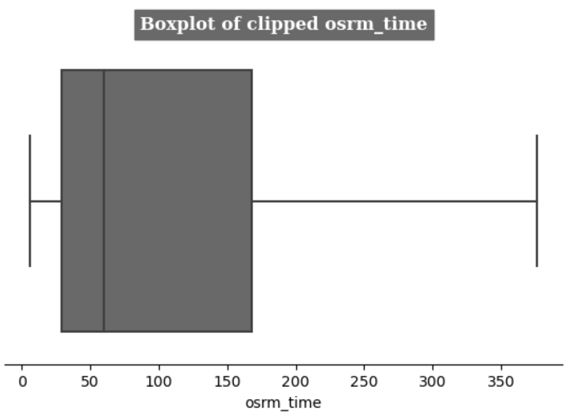


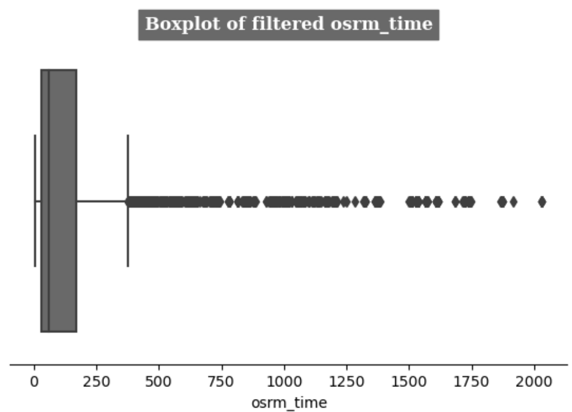
```
       actual_time
0           1562.0
1            143.0
2           3347.0
3             59.0
4            341.0
...            ...
14782         83.0
14783         21.0
14784        282.0
14785        264.0
14786        275.0

[14787 rows x 1 columns]

Clipped data of actual_time

       actual_time
0            817.0
1            143.0
2            817.0
3             59.0
4            341.0
...            ...
14782         83.0
14783         21.0
14784        282.0
14785        264.0
14786        275.0

[14787 rows x 1 columns]


Filtered data of actual_time

       actual_time
0           1562.0
1            143.0
2           3347.0
3             59.0
4            341.0
...            ...
14782         83.0
14783         21.0
14784        282.0
14785        264.0
14786        275.0

[14787 rows x 1 columns]
```




```
       osrm_time
0          717.0
1           68.0
2         1740.0
3           15.0
4          117.0
...          ...
14782       62.0
14783       12.0
14784       48.0
14785      179.0
14786       68.0

[14787 rows x 1 columns]

Clipped data of osrm_time

       osrm_time
0          376.5
1           68.0
2          376.5
3           15.0
4          117.0
...          ...
14782       62.0
14783       12.0
14784       48.0
14785      179.0
14786       68.0

[14787 rows x 1 columns]


Filtered data of osrm_time

       osrm_time
0          717.0
1           68.0
```

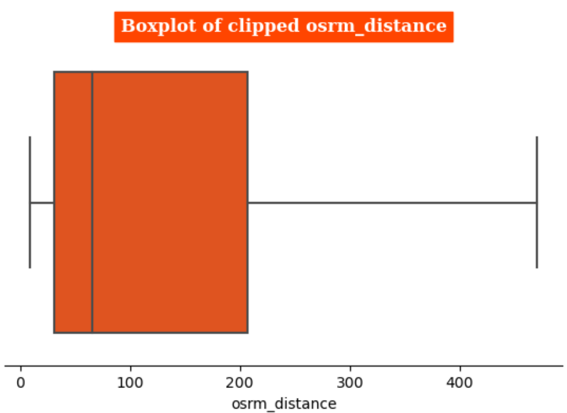
```
2           1740.0
3             15.0
4            117.0
...            ...
14782         62.0
14783         12.0
14784         48.0
14785        179.0
14786         68.0

[14787 rows x 1 columns]
```

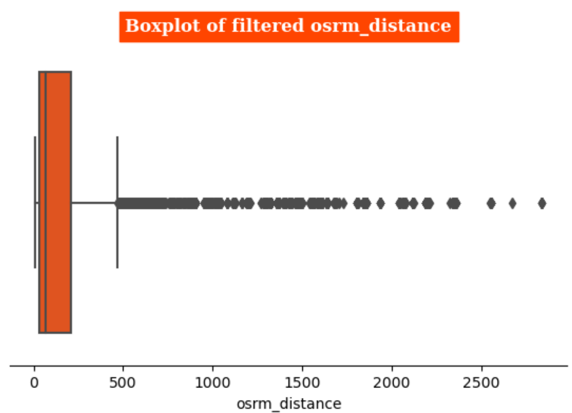





```
       osrm_distance
0         991.352295
1          85.111000
2        2354.066650
3          19.680000
4         146.791794
...              ...
14782      73.462997
14783      16.088200
14784      58.903702
14785     171.110306
14786      80.578705

[14787 rows x 1 columns]

Clipped data of osrm_distance

       osrm_distance
0         470.475158
1          85.111000
2         470.475158
3          19.680000
4         146.791794
```

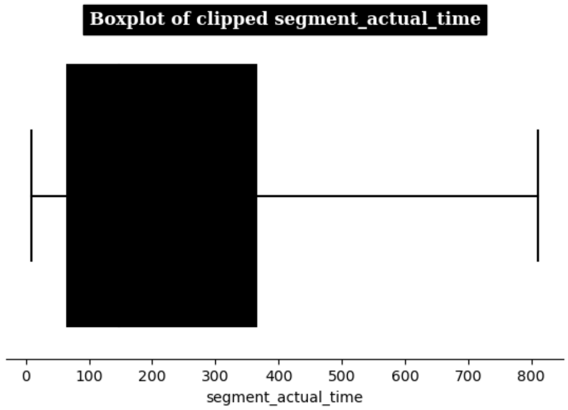
```
...                ...
14782        73.462997
14783        16.088200
14784        58.903702
14785       171.110306
14786        80.578705

[14787 rows x 1 columns]


Filtered data of osrm_distance

       osrm_distance
0         991.352295
1          85.111000
2        2354.066650
3          19.680000
4         146.791794
...                ...
14782        73.462997
14783        16.088200
14784        58.903702
14785       171.110306
14786        80.578705

[14787 rows x 1 columns]
```

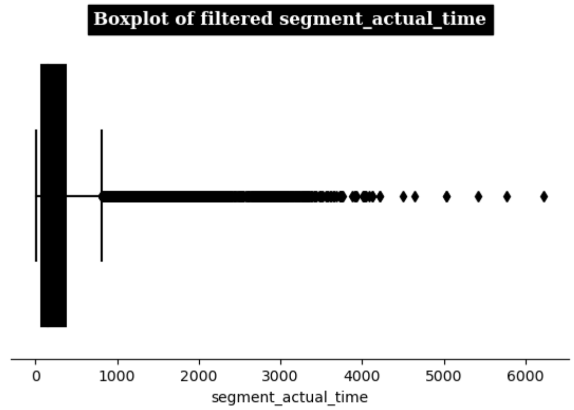





```
       segment_actual_time
0                   1548.0
1                    141.0
2                   3308.0
3                     59.0
4                    340.0
...                    ...
14782                 82.0
```

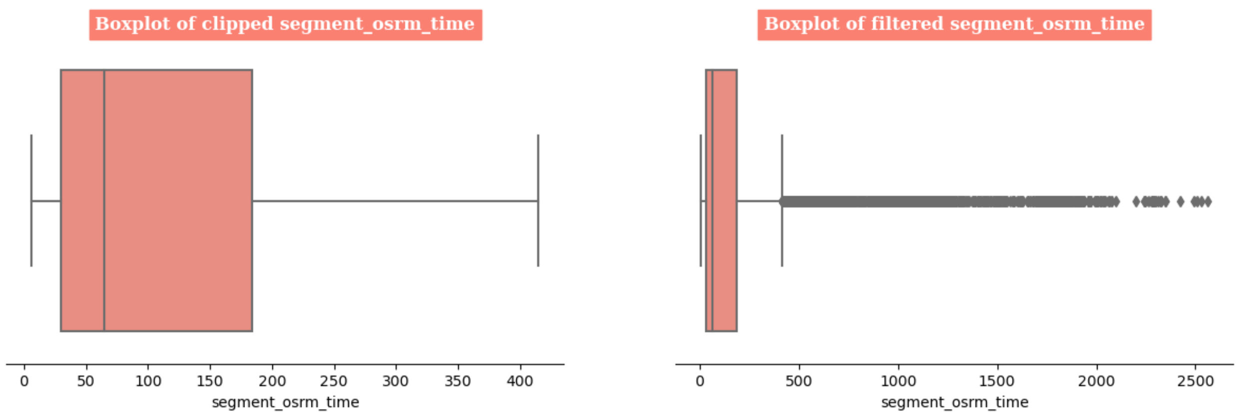
```
14783                  21.0
14784                 281.0
14785                 258.0
14786                 274.0

[14787 rows x 1 columns]

Clipped data of segment_actual_time

       segment_actual_time
0                     811.0
1                     141.0
2                     811.0
3                      59.0
4                     340.0
...                     ...
14782                  82.0
14783                  21.0
14784                 281.0
14785                 258.0
14786                 274.0

[14787 rows x 1 columns]


Filtered data of segment_actual_time

       segment_actual_time
0                    1548.0
1                     141.0
2                    3308.0
3                      59.0
4                     340.0
...                     ...
14782                  82.0
14783                  21.0
14784                 281.0
14785                 258.0
14786                 274.0

[14787 rows x 1 columns]
```





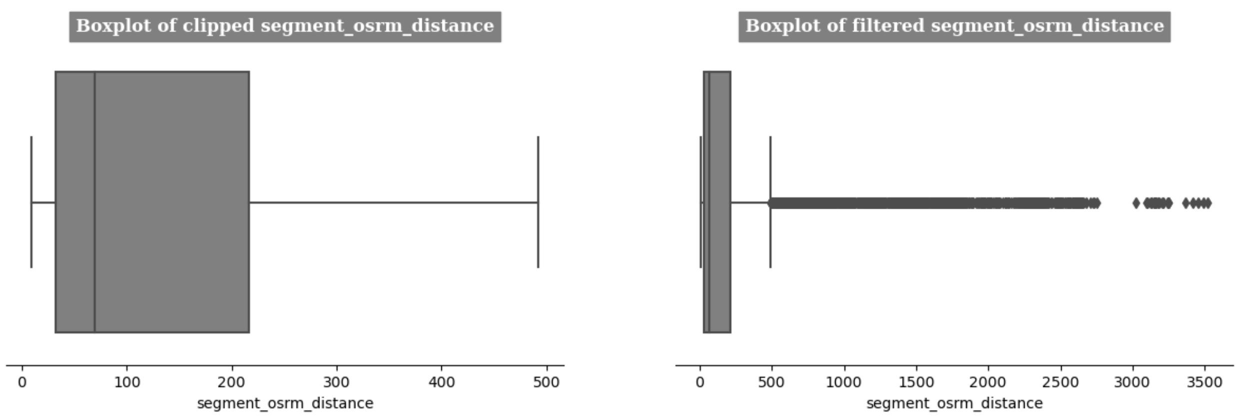

```
       segment_osrm_time
0                 1008.0
1                   65.0
2                 1941.0
3                   16.0
4                  115.0
...                  ...
14782               62.0
14783               11.0
14784               88.0
14785              221.0
14786               67.0

[14787 rows x 1 columns]

Clipped data of segment_osrm_time

       segment_osrm_time
0                  415.0
1                   65.0
2                  415.0
3                   16.0
4                  115.0
...                  ...
14782               62.0
14783               11.0
14784               88.0
14785              221.0
14786               67.0

[14787 rows x 1 columns]


Filtered data of segment_osrm_time

       segment_osrm_time
0                 1008.0
1                   65.0
```

```
2                     1941.0
3                       16.0
4                      115.0
...                      ...
14782                   62.0
14783                   11.0
14784                   88.0
14785                  221.0
14786                   67.0

[14787 rows x 1 columns]
```



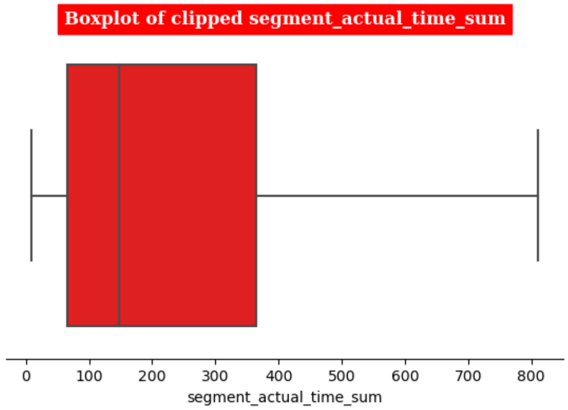

```
       segment_osrm_distance
0                1320.473267
1                  84.189400
2                2545.267822
3                  19.876600
4                 146.791901
...                      ...
14782              64.855103
14783              16.088299
14784             104.886597
14785             223.532394
14786              80.578705

[14787 rows x 1 columns]

Clipped data of segment_osrm_distance

       segment_osrm_distance
0                 492.533245
1                  84.189400
2                 492.533245
3                  19.876600
4                 146.791901
```

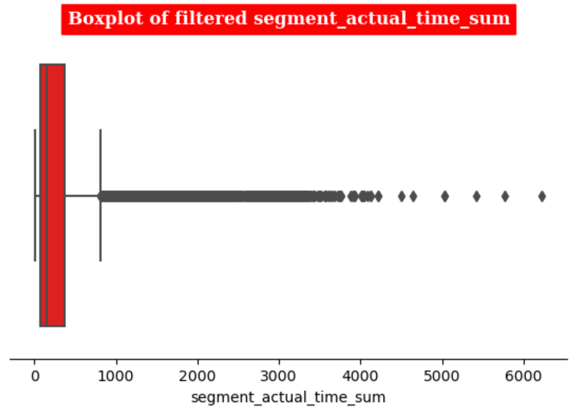
```
...                              ...
14782                      64.855103
14783                      16.088299
14784                     104.886597
14785                     223.532394
14786                      80.578705

[14787 rows x 1 columns]


Filtered data of segment_osrm_distance

       segment_osrm_distance
0                1320.473267
1                  84.189400
2                2545.267822
3                  19.876600
4                 146.791901
...                      ...
14782              64.855103
14783              16.088299
14784             104.886597
14785             223.532394
14786              80.578705

[14787 rows x 1 columns]
```




```
       segment_actual_time_sum
0                       1548.0
1                        141.0
2                       3308.0
3                         59.0
4                        340.0
...                        ...
14782                     82.0
```

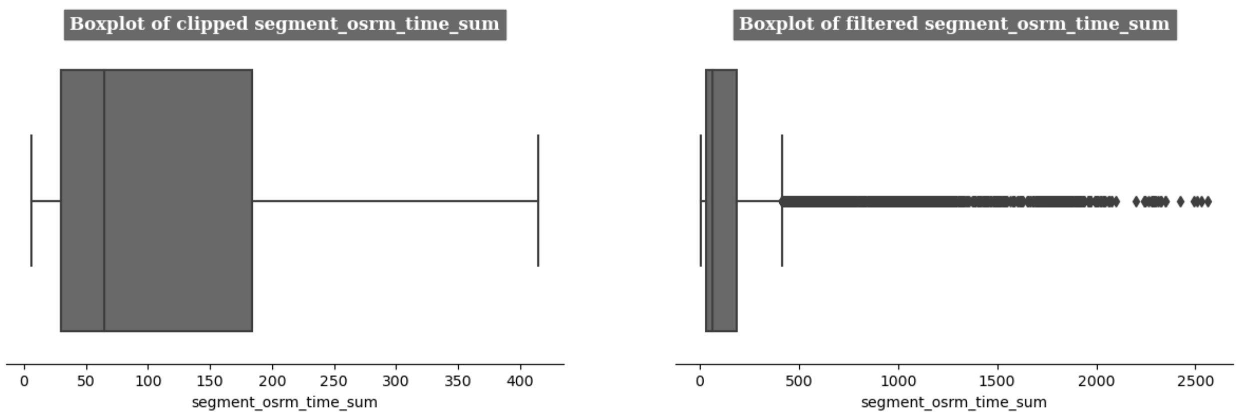
```
14783                      21.0
14784                     281.0
14785                     258.0
14786                     274.0

[14787 rows x 1 columns]

Clipped data of segment_actual_time_sum

       segment_actual_time_sum
0                         811.0
1                         141.0
2                         811.0
3                          59.0
4                         340.0
...                         ...
14782                      82.0
14783                      21.0
14784                     281.0
14785                     258.0
14786                     274.0

[14787 rows x 1 columns]


Filtered data of segment_actual_time_sum

       segment_actual_time_sum
0                        1548.0
1                         141.0
2                        3308.0
3                          59.0
4                         340.0
...                         ...
14782                      82.0
14783                      21.0
14784                     281.0
14785                     258.0
14786                     274.0

[14787 rows x 1 columns]
```





