In [1]:
```
import pandas as pd
import numpy as np
from scipy import stats
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.api as sm
from matplotlib import pyplot
import pylab as py

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

In [2]:
```
# Converting the txt file to csv file

df = pd.read_csv(r'delhivery_data.txt')
df.to_csv (r'delhivery.csv', index=None)
```

In [3]:
```
df.head()
```

Out[3]:

	data	trip_creation_time	route_schedule_uuid	route_type	trip_uuid	source_cent
0	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388121AA
1	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388121AA
2	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388121AA
3	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388121AA
4	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388121AA

5 rows × 24 columns

In [4]:
```
df.shape
```

Out[4]:
```
(144867, 24)
```

In [5]:
```
df.columns
```

Out[5]:
```
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')
```

In [6]:
```
df.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
```

1> Basic data cleaning and exploration:

a. Handle missing values in the data.
b. Analyze the structure of the data.
c. Try merging the rows using the hint mentioned above.

1.a. Analyze the structure of the data.

In [7]:
```
# Count the number of null values in each columns

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

Out[7]:
```
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
```

Inference: You can observe that source_name & destination_name has 293 & 261 null values respectively.

In [8]:
```
df.describe()
```

Out[8]:

	start_scan_to_end_scan	cutoff_factor	actual_distance_to_destination	actual_time	os
count	144867.000000	144867.000000	144867.000000	144867.000000	14486
mean	961.262986	232.926567	234.073372	416.927527	21
std	1037.012769	344.755577	344.990009	598.103621	30
min	20.000000	9.000000	9.000045	9.000000	
25%	161.000000	22.000000	23.355874	51.000000	2
50%	449.000000	66.000000	66.126571	132.000000	6
75%	1634.000000	286.000000	286.708875	513.000000	25
max	7898.000000	1927.000000	1927.447705	4532.000000	168

Inference: You can observe the mean and median in each column, very column has a huge difference in median and mean. That means, there are lot of outliers in every columns.

In [9]:
```
from numpy import NaN, NAN, nan

pd.isnull(nan)
```

Out[9]:
```
True
```

In [10]:
```
df['source_name'].value_counts(dropna = False)
```

Out[10]:
```
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
                                         ...
Shahjhnpur_NavdaCln_D (Uttar Pradesh)        1
Soro_UttarDPP_D (Orissa)                     1
Kayamkulam_Bhrnikvu_D (Kerala)               1
Krishnanagar_AnadiDPP_D (West Bengal)        1
Faridabad_Old (Haryana)                      1
Name: source_name, Length: 1499, dtype: int64
```

In [11]:
```
u = df['source_name'].unique()
u
```

Out[11]:
```
array(['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)'], dtype=object)
```

In [12]:
```
len(u)
```

Out[12]:
```
1499
```

In [13]:
```
df['source_name'].nunique(dropna=False)
```

Out[13]:
```
1499
```

In [14]:
```
df['data'].value_counts()
```

Out[14]:
```
training    104858
test         40009
Name: data, dtype: int64
```

In [15]:
```
df.columns
```

Out[15]:
```
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')
```

In [16]:
```
df
```

Out[16]:

	data	trip_creation_time	route_schedule_uuid	route_type	trip_uuid	source
0	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388
1	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388
2	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388
3	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388
4	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388
...	...	...	...	...	...	
144862	training	2018-09-20 16:24:28.436231	thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...	Carting	trip-153746066843555182	IND131
144863	training	2018-09-20 16:24:28.436231	thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...	Carting	trip-153746066843555182	IND131
144864	training	2018-09-20 16:24:28.436231	thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...	Carting	trip-153746066