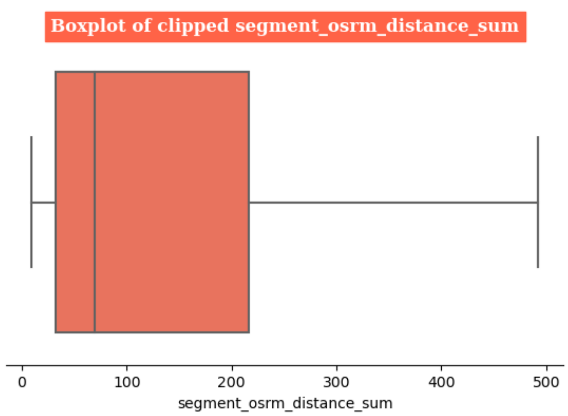

```
       segment_osrm_time_sum
0                     1008.0
1                       65.0
2                     1941.0
3                       16.0
4                      115.0
...                      ...
14782                   62.0
14783                   11.0
14784                   88.0
14785                  221.0
14786                   67.0

[14787 rows x 1 columns]

Clipped data of segment_osrm_time_sum

       segment_osrm_time_sum
0                      415.0
1                       65.0
2                      415.0
3                       16.0
4                      115.0
...                      ...
14782                   62.0
14783                   11.0
14784                   88.0
14785                  221.0
14786                   67.0

[14787 rows x 1 columns]


Filtered data of segment_osrm_time_sum

       segment_osrm_time_sum
0                     1008.0
1                       65.0
```

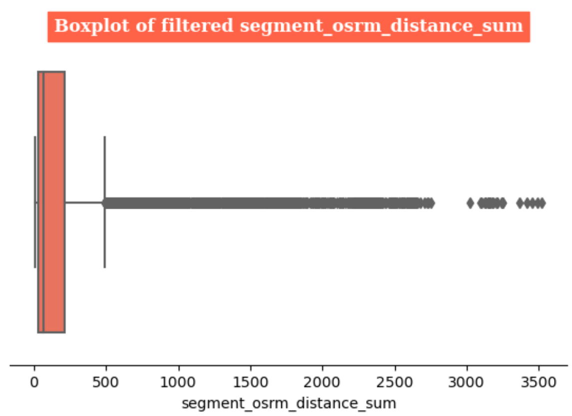
```
2                          1941.0
3                            16.0
4                           115.0
...                           ...
14782                        62.0
14783                        11.0
14784                        88.0
14785                       221.0
14786                        67.0

[14787 rows x 1 columns]
```




```
       segment_osrm_distance_sum
0                    1320.473267
1                      84.189400
2                    2545.267822
3                      19.876600
4                     146.791901
...                          ...
14782                  64.855103
14783                  16.088299
14784                 104.886597
14785                 223.532394
14786                  80.578705

[14787 rows x 1 columns]

Clipped data of segment_osrm_distance_sum

       segment_osrm_distance_sum
0                     492.533245
1                      84.189400
2                     492.533245
3                      19.876600
4                     146.791901
```

```
...                                ...
14782                        64.855103
14783                        16.088299
14784                       104.886597
14785                       223.532394
14786                        80.578705

[14787 rows x 1 columns]


Filtered data of segment_osrm_distance_sum

       segment_osrm_distance_sum
0                    1320.473267
1                      84.189400
2                    2545.267822
3                      19.876600
4                     146.791901
...                          ...
14782                  64.855103
14783                  16.088299
14784                 104.886597
14785                 223.532394
14786                  80.578705

[14787 rows x 1 columns]
```





Understanding:

- Here we see that the data after removing outliers has outliers. It has to be understood that q1 and q3 dont have to be always 25th percentile and 75th percentile. ***Try changing q1 and q3 to 10th percentile to 90th percentile and plot and see...***
- Clipped data replaces the outlier values with specified values.
- Here, I have proceeded with both clipped and filtered data(with reduced outliers) for further analysis.

```
num_df = numerical_columns.copy()
num_df

       od_time_diff_hour  start_scan_to_end_scan  \
0              37.668497                  2259.0
1               3.026865                   180.0
2              65.572709                  3933.0
3               1.674916                   100.0
4              11.972484                   717.0
...                  ...                     ...
14782           4.300482                   257.0
14783           1.009842                    60.0
14784           7.035331                   421.0
14785           5.808548                   347.0
14786           5.906793                   353.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                          824.732849       1562.0      717.0
991.352295
1                           73.186905        143.0       68.0
85.111000
2                         1927.404297       3347.0     1740.0
2354.066650
3                           17.175274         59.0       15.0
19.680000
4                          127.448502        341.0      117.0
146.791794
...                               ...          ...        ...
...
14782                       57.762333         83.0       62.0
73.462997
14783                       15.513784         21.0       12.0
16.088200
14784                       38.684837        282.0       48.0
58.903702
14785                      134.723831        264.0      179.0
171.110306
14786                       66.081528        275.0       68.0
80.578705

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                   1548.0             1008.0             1320.473267

1                    141.0               65.0               84.189400

2                   3308.0             1941.0             2545.267822

3                     59.0               16.0               19.876600
```

```
4                  340.0              115.0            146.791901
...                  ...                ...                   ...
14782               82.0               62.0             64.855103
14783               21.0               11.0             16.088299
14784              281.0               88.0            104.886597
14785              258.0              221.0            223.532394
14786              274.0               67.0             80.578705

       segment_actual_time_sum  segment_osrm_time_sum  \
0                       1548.0                 1008.0
1                        141.0                   65.0
2                       3308.0                 1941.0
3                         59.0                   16.0
4                        340.0                  115.0
...                        ...                    ...
14782                     82.0                   62.0
14783                     21.0                   11.0
14784                    281.0                   88.0
14785                    258.0                  221.0
14786                    274.0                   67.0

       segment_osrm_distance_sum
0                    1320.473267
1                      84.189400
2                    2545.267822
3                      19.876600
4                     146.791901
...                          ...
14782                  64.855103
14783                  16.088299
14784                 104.886597
14785                 223.532394
14786                  80.578705

[14787 rows x 12 columns]
```

```
num_cols
```

```
['od_time_diff_hour',
 'start_scan_to_end_scan',
 'actual_distance_to_destination',
 'actual_time',
 'osrm_time',
```

```
 'osrm_distance',
 'segment_actual_time',
 'segment_osrm_time',
 'segment_osrm_distance',
 'segment_actual_time_sum',
 'segment_osrm_time_sum',
 'segment_osrm_distance_sum']

Q1 = np.percentile(num_df[num_cols], 25)
Q3 = np.percentile(num_df[num_cols], 75)
IQR = Q3 - Q1

lower_bound = Q1 - (1.5 * IQR)
upper_bound = Q3 + (1.5 * IQR)

clipped_num_df = np.clip(num_df[num_cols], lower_bound, upper_bound)
display(clipped_num_df)

filtered_num_df = num_df[num_cols][(num_df[num_cols] >= lower_bound) |
(num_df[num_cols] <= upper_bound)]
display(filtered_num_df)
```

```
       od_time_diff_hour  start_scan_to_end_scan  \
0              37.668497              543.285302
1               3.026865              180.000000
2              65.572709              543.285302
3               1.674916              100.000000
4              11.972484              543.285302
...                  ...                     ...
14782           4.300482              257.000000
14783           1.009842               60.000000
14784           7.035331              421.000000
14785           5.808548              347.000000
14786           5.906793              353.000000

       actual_distance_to_destination  actual_time   osrm_time
osrm_distance  \
0                          543.285302   543.285302  543.285302
543.285302
1                           73.186905   143.000000   68.000000
85.111000
2                          543.285302   543.285302  543.285302
543.285302
3                           17.175274    59.000000   15.000000
19.680000
4                          127.448502   341.000000  117.000000
146.791794
...                               ...          ...         ...
...
14782                       57.762333    83.000000   62.000000
```

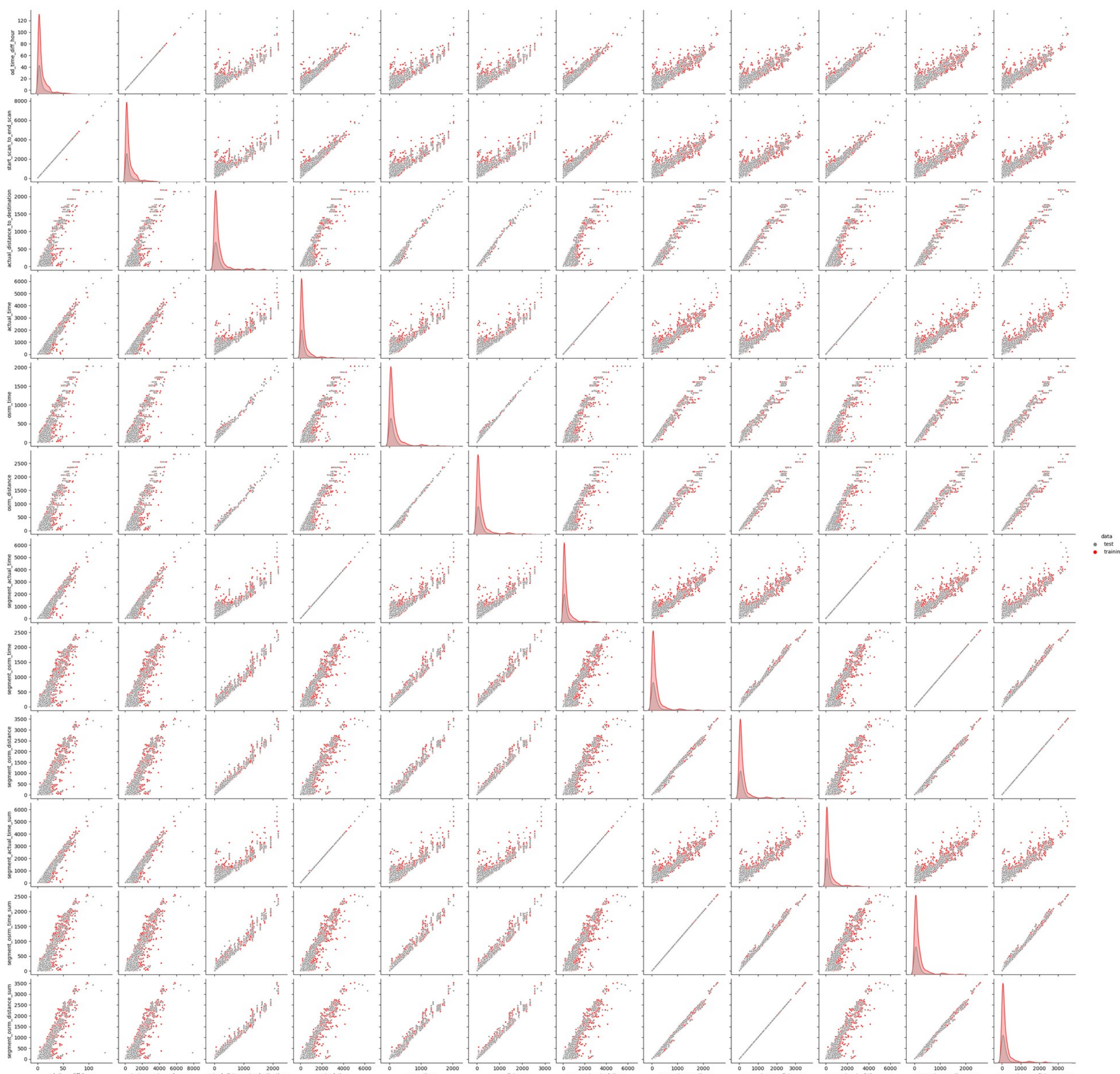
```
73.462997
14783                          15.513784    21.000000   12.000000
16.088200
14784                          38.684837   282.000000   48.000000
58.903702
14785                         134.723831   264.000000  179.000000
171.110306
14786                          66.081528   275.000000   68.000000
80.578705

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                543.285302         543.285302               543.285302

1                141.000000          65.000000                84.189400

2                543.285302         543.285302               543.285302

3                 59.000000          16.000000                19.876600

4                340.000000         115.000000               146.791901

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

14782             82.000000          62.000000                64.855103

14783             21.000000          11.000000                16.088299

14784            281.000000          88.000000               104.886597

14785            258.000000         221.000000               223.532394

14786            274.000000          67.000000                80.578705


       segment_actual_time_sum  segment_osrm_time_sum  \
0                   543.285302             543.285302
1                   141.000000              65.000000
2                   543.285302             543.285302
3                    59.000000              16.000000
4                   340.000000             115.000000
...                        ...                    ...
14782                82.000000              62.000000
14783                21.000000              11.000000
14784               281.000000              88.000000
14785               258.000000             221.000000
14786               274.000000              67.000000

       segment_osrm_distance_sum
0                     543.285302
1                      84.189400
```

```
2                       543.285302
3                        19.876600
4                       146.791901
...                            ...
14782                    64.855103
14783                    16.088299
14784                   104.886597
14785                   223.532394
14786                    80.578705

[14787 rows x 12 columns]
       od_time_diff_hour  start_scan_to_end_scan  \
0              37.668497                  2259.0
1               3.026865                   180.0
2              65.572709                  3933.0
3               1.674916                   100.0
4              11.972484                   717.0
...                  ...                     ...
14782           4.300482                   257.0
14783           1.009842                    60.0
14784           7.035331                   421.0
14785           5.808548                   347.0
14786           5.906793                   353.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                          824.732849       1562.0      717.0
991.352295
1                           73.186905        143.0       68.0
85.111000
2                         1927.404297       3347.0     1740.0
2354.066650
3                           17.175274         59.0       15.0
19.680000
4                          127.448502        341.0      117.0
146.791794
...                               ...          ...        ...
...
14782                       57.762333         83.0       62.0
73.462997
14783                       15.513784         21.0       12.0
16.088200
14784                       38.684837        282.0       48.0
58.903702
14785                      134.723831        264.0      179.0
171.110306
14786                       66.081528        275.0       68.0
80.578705
```

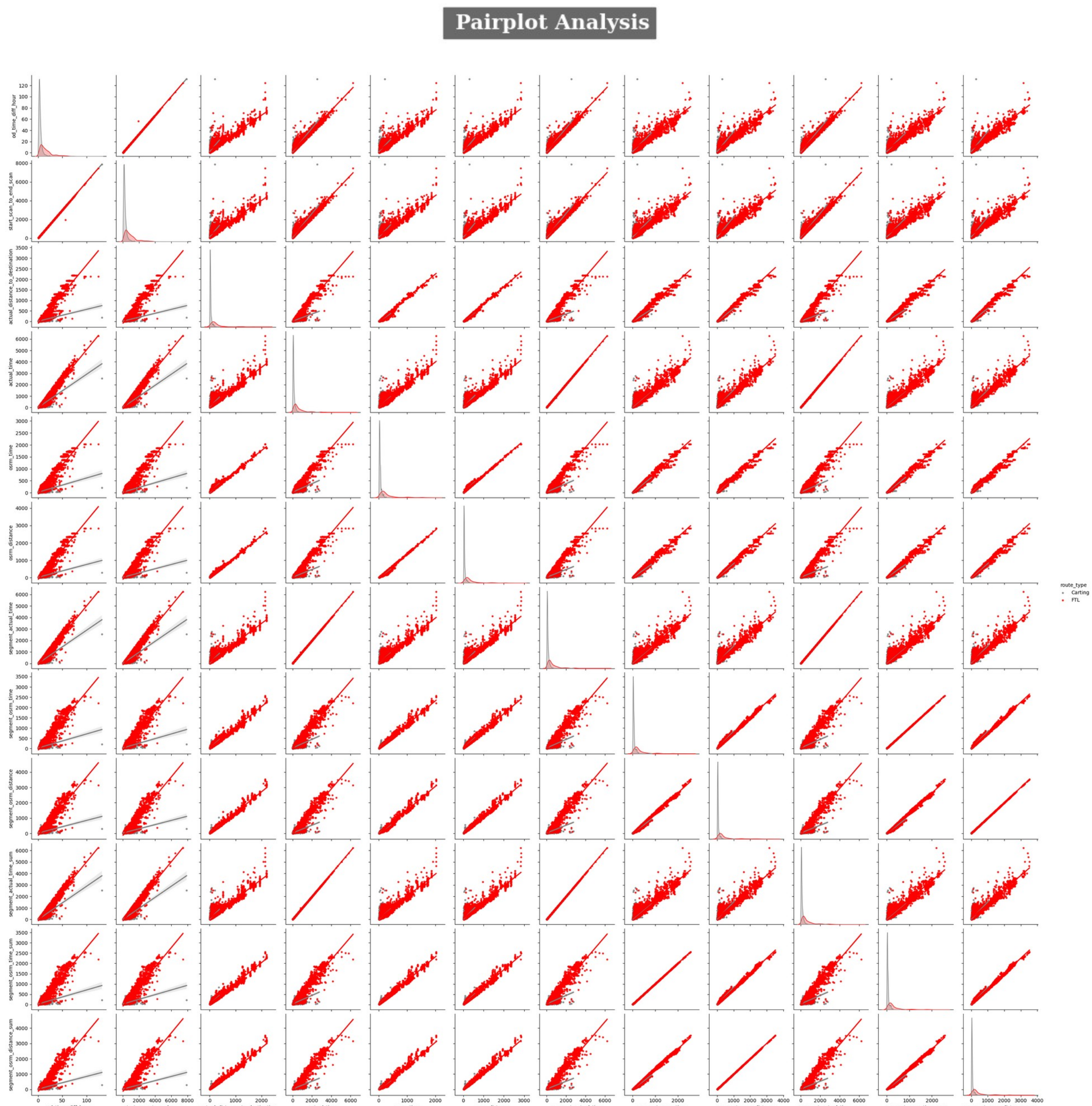
```
       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                   1548.0             1008.0            1320.473267

1                    141.0               65.0              84.189400

2                   3308.0             1941.0            2545.267822

3                     59.0               16.0              19.876600

4                    340.0              115.0             146.791901

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

14782                 82.0               62.0              64.855103

14783                 21.0               11.0              16.088299

14784                281.0               88.0             104.886597

14785                258.0              221.0             223.532394

14786                274.0               67.0              80.578705


       segment_actual_time_sum  segment_osrm_time_sum  \
0                       1548.0                 1008.0
1                        141.0                   65.0
2                       3308.0                 1941.0
3                         59.0                   16.0
4                        340.0                  115.0
...                        ...                    ...
14782                     82.0                   62.0
14783                     21.0                   11.0
14784                    281.0                   88.0
14785                    258.0                  221.0
14786                    274.0                   67.0

       segment_osrm_distance_sum
0                    1320.473267
1                      84.189400
2                    2545.267822
3                      19.876600
4                     146.791901
...                          ...
14782                  64.855103
14783                  16.088299
14784                 104.886597
14785                 223.532394
14786                  80.578705
```

```
[14787 rows x 12 columns]

plt.figure(figsize=(14,0.05))
plt.axis('off')
plt.title(f' Pairplot
Analysis',fontfamily='serif',fontweight='bold',fontsize=15,backgroundc
olor='crimson',color='w')
sns.pairplot(data = trip_df,vars = num_cols,hue='data',markers =
'.',palette=cp)
plt.show()
```

Pairplot Analysis



```
plt.figure(figsize=(14,0.05))
plt.axis('off')
plt.title(f' Pairplot
Analysis',fontfamily='serif',fontweight='bold',fontsize=15,backgroundc
olor='dimgrey',color='w')
sns.pairplot(data = trip_df,vars=num_cols,kind =
'reg',hue='route_type',markers ='.',palette=cp)
plt.show()
```




```
clipped_df_corr = clipped_num_df.corr()
clipped_df_corr
```

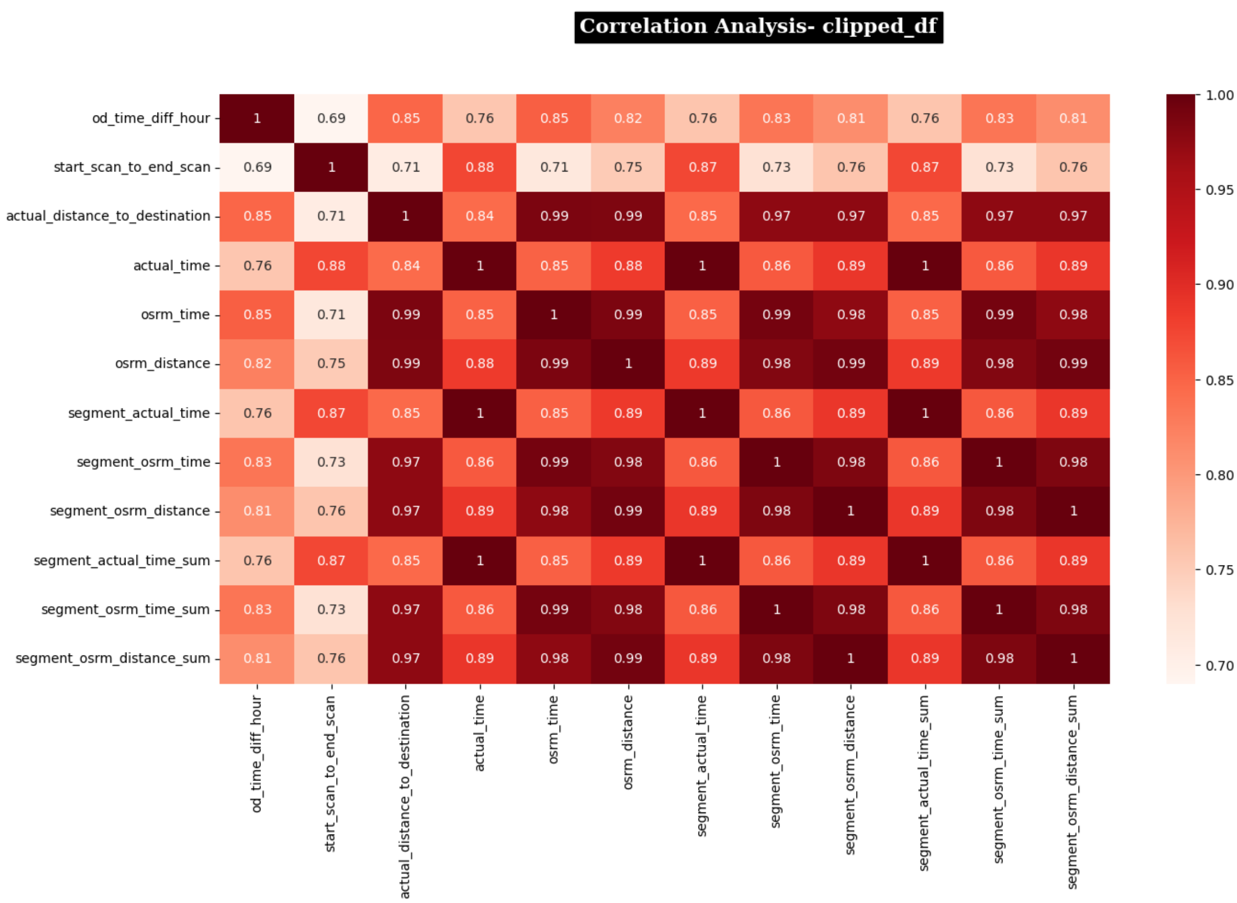
```
filtered_df_corr = filtered_num_df.corr()
filtered_df_corr
```

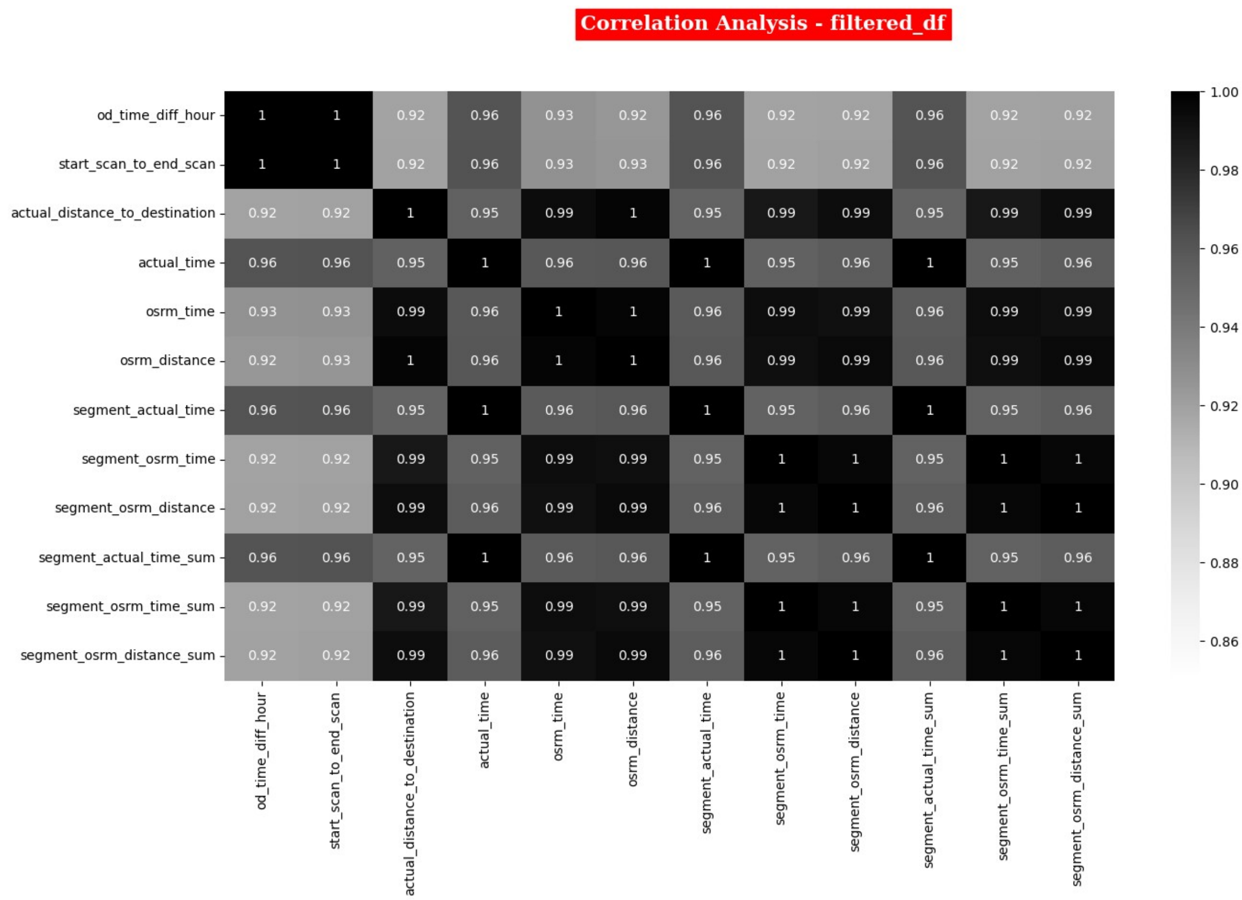
```
                                od_time_diff_hour
start_scan_to_end_scan  \
od_time_diff_hour                        1.000000
0.999837
start_scan_to_end_scan                   0.999837
1.000000
actual_distance_to_destination           0.918644
0.919159
actual_time                              0.961223
0.961612
osrm_time                                0.926973
0.927471
osrm_distance                            0.924683
0.925205
segment_actual_time                      0.961288
0.961634
segment_osrm_time                        0.918921
0.919429
segment_osrm_distance                    0.919665
0.920191
segment_actual_time_sum                  0.961288
0.961634
segment_osrm_time_sum                    0.918921
0.919429
segment_osrm_distance_sum                0.919665
0.920191

                                actual_distance_to_destination
actual_time  \
od_time_diff_hour                                     0.918644
0.961223
start_scan_to_end_scan                                0.919159
0.961612
actual_distance_to_destination                        1.000000
0.953920
actual_time                                           0.953920
1.000000
osrm_time                                             0.993568
0.958781
osrm_distance                                         0.997268
0.959398
segment_actual_time                                   0.952987
0.999989
segment_osrm_time                                     0.987542
0.954044
segment_osrm_distance                                 0.993068
```

```
0.957151
segment_actual_time_sum                                           0.952987
0.999989
segment_osrm_time_sum                                             0.987542
0.954044
segment_osrm_distance_sum                                         0.993068
0.957151

                                osrm_time  osrm_distance
segment_actual_time  \
od_time_diff_hour                0.926973       0.924683
0.961288
start_scan_to_end_scan           0.927471       0.925205
0.961634
actual_distance_to_destination   0.993568       0.997268
0.952987
actual_time                      0.958781       0.959398
0.999989
osrm_time                        1.000000       0.997588
0.957955
osrm_distance                    0.997588       1.000000
0.958540
segment_actual_time              0.957955       0.958540
1.000000
segment_osrm_time                0.993263       0.991802
0.953214
segment_osrm_distance            0.991624       0.994712
0.956293
segment_actual_time_sum          0.957955       0.958540
1.000000
segment_osrm_time_sum            0.993263       0.991802
0.953214
segment_osrm_distance_sum        0.991624       0.994712
0.956293

                                segment_osrm_time
segment_osrm_distance  \
od_time_diff_hour                        0.918921
0.919665
start_scan_to_end_scan                   0.919429
0.920191
actual_distance_to_destination           0.987542
0.993068
actual_time                              0.954044
0.957151
osrm_time                                0.993263
0.991624
osrm_distance                            0.991802
0.994712
```

```
segment_actual_time                            0.953214
0.956293
segment_osrm_time                              1.000000
0.996098
segment_osrm_distance                          0.996098
1.000000
segment_actual_time_sum                        0.953214
0.956293
segment_osrm_time_sum                          1.000000
0.996098
segment_osrm_distance_sum                      0.996098
1.000000

                                segment_actual_time_sum  \
od_time_diff_hour                              0.961288
start_scan_to_end_scan                         0.961634
actual_distance_to_destination                 0.952987
actual_time                                    0.999989
osrm_time                                      0.957955
osrm_distance                                  0.958540
segment_actual_time                            1.000000
segment_osrm_time                              0.953214
segment_osrm_distance                          0.956293
segment_actual_time_sum                        1.000000
segment_osrm_time_sum                          0.953214
segment_osrm_distance_sum                      0.956293

                                segment_osrm_time_sum  \
od_time_diff_hour                            0.918921
start_scan_to_end_scan                       0.919429
actual_distance_to_destination               0.987542
actual_time                                  0.954044
osrm_time                                    0.993263
osrm_distance                                0.991802
segment_actual_time                          0.953214
segment_osrm_time                            1.000000
segment_osrm_distance                        0.996098
segment_actual_time_sum                      0.953214
segment_osrm_time_sum                        1.000000
segment_osrm_distance_sum                    0.996098

                                segment_osrm_distance_sum
od_time_diff_hour                                0.919665
start_scan_to_end_scan                           0.920191
actual_distance_to_destination                   0.993068
actual_time                                      0.957151
osrm_time                                        0.991624
osrm_distance                                    0.994712
segment_actual_time                              0.956293
segment_osrm_time                                0.996098
```

```
segment_osrm_distance                                   1.000000
segment_actual_time_sum                                 0.956293
segment_osrm_time_sum                                   0.996098
segment_osrm_distance_sum                               1.000000

plt.figure(figsize = (15,8))
plt.suptitle(f'Correlation Analysis-
clipped_df',fontfamily='serif',fontweight='bold',fontsize=15,backgroun
dcolor='k',color='w')
sns.heatmap(data = clipped_df_corr,vmin=0.69, annot = True,
cmap='Reds')
plt.show()

plt.figure(figsize = (15,8))
plt.suptitle(f'Correlation Analysis -
filtered_df',fontfamily='serif',fontweight='bold',fontsize=15,backgrou
ndcolor='r',color='w')
sns.heatmap(data = filtered_df_corr,vmin=0.85, annot = True,
cmap='Greys')
plt.show()
```





Insights:

- Very High Correlation exists between all the numerical columns.

```
trip_df.skew(numeric_only = True)
```

```
od_time_diff_hour                  2.893550
trip_creation_month                2.337439
trip_creation_year                 0.000000
trip_creation_day                 -0.695241
trip_creation_hour                -0.206092
trip_creation_weekday              0.065904
trip_creation_week                 0.181308
start_scan_to_end_scan             2.895337
actual_distance_to_destination     3.562931
actual_time                        3.375178
osrm_time                          3.455256
osrm_distance                      3.553619
segment_actual_time                3.372043
segment_osrm_time                  3.602915
segment_osrm_distance              3.714016
segment_actual_time_sum            3.372043
```

```
segment_osrm_time_sum             3.602915
segment_osrm_distance_sum         3.714016
trip_creation_dayofdate          -0.695241
dtype: float64
```

Insights:

- We can see that Many of the data is ***Right-Skewed***.

1one-hot encoding

```
trip_df.info()

categorical_cols = ['data','route_type']

# one hot encoding the categorical features
ohe = OneHotEncoder(sparse=False)
encoded_cat_cols = ohe.fit_transform(trip_df[categorical_cols])

categorical_encoded_df = pd.DataFrame(encoded_cat_cols,
columns=ohe.get_feature_names_out(categorical_cols))
display(categorical_encoded_df)

encoded_df = pd.concat([trip_df,categorical_encoded_df],axis=1)
encoded_df
```

```
       data_test  data_training  route_type_Carting  route_type_FTL
0            0.0            1.0                 0.0             1.0
1            0.0            1.0                 1.0             0.0
2            0.0            1.0                 0.0             1.0
3            0.0            1.0                 1.0             0.0
4            0.0            1.0                 0.0             1.0
...          ...            ...                 ...             ...
14782        1.0            0.0                 1.0             0.0
14783        1.0            0.0                 1.0             0.0
14784        1.0            0.0                 1.0             0.0
14785        1.0            0.0                 1.0             0.0
14786        1.0            0.0                 0.0             1.0

[14787 rows x 4 columns]

                     trip_uuid      data route_type  \
0      trip-153671041653548748  training        FTL
1      trip-153671042288605164  training    Carting
2      trip-153671043369099517  training        FTL
3      trip-153671046011330457  training    Carting
4      trip-153671052974046625  training        FTL
...                        ...       ...        ...
14782  trip-153861095625827784      test    Carting
14783  trip-153861104386292051      test    Carting
14784  trip-153861106442901555      test    Carting
```

```
14785  trip-153861115439069069      test    Carting
14786  trip-153861118270144424      test        FTL

                    od_start_time                od_end_time  \
0     2018-09-12 16:39:46.858469 2018-09-12 16:39:46.858469
1     2018-09-12 02:03:09.655591 2018-09-12 02:03:09.655591
2     2018-09-14 03:40:17.106733 2018-09-14 03:40:17.106733
3     2018-09-12 00:01:00.113710 2018-09-12 01:41:29.809822
4     2018-09-12 00:02:09.740725 2018-09-12 03:54:43.114421
...                          ...                        ...
14782 2018-10-03 23:55:56.258533 2018-10-04 06:41:25.409035
14783 2018-10-03 23:57:23.863155 2018-10-04 00:57:59.294434
14784 2018-10-04 02:51:27.075797 2018-10-04 02:51:27.075797
14785 2018-10-03 23:59:14.390954 2018-10-04 02:29:04.272194
14786 2018-10-04 03:58:40.726547 2018-10-04 03:58:40.726547

       od_time_diff_hour         trip_creation_time
trip_creation_month  \
0              37.668497 2018-09-12 00:00:16.535741
9
1               3.026865 2018-09-12 00:00:22.886430
9
2              65.572709 2018-09-12 00:00:33.691250
9
3               1.674916 2018-09-12 00:01:00.113710
9
4              11.972484 2018-09-12 00:02:09.740725
9
...                  ...                        ...                  .
..
14782           4.300482 2018-10-03 23:55:56.258533
10
14783           1.009842 2018-10-03 23:57:23.863155
10
14784           7.035331 2018-10-03 23:57:44.429324
10
14785           5.808548 2018-10-03 23:59:14.390954
10
14786           5.906793 2018-10-03 23:59:42.701692
10

       trip_creation_year  trip_creation_day  trip_creation_hour  \
0                    2018                 12                   0
1                    2018                 12                   0
2                    2018                 12                   0
3                    2018                 12                   0
4                    2018                 12                   0
...                   ...                ...                 ...
14782                2018                  3                  23
14783                2018                  3                  23
```

```
14784                2018                 3                  23
14785                2018                 3                  23
14786                2018                 3                  23

       trip_creation_weekday  trip_creation_week
start_scan_to_end_scan  \
0                          2                  37
2259.0
1                          2                  37
180.0
2                          2                  37
3933.0
3                          2                  37
100.0
4                          2                  37
717.0
...                      ...                 ...                       .
..
14782                      2                  40
257.0
14783                      2                  40
60.0
14784                      2                  40
421.0
14785                      2                  40
347.0
14786                      2                  40
353.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                          824.732849       1562.0      717.0
991.352295
1                           73.186905        143.0       68.0
85.111000
2                         1927.404297       3347.0     1740.0
2354.066650
3                           17.175274         59.0       15.0
19.680000
4                          127.448502        341.0      117.0
146.791794
...                               ...          ...        ...
...
14782                       57.762333         83.0       62.0
73.462997
14783                       15.513784         21.0       12.0
16.088200
14784                       38.684837        282.0       48.0
58.903702
```

```
14785                          134.723831        264.0      179.0
171.110306
14786                           66.081528        275.0       68.0
80.578705

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                   1548.0             1008.0            1320.473267

1                    141.0               65.0              84.189400

2                   3308.0             1941.0            2545.267822

3                     59.0               16.0              19.876600

4                    340.0              115.0             146.791901

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

14782                 82.0               62.0              64.855103

14783                 21.0               11.0              16.088299

14784                281.0               88.0             104.886597

14785                258.0              221.0             223.532394

14786                274.0               67.0              80.578705


       segment_actual_time_sum  segment_osrm_time_sum  \
0                       1548.0                 1008.0
1                        141.0                   65.0
2                       3308.0                 1941.0
3                         59.0                   16.0
4                        340.0                  115.0
...                        ...                    ...
14782                     82.0                   62.0
14783                     21.0                   11.0
14784                    281.0                   88.0
14785                    258.0                  221.0
14786                    274.0                   67.0

       segment_osrm_distance_sum                          source_name
\
0                    1320.473267   Kanpur_Central_H_6 (Uttar Pradesh)

1                      84.189400    Doddablpur_ChikaDPP_D (Karnataka)

2                    2545.267822        Gurgaon_Bilaspur_HB (Haryana)
```

```
3                          19.876600             Mumbai Hub (Maharashtra)

4                         146.791901               Bellary_Dc (Karnataka)

...                              ...                                  ...

14782                      64.855103       Chandigarh_Mehmdpur_H (Punjab)

14783                      16.088299         FBD_Balabhgarh_DPC (Haryana)

14784                     104.886597   Kanpur_GovndNgr_DC (Uttar Pradesh)

14785                     223.532394  Tirunelveli_VdkkuSrt_I (Tamil Nadu)

14786                      80.578705        Sandur_WrdN1DPP_D (Karnataka)


       source_city   source_state    source_place  \
0           Kanpur  Uttar Pradesh     Central_H_6
1       Doddablpur      Karnataka      ChikaDPP_D
2          Gurgaon        Haryana     Bilaspur_HB
3           Mumbai    Maharashtra             Hub
4          Bellary      Karnataka              Dc
...            ...            ...             ...
14782   Chandigarh         Punjab      Mehmdpur_H
14783          FBD        Haryana  Balabhgarh_DPC
14784       Kanpur  Uttar Pradesh     GovndNgr_DC
14785  Tirunelveli     Tamil Nadu      VdkkuSrt_I
14786       Sandur      Karnataka      WrdN1DPP_D

                         destination_name destination_city
destination_state  \
0           Gurgaon_Bilaspur_HB (Haryana)          Gurgaon
Haryana
1       Chikblapur_ShntiSgr_D (Karnataka)       Chikblapur
Karnataka
2          Chandigarh_Mehmdpur_H (Punjab)       Chandigarh
Punjab
3          Mumbai_MiraRd_IP (Maharashtra)           Mumbai
Maharashtra
4                      Hospet (Karnataka)           Hospet
Karnataka
...                                   ...              ...
...
14782                Zirakpur_DC (Punjab)         Zirakpur
Punjab
14783     Faridabad_Blbgarh_DC (Haryana)         Faridabad
Haryana
14784  Kanpur_Central_H_6 (Uttar Pradesh)           Kanpur     Uttar
Pradesh
```

```
14785        Eral_Busstand_D (Tamil Nadu)            Eral
Tamil Nadu
14786              Bellary_Dc (Karnataka)         Bellary
Karnataka

      destination_place
corridor  \
0           Bilaspur_HB  Kanpur_Central_H_6 (Uttar Pradesh) <--->
Gurga...
1            ShntiSgr_D  Doddablpur_ChikaDPP_D (Karnataka) <--->
Chikbl...
2            Mehmdpur_H  Gurgaon_Bilaspur_HB (Haryana) <--->
Chandigarh...
3             MiraRd_IP  Mumbai Hub (Maharashtra) <--->
Mumbai_MiraRd_I...
4                Hospet    Bellary_Dc (Karnataka) <---> Hospet
(Karnataka)
...                 ...
...
14782                DC  Chandigarh_Mehmdpur_H (Punjab) <--->
Zirakpur_...
14783        Blbgarh_DC  FBD_Balabhgarh_DPC (Haryana) <--->
Faridabad_B...
14784       Central_H_6  Kanpur_GovndNgr_DC (Uttar Pradesh) <--->
Kanpu...
14785        Busstand_D  Tirunelveli_VdkkuSrt_I (Tamil Nadu) <--->
Eral...
14786                Dc  Sandur_WrdN1DPP_D (Karnataka) <--->
Bellary_Dc...

                                          state_corridor  \
0           Uttar Pradesh--Kanpur <---> Haryana--Gurgaon
1      Karnataka--Doddablpur <---> Karnataka--Chikblapur
2             Haryana--Gurgaon <---> Punjab--Chandigarh
3          Maharashtra--Mumbai <---> Maharashtra--Mumbai
4             Karnataka--Bellary <---> Karnataka--Hospet
...                                                  ...
14782         Punjab--Chandigarh <---> Punjab--Zirakpur
14783              Haryana--FBD <---> Haryana--Faridabad
14784  Uttar Pradesh--Kanpur <---> Uttar Pradesh--Kanpur
14785     Tamil Nadu--Tirunelveli <---> Tamil Nadu--Eral
14786         Karnataka--Sandur <---> Karnataka--Bellary

                                           city_corridor  \
0         Kanpur--Central_H_6 <---> Gurgaon--Bilaspur_HB
1      Doddablpur--ChikaDPP_D <---> Chikblapur--Shnti...
2      Gurgaon--Bilaspur_HB <---> Chandigarh--Mehmdpur_H
3                     Mumbai--Hub <---> Mumbai--MiraRd_IP
4                        Bellary--Dc <---> Hospet--Hospet
...                                                  ...
```

```
14782          Chandigarh--Mehmdpur_H <---> Zirakpur--DC
14783    FBD--Balabhgarh_DPC <---> Faridabad--Blbgarh_DC
14784      Kanpur--GovndNgr_DC <---> Kanpur--Central_H_6
14785     Tirunelveli--VdkkuSrt_I <---> Eral--Busstand_D
14786               Sandur--WrdN1DPP_D <---> Bellary--Dc

      trip_creation_day_week  trip_creation_dayofdate  data_test  \
0                  Wednesday                       12        0.0
1                  Wednesday                       12        0.0
2                  Wednesday                       12        0.0
3                  Wednesday                       12        0.0
4                  Wednesday                       12        0.0
...                      ...                      ...        ...
14782              Wednesday                        3        1.0
14783              Wednesday                        3        1.0
14784              Wednesday                        3        1.0
14785              Wednesday                        3        1.0
14786              Wednesday                        3        1.0

       data_training  route_type_Carting  route_type_FTL
0                1.0                 0.0             1.0
1                1.0                 1.0             0.0
2                1.0                 0.0             1.0
3                1.0                 1.0             0.0
4                1.0                 0.0             1.0
...              ...                 ...             ...
14782            0.0                 1.0             0.0
14783            0.0                 1.0             0.0
14784            0.0                 1.0             0.0
14785            0.0                 1.0             0.0
14786            0.0                 0.0             1.0

[14787 rows x 41 columns]
```

##Minmax scaler

Most appropriate since the data is not gaussian

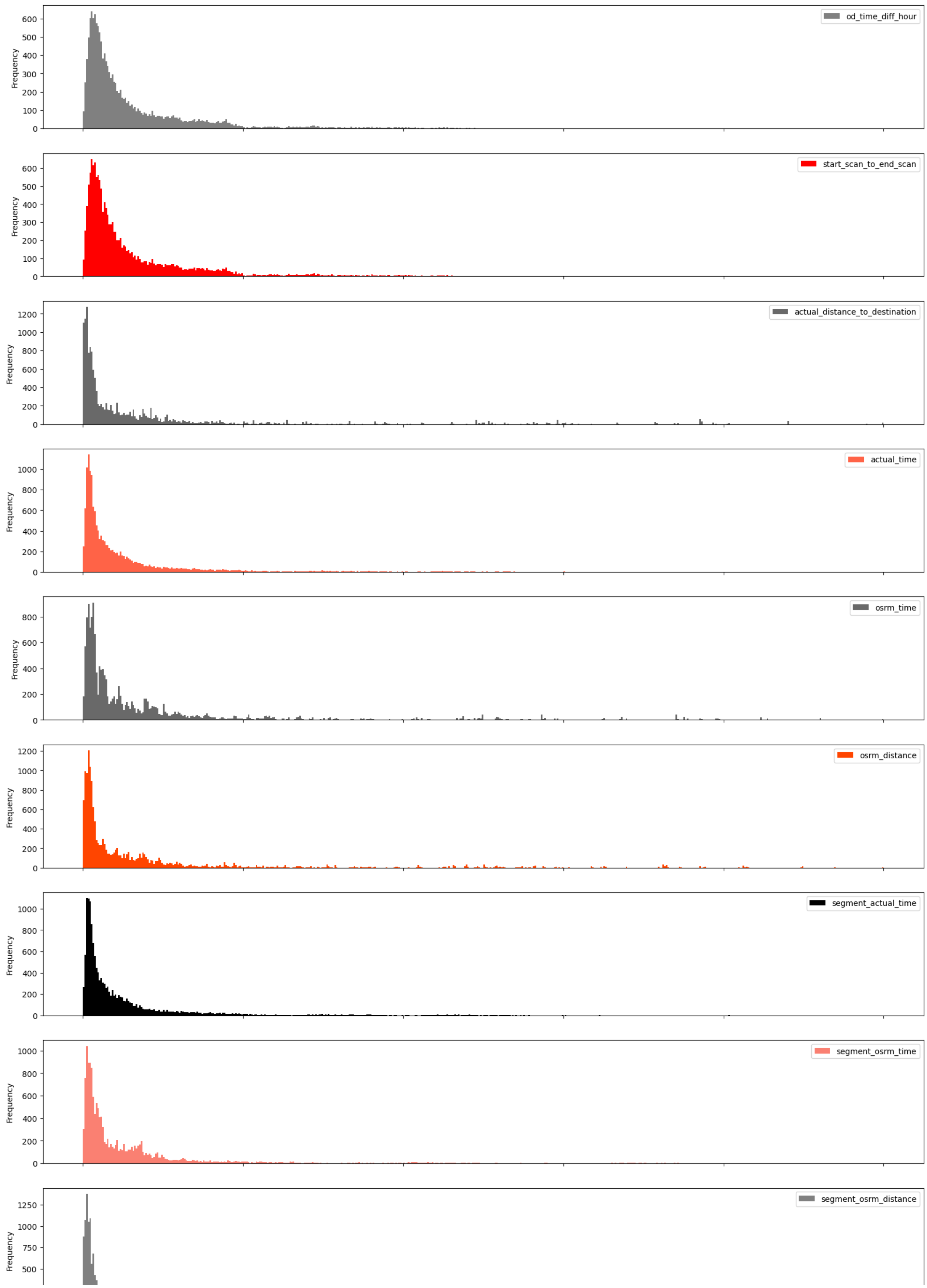
```
# Normalizing/Standardizing the numerical features using MinMaxScaler
min_max_scaler = MinMaxScaler()
min_max_scaled_numerical =
min_max_scaler.fit_transform(trip_df[num_cols])

# Converting the scaled features back to a dataframe
min_max_scaled_df = pd.DataFrame(min_max_scaled_numerical,
columns=num_cols)
min_max_scaled_df

       od_time_diff_hour  start_scan_to_end_scan  \
0               0.284016                0.283937
```

```
1              0.020082                0.019937
2              0.496617                0.496508
3              0.009782                0.009778
4              0.088239                0.088127
...                 ...                     ...
14782          0.029786                0.029714
14783          0.004715                0.004698
14784          0.050623                0.050540
14785          0.041276                0.041143
14786          0.042024                0.041905

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                            0.374613     0.248242   0.350938
0.346972
1                            0.029476     0.021419   0.030602
0.026859
2                            0.880999     0.533568   0.855874
0.828325
3                            0.003753     0.007992   0.004442
0.003747
4                            0.054395     0.053069   0.054788
0.048647
...                               ...          ...        ...
...
14782                        0.022392     0.011829   0.027641
0.022745
14783                        0.002990     0.001918   0.002962
0.002478
14784                        0.013631     0.043638   0.020731
0.017602
14785                        0.057736     0.040761   0.085390
0.057237
14786                        0.026213     0.042519   0.030602
0.025258

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
0                 0.247388           0.391712               0.373134

1                 0.021218           0.023065               0.021373

2                 0.530301           0.756450               0.721625

3                 0.008037           0.003909               0.003074

4                 0.053207           0.042611               0.039185

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

```
14782                  0.011734               0.021892                   0.015872

14783                  0.001929               0.001955                   0.001996

14784                  0.043723               0.032056                   0.027262

14785                  0.040026               0.084050                   0.061020

14786                  0.042598               0.023847                   0.020346


       segment_actual_time_sum  segment_osrm_time_sum  \
0                     0.247388               0.391712
1                     0.021218               0.023065
2                     0.530301               0.756450
3                     0.008037               0.003909
4                     0.053207               0.042611
...                        ...                    ...
14782                 0.011734               0.021892
14783                 0.001929               0.001955
14784                 0.043723               0.032056
14785                 0.040026               0.084050
14786                 0.042598               0.023847

       segment_osrm_distance_sum
0                       0.373134
1                       0.021373
2                       0.721625
3                       0.003074
4                       0.039185
...                          ...
14782                   0.015872
14783                   0.001996
14784                   0.027262
14785                   0.061020
14786                   0.020346

[14787 rows x 12 columns]
```

```
plt.figure(figsize=(14,0.05))
plt.axis('off')
plt.suptitle(f'Min-Max scaled visualization of 
num_cols',fontfamily='serif',fontweight='bold',fontsize=15,backgroundc
olor='k',color='w')
min_max_scaled_df.plot(kind='hist', 
figsize=(20,40),subplots=True,color=cp,bins=500)
plt.show()
```

Min-Max scaled visualization of num_cols



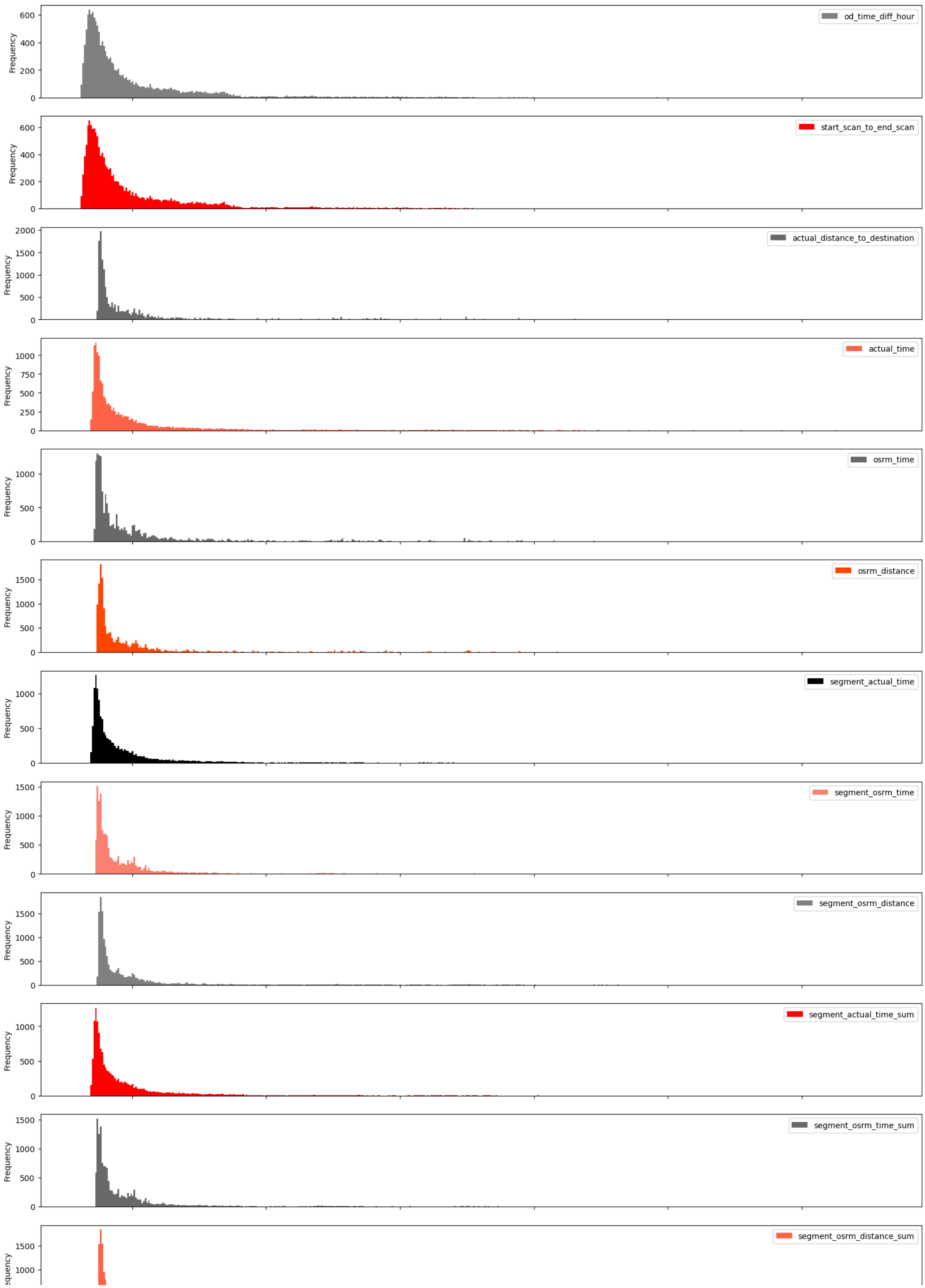
od_time_diff_hour
start_scan_to_end_scan
actual_distance_to_destination
actual_time
osrm_time
osrm_distance
segment_actual_time
segment_osrm_time
segment_osrm_distance
Frequency

```
# Just so to know ... cant do this as `data is not gaussian`
# Standardization works only with data which follows normal
distribution
# Standardizing the numerical features using StandardScaler
std_scaler = StandardScaler()
std_scaled = std_scaler.fit_transform(trip_df[num_cols])

# Converting the scaled features back to a dataframe
std_scaled_df = pd.DataFrame(std_scaled, columns=num_cols)
std_scaled_df

       od_time_diff_hour  start_scan_to_end_scan  \
0               2.625886                2.627598
1              -0.529518               -0.530859
2               5.167598                5.170772
3              -0.652664               -0.652397
4               0.285312                0.284962
...                  ...                     ...
14782          -0.413508               -0.413880
14783          -0.713243               -0.713166
14784          -0.164399               -0.164728
14785          -0.276143               -0.277150
14786          -0.267194               -0.268034

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
0                            2.162548     2.147277   2.048290
2.125107
1                           -0.297563    -0.379887  -0.342571      -
0.320538
2                            5.772034     5.326268   5.816936
5.802622
3                           -0.480911    -0.529486  -0.537818      -
0.497115
4                           -0.119943    -0.027259  -0.162059      -
0.154082
...                               ...          ...        ...
...
14782                       -0.348054    -0.486744  -0.364674      -
0.351972
14783                       -0.486350    -0.597162  -0.548870      -
0.506808
14784                       -0.410502    -0.132335  -0.416249      -
0.391263
14785                       -0.096128    -0.164392   0.066344      -
0.088455
14786                       -0.320822    -0.144802  -0.342571      -
0.332769

       segment_actual_time  segment_osrm_time
```

```
segment_osrm_distance  \
0                   2.147833          2.629714                2.633597

1                  -0.381163         -0.367090               -0.332307

2                   5.311326          5.594737                5.571936

3                  -0.528553         -0.522809               -0.486596

4                  -0.023473         -0.208192               -0.182120

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

14782              -0.487212         -0.376623               -0.378690

14783              -0.596856         -0.538699               -0.495684

14784              -0.129522         -0.293997               -0.282653

14785              -0.170863          0.128670                0.001984

14786              -0.142104         -0.360734               -0.340969


       segment_actual_time_sum  segment_osrm_time_sum  \
0                     2.147833               2.629714
1                    -0.381163              -0.367090
2                     5.311326               5.594737
3                    -0.528553              -0.522809
4                    -0.023473              -0.208192
...                        ...                    ...
14782                -0.487212              -0.376623
14783                -0.596856              -0.538699
14784                -0.129522              -0.293997
14785                -0.170863               0.128670
14786                -0.142104              -0.360734

       segment_osrm_distance_sum
0                       2.633597
1                      -0.332307
2                       5.571936
3                      -0.486596
4                      -0.182120
...                          ...
14782                  -0.378690
14783                  -0.495684
14784                  -0.282653
14785                   0.001984
14786                  -0.340969

[14787 rows x 12 columns]
```

```
plt.figure(figsize=(14,0.05))
plt.axis('off')
plt.suptitle(f'Standardized Num_cols scaled
visualization',fontfamily='serif',fontweight='bold',fontsize=15,backgr
oundcolor='r',color='w')
std_scaled_df.plot(kind='hist',
figsize=(20,30),subplots=True,color=cp,bins=500)
plt.show()
```

Standardized Num_cols scaled visualization


od_time_diff_hour
start_scan_to_end_scan
actual_distance_to_destination
actual_time
osrm_time
osrm_distance
segment_actual_time
segment_osrm_time
segment_osrm_distance
segment_actual_time_sum
segment_osrm_time_sum
segment_osrm_distance_sum
Frequency

Hypothesis Testing:

- Perform hypothesis testing / visual analysis between :

  actual_time aggregated value and OSRM time aggregated value.

  actual_time aggregated value and segment actual time aggregated value.

  OSRM distance aggregated value and segment OSRM distance aggregated value.

  OSRM time aggregated value and segment OSRM time aggregated value.

- Note: Aggregated values are the values you'll get after merging the rows on the basis of trip_uuid.

Assumptions of T-Test

1. The sample size should be less than 30.
2. The population variance is unknown.
3. The population mean and standard deviation are finite.
4. The means of the two populations being compared should follow normal distributions.
5. If using Student's original definition of the t-test, the two populations being compared should have the same variance. If the sample sizes in the two groups being compared are equal, Student's original t-test is highly robust to the presence of unequal variances.

STEP-1: Set up Null Hypothesis

Null Hypothesis (Ho) - There is no significant difference in the mean values between column1 and column2
H_o: $\mu_{col1} = \mu_{col2}$

Alternate Hypothesis (Ha) - There is a significant difference in the mean values between column1 and column2
H_a: μ_{col1} != μ_{col2}

STEP-2: Checking for basic assumpitons for the hypothesis

Normality checks

- Distribution check using **QQ Plot** & **prob Plot**
- Confirmation by **Shapiro-wilks Test**
- Confirmation by **Anderson-darling Test**
- Homogeneity of Variances using **Levene's test**

STEP-3: Define Test statistics; Distribution of T under Ho.

- We know that the test statistic while performing a T-Test follows T-distribution.

  for independent variables:

```
>>If data follows normal distribution we go with **ttest_ind**
>> Else we will go with **Mannwhitney_u test** (Non - Parametric test)
```

for dependent variables: (paired T-test)

```
>>If data follows normal distribution we go with **ttest_rel**
>>Else we will go with **Wilcoxon signed rank test** (Non - Parametric
test)
```

STEP-4: Decide the kind of test.

- We will be performing **Two tailed t-test**

STEP-5: Compute the p-value and fix value of alpha.

- we will be computing the t-stat value using the ttest function using scipy.stats.
- We set our ***alpha to be 0.05 (i.e) confidence level = 95%***

STEP-6: Compare p-value and alpha.

- Based on p-value, we will accept or reject H0.

  p-val < alpha : Reject Ho

  p-val > alpha : Accept Ho

```
# def shapiro_and_anderson(name,col):

#     print(f"Performing SHAPIRO & ANDERSON DARLING TEST for {name}
column")
#     print()
#     print('Shapiro Wilks Test')
#     shapiro_stat , p_val = shapiro(col)
#     if p_val < 0.05:
#         print(f'{name} - Data is not Gaussian')
#     else:
#         print(f'{name} - Data is Gaussian')
#     print()

#     print("As shapiro is sensitive, we go with ANDERSON DARLING
TEST")
#     result = anderson(col)
#     if result.statistic > result.critical_values[2]:
#         print(f"{name} - Data does not follow normal distribution.")
#     else:
#         print(f"{name} - Data follows normal distribution.")
#     print()
#     print('-'*50)

#     def boxcox_tranformation(name,col):
```

```
#         print(f'Performing BOXCOX transformation on {name} column')
#         transformed_data,best_lambda = boxcox(col)

    #     return " "


# class NormalCheck:
#     def __init__(self, name, col):
#         self.name = name
#         self.col = col

#     def perform_checks(self):
#         boxcox_transformation(self.name, self.col)
#         shapiro_and_anderson(self.name, self.col)

class Normality_check:
    def __init__(self, name, col):
        self.name = name
        self.col = col

    def shapiro_and_anderson(self):
        print(f"Performing SHAPIRO & ANDERSON-DARLING TEST for
{self.name} column")
        print()

        # Shapiro-Wilk Test
        print('Shapiro-Wilk Test')
        shapiro_stat, p_val = shapiro(self.col)
        if p_val < 0.05:
            print(f'{self.name} - Data is not Gaussian')
        else:
            print(f'{self.name} - Data is Gaussian')
        print()

        # Using Anderson-Darling Test
        print("Since Shapiro-Wilk test is sensitive, we go with
Anderson-Darling Test")
        result = anderson(self.col)
        if result.statistic > result.critical_values[2]:
            print(f"{self.name} - Data does not follow a normal
distribution.")
        else:
            print(f"{self.name} - Data follows a normal
distribution.")
        print()
        print('-'*50)

    def boxcox_transformation(self):
        print(f'Performing BOXCOX transformation on {self.name}
column')
```

```
        transformed_data, best_lambda = boxcox(self.col)
        self.col = transformed_data  # Update column data with
transformed data
        self.shapiro_and_anderson()  # Calling shapiro_and_anderson
method after transformation


# normality_check = NormalCheck(name, col)
# normality_check.boxcox_transformation()

def levene_test(name1,name2,col1,col2):

    levene_stat, p_value = levene(col1,col2)

    print(f'Performing Levene Test for {name1} & {name2}')

    if p_value < 0.05:
        print('Does not have Homogenous (different) Variance')
    else:
        print('Have Homogenous (similar) variance')
    print()
    print('-'*50)
    print()
    return ""

## MannWhitney u Rank test
### Test statistics : Mann-Whitney U rank test for two independent
samples

def mannwhitneyu_test(name1,name2,col1,col2):

    print(f'Performing Non-parametric Test - MannWhitneyU for {name1}
& {name2}')
    test_stat, p_value = mannwhitneyu(col1,col2)

    if p_value < 0.05:
        print("Reject Null Hypothesis")
        print(f'There is a significant difference in the Mean values
of {name1} and {name2}')
    else:
        print("Failed to Reject Null Hypothesis - Accept Ho")
        print(f'There is NO significant difference in the Mean values
of {name1} and {name2}')

    print()
    print('-'*50)
    print()

    return ""
```

```
def normality_plots(name1,name2,name3,name4,col1,col2,col3,col4):

    plt.figure(figsize = (20,10))
    plt.suptitle("Normality check - Histplot &
QQ(prob)plot",fontsize=16,fontweight="bold",backgroundcolor=cp[5],colo
r='w')

    plt.subplot(241)
    sns.histplot(col1, element = 'step', color =cp[1], kde = True,
label = name1)
    plt.title(f'Histplot -
{name1}',fontsize=10,fontweight="bold",backgroundcolor=cp[1],color='w'
)
    plt.legend()

    plt.subplot(242)
    sns.histplot(col3,element = 'step', color = cp[2], kde = True,
label = name3 )
    plt.title(f'Histplot -
{name3}',fontsize=10,fontweight="bold",backgroundcolor=cp[2],color='w'
)
    plt.legend()

    plt.subplot(243)
    probplot(col1, plot = plt, dist = 'norm')
    plt.title(f'Probplot -
{name1}',fontsize=10,fontweight="bold",backgroundcolor=cp[1],color='w'
)

    plt.subplot(244)
    probplot(col3, plot = plt, dist = 'norm')
    plt.title(f'Probplot -
{name3}',fontsize=10,fontweight="bold",backgroundcolor=cp[2],color='w'
)

    plt.subplot(245)
    sns.histplot(col2, element = 'step', color =cp[1], kde = True,
label = name2 )
    plt.title(f'Histplot -
{name2}',fontsize=10,fontweight="bold",backgroundcolor=cp[1],color='w'
)
    plt.legend()

    plt.subplot(246)
    sns.histplot(col4,element = 'step', color = cp[2], kde = True,
label = name4)
    plt.title(f'Histplot -
{name4}',fontsize=10,fontweight="bold",backgroundcolor=cp[2],color='w'
)
    plt.legend()
```

```
    plt.subplot(247)
    probplot(col2, plot = plt, dist = 'norm')
    plt.title(f'Probplot -
{name2}',fontsize=10,fontweight="bold",backgroundcolor=cp[1],color='w'
)

    plt.subplot(248)
    probplot(col4, plot = plt, dist = 'norm')
    plt.title(f'Probplot -
{name4}',fontsize=10,fontweight="bold",backgroundcolor=cp[2],color='w'
)

    sns.despine()
    plt.show()
```

Hypothesis testing - actual_time aggregated value and OSRM time aggregated value.

```
clipped_num_df.sample(3)
```

```
      od_time_diff_hour  start_scan_to_end_scan  \
4578          10.118006              543.285302
176            1.358135               81.000000
505            6.646569              398.000000

      actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
4578                      220.068207        353.0      221.0
249.271805
176                         9.083277         28.0       11.0
14.245600
505                       101.146736        259.0       98.0
130.815598

      segment_actual_time  segment_osrm_time  segment_osrm_distance  \
4578                351.0              238.0             272.674194
176                  28.0               11.0              14.245600
505                 257.0              115.0             130.997910

      segment_actual_time_sum  segment_osrm_time_sum  \
4578                    351.0                  238.0
176                      28.0                   11.0
505                     257.0                  115.0

      segment_osrm_distance_sum
4578                 272.674194
176                   14.245600
505                  130.997910
```

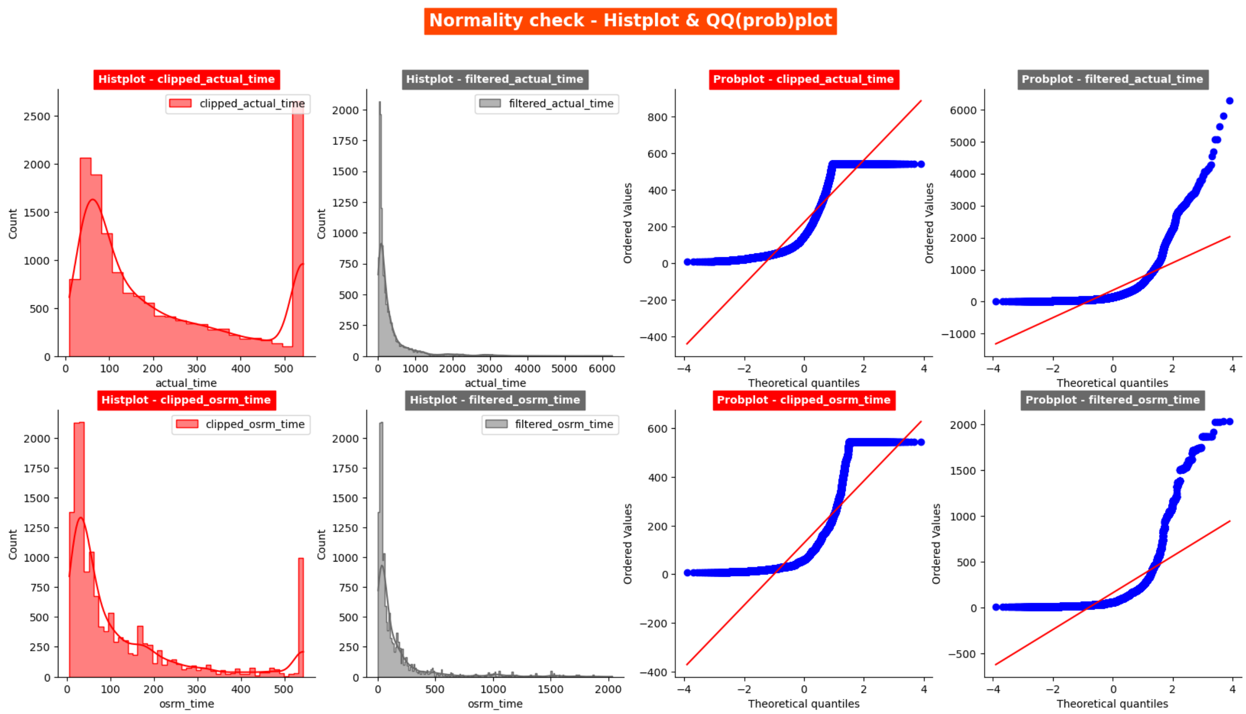
```
clipped_num_df[['actual_time','osrm_time']].describe().T
```

```
                 count        mean         std  min   25%    50%    75%  \
actual_time    14787.0  224.212577  185.922840  9.0  67.0  148.0  367.0

osrm_time      14787.0  128.190912  150.301267  6.0  29.0   60.0  168.0


                     max
actual_time   543.285302
osrm_time     543.285302
```

```
filtered_num_df[['actual_time','osrm_time']].describe().T
```

```
                 count        mean         std  min   25%    50%    75%  
max
actual_time    14787.0  356.306000  561.517761  9.0  67.0  148.0  367.0  
6265.0
osrm_time      14787.0  160.990936  271.459229  6.0  29.0   60.0  168.0  
2032.0
```

```
actual_time = clipped_num_df['actual_time']
osrm_time = clipped_num_df['osrm_time']
fil_actual_time = filtered_num_df['actual_time']
fil_osrm_time = filtered_num_df['osrm_time']

normality_plots('clipped_actual_time','clipped_osrm_time','filtered_ac
tual_time','filtered_osrm_time',actual_time,osrm_time,fil_actual_time,
fil_osrm_time)
```




```
col_names=
['clipped_actual_time','clipped_osrm_time','filtered_actual_time','fil
tered_osrm_time']
cols = [actual_time,osrm_time,fil_actual_time,fil_osrm_time]

for _ in zip(col_names,cols):
    normality = Normality_check(_[0],_[1])
    normality.shapiro_and_anderson()
    normality.boxcox_transformation()

Performing SHAPIRO & ANDERSON-DARLING TEST for clipped_actual_time
column

Shapiro-Wilk Test
clipped_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_actual_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing BOXCOX transformation on clipped_actual_time column
Performing SHAPIRO & ANDERSON-DARLING TEST for clipped_actual_time
column

Shapiro-Wilk Test
clipped_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
```

```
clipped_actual_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for clipped_osrm_time
column

Shapiro-Wilk Test
clipped_osrm_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_osrm_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing BOXCOX transformation on clipped_osrm_time column
Performing SHAPIRO & ANDERSON-DARLING TEST for clipped_osrm_time
column

Shapiro-Wilk Test
clipped_osrm_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_osrm_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for filtered_actual_time
column

Shapiro-Wilk Test
filtered_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_actual_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing BOXCOX transformation on filtered_actual_time column
Performing SHAPIRO & ANDERSON-DARLING TEST for filtered_actual_time
column

Shapiro-Wilk Test
filtered_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_actual_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for filtered_osrm_time
column

Shapiro-Wilk Test
filtered_osrm_time - Data is not Gaussian
```

```
Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_osrm_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing BOXCOX transformation on filtered_osrm_time column
Performing SHAPIRO & ANDERSON-DARLING TEST for filtered_osrm_time
column

Shapiro-Wilk Test
filtered_osrm_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_osrm_time - Data does not follow a normal distribution.

--------------------------------------------------

levene_test('clipped_actual_time','clipped_osrm_time',actual_time,osrm
_time),
levene_test('filtered_actual_time','filtered_osrm_time',fil_actual_tim
e,fil_osrm_time)

Performing Levene Test for clipped_actual_time & clipped_osrm_time
Does not have Homogenous (different) Variance

--------------------------------------------------

Performing Levene Test for filtered_actual_time & filtered_osrm_time
Does not have Homogenous (different) Variance

--------------------------------------------------


''
```

Wilcoxon signed rank test:

```
## with clipped data

# H0 : aggregated actual time is same as aggregated osrm time
# Ha : aggregated actual time is more than the aggregated osrm time

alpha = 0.05  #testing at 95% confidence

test_stat , p_value =
wilcoxon(actual_time,osrm_time,alternative='greater')

if p_value < alpha:
    print("Reject Null Hypothesis - The Aggregated Actual_time is More
than the Aggregated OSRM_time")
else:
```

```
    print("Fail to Reject Null Hypothesis - The Aggregated Actual_time
is same as the Aggregated OSRM_time")
```

```
Reject Null Hypothesis - The Aggregated Actual_time is More than the
Aggregated OSRM_time
```

```
## with filtered data

alpha = 0.05  #testing at 95% confidence

test_stat , p_value =
wilcoxon(fil_actual_time,fil_osrm_time,alternative='greater')

if p_value < alpha:
    print("Reject Null Hypothesis - The Aggregated Actual_time is More
than the Aggregated OSRM_time")
else:
    print("Fail to Reject Null Hypothesis - The Aggregated Actual_time
is same as the Aggregated OSRM_time")
```

```
Reject Null Hypothesis - The Aggregated Actual_time is More than the
Aggregated OSRM_time
```

```
### MannWhitney u Rank test

test_cols =
[('clipped_actual_time','clipped_osrm_time',actual_time,osrm_time),

('filtered_actual_time','filtered_osrm_time',fil_actual_time,fil_osrm_
time)]

for _ in test_cols:
    mannwhitneyu_test(_[0],_[1],_[2],_[3])
```

```
Performing Non-parametric Test - MannWhitneyU for clipped_actual_time
& clipped_osrm_time
Reject Null Hypothesis
There is a significant difference in the Mean values of
clipped_actual_time and clipped_osrm_time

--------------------------------------------------

Performing Non-parametric Test - MannWhitneyU for filtered_actual_time
& filtered_osrm_time
Reject Null Hypothesis
There is a significant difference in the Mean values of
filtered_actual_time and filtered_osrm_time

--------------------------------------------------
```

Insights:

It is confirmed that `There is a significant difference in the Mean values of Aggregated actual_time and Aggregated osrm_time` through ***MannwhitneyU*** test.

- $H_o: \mu_{Aggregated-actual-time} != \mu_{Aggregated-osrm-time}$

Further, it is found that `The Aggregated Actual_time is More than the Aggregated OSRM_time` through ***Wilcoxon signed Rank*** test.

- $H_o: \mu_{Aggregated-actual-time} > \mu_{Aggregated-osrm-time}$

Actual_time aggregated value and Segment actual time aggregated value.

```
clipped_num_df.sample()
```

```
       od_time_diff_hour  start_scan_to_end_scan  \
11839           4.644768                   278.0

       actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
11839                       46.165558        104.0       63.0
75.968498

       segment_actual_time  segment_osrm_time
segment_osrm_distance  \
11839                101.0               61.0                62.8657


       segment_actual_time_sum  segment_osrm_time_sum  \
11839                    101.0                   61.0

       segment_osrm_distance_sum
11839                    62.8657
```

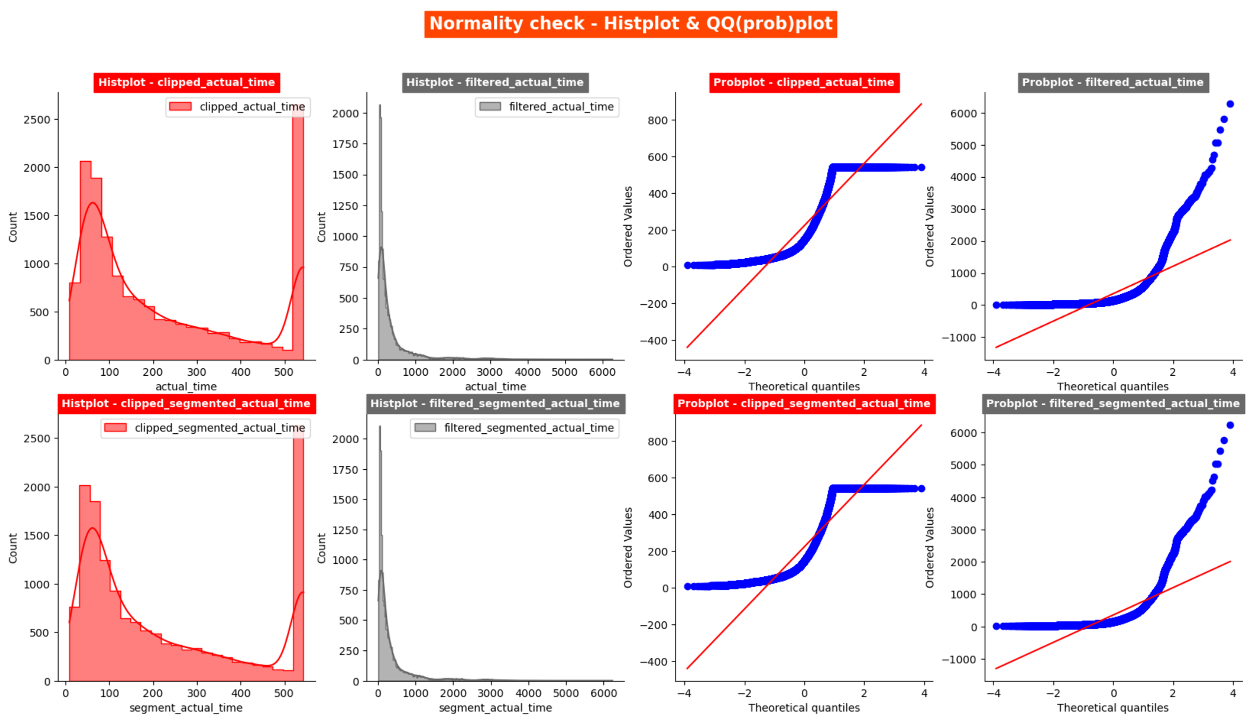
```
clipped_num_df[['actual_time','segment_actual_time']].describe().T
```

```
                       count        mean         std  min   25%    50%
75%  \
actual_time          14787.0  224.212577  185.922840  9.0  67.0  148.0
367.0
segment_actual_time  14787.0  222.904643  185.797003  9.0  66.0  147.0
364.0

                            max
actual_time          543.285302
segment_actual_time  543.285302
```

```
filtered_num_df[['actual_time','segment_actual_time']].describe().T
```

```
                         count        mean          std  min   25%    50%
75%  \
actual_time            14787.0  356.306000  561.517761  9.0  67.0  148.0
367.0
segment_actual_time    14787.0  353.059174  556.364441  9.0  66.0  147.0
364.0

                          max
actual_time            6265.0
segment_actual_time    6230.0
```

```
clipped_actual_time = clipped_num_df['actual_time']
clipped_segmented_actual_time = clipped_num_df['segment_actual_time']
filtered_actual_time = filtered_num_df['actual_time']
filtered_segmented_actual_time =
filtered_num_df['segment_actual_time']

normality_plots("clipped_actual_time","clipped_segmented_actual_time",
"filtered_actual_time","filtered_segmented_actual_time",

clipped_actual_time,clipped_segmented_actual_time,filtered_actual_time
,filtered_segmented_actual_time)
```




```
col_names=
["clipped_actual_time","clipped_segmented_actual_time","filtered_actua
l_time","filtered_segmented_actual_time"]
cols =
[clipped_actual_time,clipped_segmented_actual_time,filtered_actual_tim
```

```
e,filtered_segmented_actual_time]

for _ in zip(col_names,cols):
    normality = Normality_check(_[0],_[1])
    normality.shapiro_and_anderson()
    normality.boxcox_transformation()
```

```
Performing SHAPIRO & ANDERSON-DARLING TEST for clipped_actual_time
column

Shapiro-Wilk Test
clipped_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_actual_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing BOXCOX transformation on clipped_actual_time column
Performing SHAPIRO & ANDERSON-DARLING TEST for clipped_actual_time
column

Shapiro-Wilk Test
clipped_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_actual_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for
clipped_segmented_actual_time column

Shapiro-Wilk Test
clipped_segmented_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_segmented_actual_time - Data does not follow a normal
distribution.

--------------------------------------------------
Performing BOXCOX transformation on clipped_segmented_actual_time
column
Performing SHAPIRO & ANDERSON-DARLING TEST for
clipped_segmented_actual_time column

Shapiro-Wilk Test
clipped_segmented_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_segmented_actual_time - Data does not follow a normal
distribution.
```

```
--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for filtered_actual_time
column

Shapiro-Wilk Test
filtered_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_actual_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing BOXCOX transformation on filtered_actual_time column
Performing SHAPIRO & ANDERSON-DARLING TEST for filtered_actual_time
column

Shapiro-Wilk Test
filtered_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_actual_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for
filtered_segmented_actual_time column

Shapiro-Wilk Test
filtered_segmented_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_segmented_actual_time - Data does not follow a normal
distribution.

--------------------------------------------------
Performing BOXCOX transformation on filtered_segmented_actual_time
column
Performing SHAPIRO & ANDERSON-DARLING TEST for
filtered_segmented_actual_time column

Shapiro-Wilk Test
filtered_segmented_actual_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_segmented_actual_time - Data does not follow a normal
distribution.

--------------------------------------------------
```

```
levene_test("clipped_actual_time","clipped_segmented_actual_time",clip
ped_actual_time,clipped_segmented_actual_time),
levene_test("filtered_actual_time","filtered_segmented_actual_time",fi
ltered_actual_time,filtered_segmented_actual_time)
```

```
Performing Levene Test for clipped_actual_time &
clipped_segmented_actual_time
Have Homogenous (similar) variance

--------------------------------------------------

Performing Levene Test for filtered_actual_time &
filtered_segmented_actual_time
Have Homogenous (similar) variance

--------------------------------------------------


''

### MannWhitney u Rank test

test_cols =
[("clipped_actual_time","clipped_segmented_actual_time",clipped_actual
_time,clipped_segmented_actual_time),

("filtered_actual_time","filtered_segmented_actual_time",filtered_actu
al_time,filtered_segmented_actual_time)]

for _ in test_cols:
    mannwhitneyu_test(_[0],_[1],_[2],_[3])

Performing Non-parametric Test - MannWhitneyU for clipped_actual_time
& clipped_segmented_actual_time
Failed to Reject Null Hypothesis - Accept Ho
There is NO significant difference in the Mean values of
clipped_actual_time and clipped_segmented_actual_time

--------------------------------------------------

Performing Non-parametric Test - MannWhitneyU for filtered_actual_time
& filtered_segmented_actual_time
Failed to Reject Null Hypothesis - Accept Ho
There is NO significant difference in the Mean values of
filtered_actual_time and filtered_segmented_actual_time

--------------------------------------------------
```

Insights:

Even thought data is not gaussian , though it has similar variance (confirmed by ***Levene's*** test)

It is confirmed that `There is NO significant difference in the Mean values of Aggregated actual_time and segmented_actual_time` through ***MannWHitneyU*** test.

- H_o: $\mu_{Aggregated-actual-time} = \mu_{Segmented-actual-time}$

OSRM distance aggregated value and segment OSRM distance aggregated value.

```
filtered_num_df.sample()
```

```
      od_time_diff_hour  start_scan_to_end_scan  \
3944           5.694592                   341.0

      actual_distance_to_destination  actual_time  osrm_time
osrm_distance  \
3944                       88.352287        156.0       71.0
101.823898

      segment_actual_time  segment_osrm_time  segment_osrm_distance  \
3944                155.0               70.0             101.823898

      segment_actual_time_sum  segment_osrm_time_sum  \
3944                    155.0                   70.0

      segment_osrm_distance_sum
3944                 101.823898
```

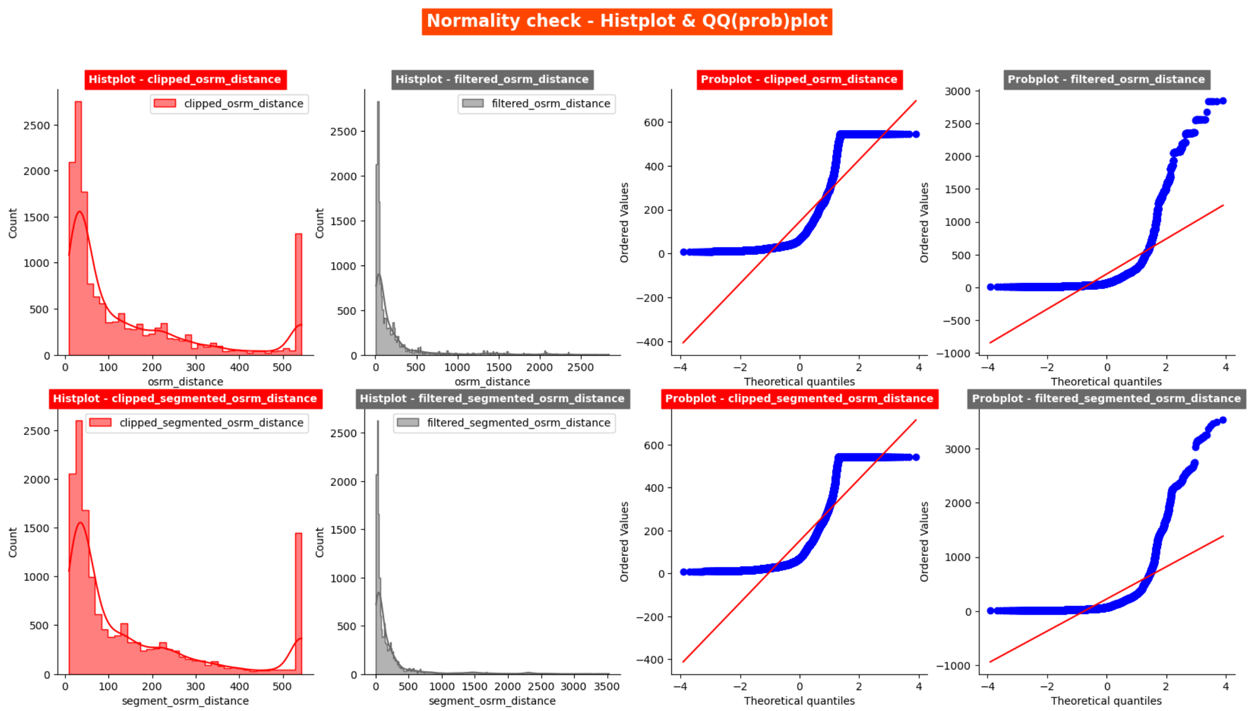
```
clipped_num_df[['osrm_distance','segment_osrm_distance']].describe().T
```

```
                         count        mean         std     min
25%  \
osrm_distance          14787.0  144.551531  162.880435  9.0729
30.75690
segment_osrm_distance  14787.0  150.959153  165.473080  9.0729
32.57885

                             50%         75%         max
osrm_distance          65.302795  206.644203  543.285302
segment_osrm_distance  69.784203  216.560608  543.285302
```

```
filtered_num_df[['osrm_distance','segment_osrm_distance']].describe().
T
```

```
                         count        mean         std     min
25%  \
osrm_distance          14787.0  203.887405  370.565460  9.0729
30.75690
segment_osrm_distance  14787.0  222.705444  416.845642  9.0729
32.57885

                             50%         75%          max
osrm_distance          65.302795  206.644203  2840.081055
segment_osrm_distance  69.784203  216.560608  3523.632324
```

```
clipped_osrm_distance = clipped_num_df['osrm_distance']
clipped_segmented_osrm_distance =
clipped_num_df['segment_osrm_distance']
filtered_osrm_distance = filtered_num_df['osrm_distance']
filtered_segmented_osrm_distance =
filtered_num_df['segment_osrm_distance']

normality_plots("clipped_osrm_distance","clipped_segmented_osrm_distan
ce","filtered_osrm_distance","filtered_segmented_osrm_distance",

clipped_osrm_distance,clipped_segmented_osrm_distance,filtered_osrm_di
stance,filtered_segmented_osrm_distance)
```




```
col_names=
["clipped_osrm_distance","clipped_segmented_osrm_distance","filtered_o
srm_distance","filtered_segmented_osrm_distance"]
cols =
[clipped_osrm_distance,clipped_segmented_osrm_distance,filtered_osrm_d
istance,filtered_segmented_osrm_distance]

for _ in zip(col_names,cols):
    normality = Normality_check(_[0],_[1])
    normality.shapiro_and_anderson()
    normality.boxcox_transformation()
```

```
Performing SHAPIRO & ANDERSON-DARLING TEST for clipped_osrm_distance
column
```

```
Shapiro-Wilk Test
clipped_osrm_distance - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_osrm_distance - Data does not follow a normal distribution.

--------------------------------------------------
Performing BOXCOX transformation on clipped_osrm_distance column
Performing SHAPIRO & ANDERSON-DARLING TEST for clipped_osrm_distance
column

Shapiro-Wilk Test
clipped_osrm_distance - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_osrm_distance - Data does not follow a normal distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for
clipped_segmented_osrm_distance column

Shapiro-Wilk Test
clipped_segmented_osrm_distance - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_segmented_osrm_distance - Data does not follow a normal
distribution.

--------------------------------------------------
Performing BOXCOX transformation on clipped_segmented_osrm_distance
column
Performing SHAPIRO & ANDERSON-DARLING TEST for
clipped_segmented_osrm_distance column

Shapiro-Wilk Test
clipped_segmented_osrm_distance - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_segmented_osrm_distance - Data does not follow a normal
distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for filtered_osrm_distance
column

Shapiro-Wilk Test
filtered_osrm_distance - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_osrm_distance - Data does not follow a normal distribution.
```

```
--------------------------------------------------
Performing BOXCOX transformation on filtered_osrm_distance column
Performing SHAPIRO & ANDERSON-DARLING TEST for filtered_osrm_distance
column

Shapiro-Wilk Test
filtered_osrm_distance - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_osrm_distance - Data does not follow a normal distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for
filtered_segmented_osrm_distance column

Shapiro-Wilk Test
filtered_segmented_osrm_distance - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_segmented_osrm_distance - Data does not follow a normal
distribution.

--------------------------------------------------
Performing BOXCOX transformation on filtered_segmented_osrm_distance
column
Performing SHAPIRO & ANDERSON-DARLING TEST for
filtered_segmented_osrm_distance column

Shapiro-Wilk Test
filtered_segmented_osrm_distance - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_segmented_osrm_distance - Data does not follow a normal
distribution.

--------------------------------------------------
```

```
levene_test("clipped_osrm_distance","clipped_segmented_osrm_distance",
clipped_osrm_distance,clipped_segmented_osrm_distance),
levene_test("filtered_osrm_distance","filtered_segmented_osrm_distance
",filtered_osrm_distance,filtered_segmented_osrm_distance)
```

```
Performing Levene Test for clipped_osrm_distance &
clipped_segmented_osrm_distance
Does not have Homogenous (different) Variance

--------------------------------------------------

Performing Levene Test for filtered_osrm_distance &
filtered_segmented_osrm_distance
Does not have Homogenous (different) Variance
```

```
--------------------------------------------------

''

### MannWhitney u Rank test

test_cols = 
[("clipped_osrm_distance","clipped_segmented_osrm_distance",clipped_osrm_distance,clipped_segmented_osrm_distance),

("filtered_osrm_distance","filtered_segmented_osrm_distance",filtered_osrm_distance,filtered_segmented_osrm_distance)]

for _ in test_cols:
    mannwhitneyu_test(_[0],_[1],_[2],_[3])

Performing Non-parametric Test - MannWhitneyU for 
clipped_osrm_distance & clipped_segmented_osrm_distance
Reject Null Hypothesis
There is a significant difference in the Mean values of 
clipped_osrm_distance and clipped_segmented_osrm_distance

--------------------------------------------------

Performing Non-parametric Test - MannWhitneyU for 
filtered_osrm_distance & filtered_segmented_osrm_distance
Reject Null Hypothesis
There is a significant difference in the Mean values of 
filtered_osrm_distance and filtered_segmented_osrm_distance

--------------------------------------------------
```

Insights:

> It is confirmed that `There is a significant difference in the Mean values of osrm_distance and segmented_osrm_distance aggregated` through ***MannwhitneyU*** test.

- $H_o: \mu_{Aggregated-osrm-distance} != \mu_{Segmented-osrm-distance-aggregated}$

OSRM time aggregated value and segment OSRM time aggregated value.

```
filtered_num_df.sample()

     od_time_diff_hour  start_scan_to_end_scan  \
113           3.763914                   225.0
```

```
     actual_distance_to_destination  actual_time  osrm_time  
osrm_distance  \
113                       45.959438        140.0       57.0  
54.921398

     segment_actual_time  segment_osrm_time  segment_osrm_distance  \
113                138.0               66.0              64.504799

     segment_actual_time_sum  segment_osrm_time_sum  
segment_osrm_distance_sum
113                    138.0                   66.0  
64.504799
```

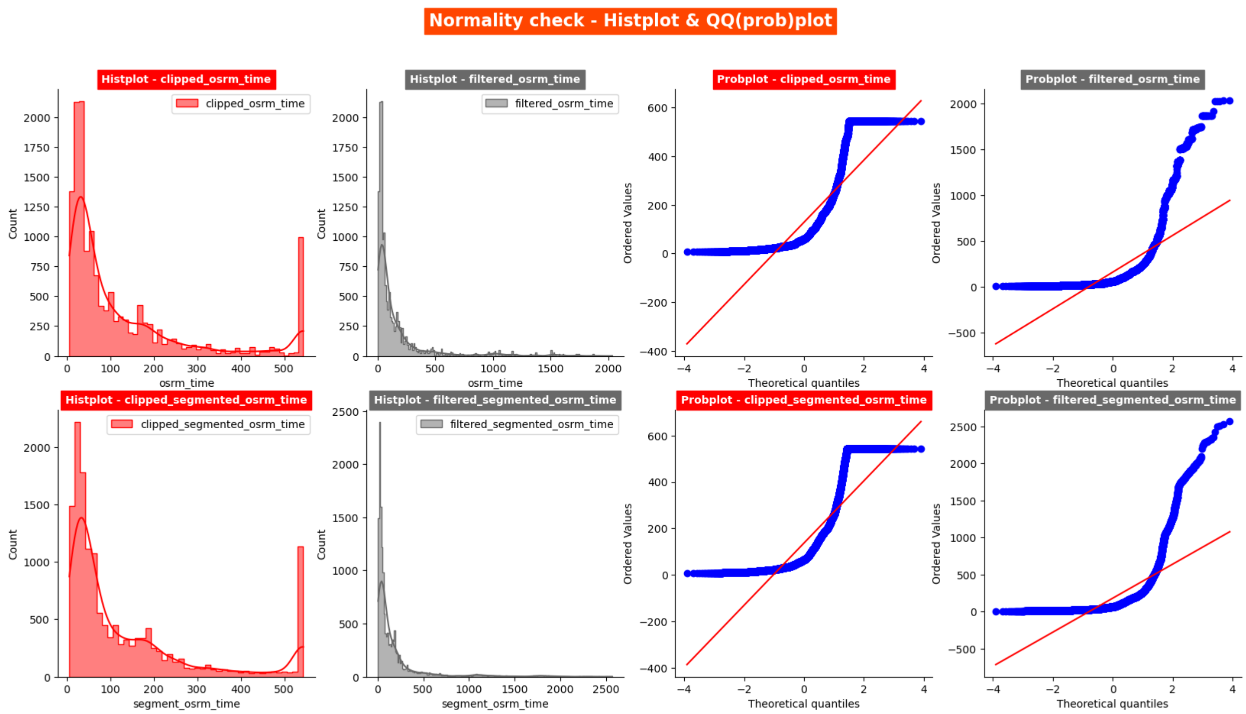
```
clipped_num_df[['osrm_time','segment_osrm_time']].describe().T
```

```
                     count        mean         std  min   25%   50%  
75%  \
osrm_time          14787.0  128.190912  150.301267  6.0  29.0  60.0  
168.0
segment_osrm_time  14787.0  136.843818  155.422255  6.0  30.0  65.0  
184.0

                          max
osrm_time          543.285302
segment_osrm_time  543.285302
```

```
filtered_num_df[['osrm_time','segment_osrm_time']].describe().T
```

```
                     count        mean         std  min   25%   50%  
75%  \
osrm_time          14787.0  160.990936  271.459229  6.0  29.0  60.0  
168.0
segment_osrm_time  14787.0  180.511597  314.678741  6.0  30.0  65.0  
184.0

                      max
osrm_time          2032.0
segment_osrm_time  2564.0
```

```
clipped_osrm_time = clipped_num_df['osrm_time']
clipped_segmented_osrm_time = clipped_num_df['segment_osrm_time']
filtered_osrm_time = filtered_num_df['osrm_time']
filtered_segmented_osrm_time = filtered_num_df['segment_osrm_time']

normality_plots("clipped_osrm_time","clipped_segmented_osrm_time","fil
tered_osrm_time","filtered_segmented_osrm_time",

clipped_osrm_time,clipped_segmented_osrm_time,filtered_osrm_time,filte
red_segmented_osrm_time)
```




```
col_names=
["clipped_osrm_time","clipped_segmented_osrm_time","filtered_osrm_time
","filtered_segmented_osrm_time"]
cols =
[clipped_osrm_time,clipped_segmented_osrm_time,filtered_osrm_time,filt
ered_segmented_osrm_time]

for _ in zip(col_names,cols):
    normality = Normality_check(_[0],_[1])
    normality.shapiro_and_anderson()
    normality.boxcox_transformation()

Performing SHAPIRO & ANDERSON-DARLING TEST for clipped_osrm_time
column

Shapiro-Wilk Test
clipped_osrm_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_osrm_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing BOXCOX transformation on clipped_osrm_time column
Performing SHAPIRO & ANDERSON-DARLING TEST for clipped_osrm_time
column

Shapiro-Wilk Test
clipped_osrm_time - Data is not Gaussian
```

```
Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_osrm_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for
clipped_segmented_osrm_time column

Shapiro-Wilk Test
clipped_segmented_osrm_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_segmented_osrm_time - Data does not follow a normal
distribution.

--------------------------------------------------
Performing BOXCOX transformation on clipped_segmented_osrm_time column
Performing SHAPIRO & ANDERSON-DARLING TEST for
clipped_segmented_osrm_time column

Shapiro-Wilk Test
clipped_segmented_osrm_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
clipped_segmented_osrm_time - Data does not follow a normal
distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for filtered_osrm_time
column

Shapiro-Wilk Test
filtered_osrm_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_osrm_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing BOXCOX transformation on filtered_osrm_time column
Performing SHAPIRO & ANDERSON-DARLING TEST for filtered_osrm_time
column

Shapiro-Wilk Test
filtered_osrm_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_osrm_time - Data does not follow a normal distribution.

--------------------------------------------------
Performing SHAPIRO & ANDERSON-DARLING TEST for
filtered_segmented_osrm_time column
```

```
Shapiro-Wilk Test
filtered_segmented_osrm_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_segmented_osrm_time - Data does not follow a normal
distribution.

--------------------------------------------------
Performing BOXCOX transformation on filtered_segmented_osrm_time
column
Performing SHAPIRO & ANDERSON-DARLING TEST for
filtered_segmented_osrm_time column

Shapiro-Wilk Test
filtered_segmented_osrm_time - Data is not Gaussian

Since Shapiro-Wilk test is sensitive, we go with Anderson-Darling Test
filtered_segmented_osrm_time - Data does not follow a normal
distribution.

--------------------------------------------------
```

```
levene_test("clipped_osrm_time","clipped_segmented_osrm_time",clipped_
osrm_time,clipped_segmented_osrm_time),
levene_test("filtered_osrm_time","filtered_segmented_osrm_time",filter
ed_osrm_time,filtered_segmented_osrm_time)
```

```
Performing Levene Test for clipped_osrm_time &
clipped_segmented_osrm_time
Does not have Homogenous (different) Variance

--------------------------------------------------

Performing Levene Test for filtered_osrm_time &
filtered_segmented_osrm_time
Does not have Homogenous (different) Variance

--------------------------------------------------


''
```

```
### MannWhitney u Rank test

test_cols =
[("clipped_osrm_time","clipped_segmented_osrm_time",clipped_osrm_time,
clipped_segmented_osrm_time),

("filtered_osrm_time","filtered_segmented_osrm_time",filtered_osrm_tim
e,filtered_segmented_osrm_time)]
```

```
for _ in test_cols:
    mannwhitneyu_test(_[0],_[1],_[2],_[3])
```

```
Performing Non-parametric Test - MannWhitneyU for clipped_osrm_time &
clipped_segmented_osrm_time
Reject Null Hypothesis
There is a significant difference in the Mean values of
clipped_osrm_time and clipped_segmented_osrm_time

--------------------------------------------------

Performing Non-parametric Test - MannWhitneyU for filtered_osrm_time &
filtered_segmented_osrm_time
Reject Null Hypothesis
There is a significant difference in the Mean values of
filtered_osrm_time and filtered_segmented_osrm_time

--------------------------------------------------
```

Insights:

It is confirmed that `There is a significant difference in the Mean values of Aggregated osrm_time and segmented_osrm_time aggregated` through ***MannwhitneyU*** test.

- $H_o: \mu_{Aggregated-osrm-time} != \mu_{Segmented-osrm-time-aggregated}$

```
trip_df.sample()
```

```
                    trip_uuid      data route_type
od_start_time  \
8533  trip-153774183943645102  training    Carting 2018-09-24
00:46:07.807847

                    od_end_time  od_time_diff_hour
trip_creation_time  \
8533 2018-09-24 07:32:00.833381            9.02261 2018-09-23
22:30:39.436721

      trip_creation_month  trip_creation_year  trip_creation_day  \
8533                    9                2018                 23

      trip_creation_hour  trip_creation_weekday  trip_creation_week  \
8533                  22                      6                  38

      start_scan_to_end_scan  actual_distance_to_destination
actual_time  \
8533                   540.0                       110.157166
```

```
268.0

      osrm_time  osrm_distance  segment_actual_time  segment_osrm_time
\
8533      132.0     168.731094                265.0              153.0


      segment_osrm_distance  segment_actual_time_sum
segment_osrm_time_sum  \
8533             195.579712                    265.0
153.0

      segment_osrm_distance_sum                   source_name
source_city  \
8533                 195.579712  Bagnan_Harop_D (West Bengal)
Bagnan

     source_state source_place
destination_name  \
8533  West Bengal      Harop_D  Kolaghat_Central_DPP_2 (West Bengal)


     destination_city destination_state destination_place  \
8533         Kolaghat       West Bengal     Central_DPP_2

                                                         corridor  \
8533  Bagnan_Harop_D (West Bengal) <---> Kolaghat_Ce...

                                             state_corridor  \
8533  West Bengal--Bagnan <---> West Bengal--Kolaghat

                                            city_corridor
trip_creation_day_week  \
8533  Bagnan--Harop_D <---> Kolaghat--Central_DPP_2
Sunday

      trip_creation_dayofdate
8533                        23

# To find the busiest corridor, we'll look at the most common
combinations of source and destination states
corridor_counts = trip_df.groupby(['source_state',
'destination_state']).size().reset_index(name='count')
busiest_corridor = corridor_counts.sort_values(by='count',
ascending=False).head(1)

# Average distance and time taken for the busiest corridor
busiest_corridor_details = busiest_corridor.merge(trip_df,
on=['source_state', 'destination_state'])
average_distance =
busiest_corridor_details['actual_distance_to_destination'].mean()
```

```
average_time = busiest_corridor_details['od_time_diff_hour'].mean()

print("Busiest corridor:  ")
display(busiest_corridor)
print("Average distance:  ",average_distance)
print("Average time (in hours):  ",average_time)
```

```
Busiest corridor:

   source_state destination_state  count
85  Maharashtra       Maharashtra   2458

Average distance:   74.852844
Average time (in hours):   5.346577921457034
```

Buisness Insights

Based on EDA:

- The Timeframe of the data is '2018-09-12' to '2018-10-08' i.e(26 days).
- 88% of the trips are from October Month & remaining are from November
- The entire data is heavily right skewed
- Almost all the features are heavy positively correleated with each other & which is intutive as well.
- Start & End dates of the months have less percent of trips compare to mid of the month. Though the difference is not huge
- Thats very strange to see that there is absolutely no trip from 4th- 11th day of the month
- Most orders come mid-month. That means customers usually make more orders in the mid of the month.

Route type:

- The analysis reveals that a higher proportion of shipments are routed through Full Truck Load (FTL) as opposed to carting. This has important implications for the efficiency and speed of the delivery process.

Geographical Focus:

Understanding the busiest routes and distances can help in optimizing logistics operations, improving transportation efficiency, and potentially reducing costs.

- **State:** The states of Haryana, Maharashtra, and Karnataka are not only busy source states but also emerge as the busiest source states, indicating a high demand or significant business activities originating from these regions.

- **source city:** Gurgaon, Bangalore, and Bhiwandi are identified as the busiest source cities, suggesting that these cities play a crucial role in contributing to the overall business operations or transportation activities.

- **Destination city:** Gurgaon, Bangalore, and Hyderabad are identified as the busiest destination cities, underscoring their significance in terms of business activities or population movement.
- **Busiest corridor:** Overall, the busiest corridor is Mumbai_Maharashtra and Bangalore_Karnataka which has the maximum trips.
  - Average distance: 74.852844 kms
  - Average time (in hours): 5.346577921457034

Delivery Time & Distance Accuracy:

OSRM Time vs. Actual Time:

- The difference between the mean values of estimated delivery time and actual delivery time suggests that there may be variations or delays in the actual delivery process compared to the initial estimates.
- The fact that the mean of OSRM time is less than the mean of actual delivery time indicates that the estimated times provided by the OSRM (Open Source Routing Machine) service tend to be optimistic.

OSRM Distance vs. Actual Distance:

- The mean of OSRM distance being greater than the mean of actual distance to the destination suggests that the OSRM might overestimate the distances. This could impact route planning and fuel efficiency calculations.

Segment-wise time Analysis:

- The equality in the mean values of actual time and segment actual time suggests that the time measurements are consistent across different segments of the delivery process

Segment-wise distance Analysis:

- The mean of segment OSRM distance being greater than the mean of OSRM distance implies that the OSRM might provide more conservative estimates for distance within individual segments.

Further look into :

- As its depicted from the analysis that there is absolutely no trip from 4th- 11th day of the month, The reason for that can be figured out and catered to receive the orders in the these dates as well.
- More ways to promote FTL route handling system can be implemented to increase this percentage

---

Business Recommendations

Route Optimization:

- Given that the busiest state route is within Karnataka, it might be beneficial to optimize the transportation network within Karnataka to improve efficiency and reduce congestion. Consider implementing route optimization algorithms and real-time traffic monitoring to enhance the transportation system.
- Since Gurgaon and Bangalore are identified as the busiest source and destination cities, respectively, focus on city-specific strategies to manage the high traffic volume.

Operational Efficiency:

- Since mean of OSRM time is less than the mean of actual delivery time, Businesses could use this insight to set more realistic delivery time expectations for customers.
- Since the mean of OSRM distance greater than the mean of actual distance, Businesses should consider adjusting their distance estimations for more accurate logistics planning.
- Since the mean of segment OSRM distance greater than the mean of OSRM distance, along with this, we have the actual distance travelled, Businesses can use this information to fine-tune their route planning and optimize segment-specific logistics.
- Implement advanced demand forecasting techniques to anticipate peak travel times and adjust transportation services accordingly. This proactive approach can help in better resource allocation and minimize the impact of congestion during peak hours.
- Overall, the analysis hints at potential areas for operational improvement. Businesses could focus on refining their route planning algorithms, addressing discrepancies in estimated times and distances, and streamlining processes between different stages of delivery to enhance overall operational efficiency.

Customer Satisfaction:

- Improving accuracy in estimated delivery times and distances can contribute to increased customer satisfaction.
- FTL shipments: Faster delivery times, facilitated by a higher proportion of FTL shipments, can directly impact customer satisfaction. Customers typically value timely deliveries, and this strategic choice aligns with meeting or exceeding customer expectations in terms of shipment speed.

Customer profiling:

- Customer profiling of the customers belonging to the states Maharashtra, Karnataka, Haryana, Tamil Nadu and Uttar Pradesh has to be done to get to know why major orders are coming from these atates and to improve customers' buying and delivery experience.

Cost Optimization:

- Understanding the differences in estimated and actual times and distances can aid in cost optimization efforts.
- Fine-tuning logistics planning based on more accurate measurements can lead to better resource allocation and potentially reduce operational costs.

Strategic Decision-making:

- The preference for FTL over carting reflects a strategic decision by the logistics management.
- Understanding the reasons behind this choice and continuously evaluating its impact can guide future decision-making processes and help adapt to evolving business needs.

Collaboration with Stakeholders:

- Collaborate with relevant stakeholders, including government authorities, transportation companies, and local communities, to develop and implement comprehensive strategies for managing and optimizing transportation in the identified busy corridors and cities.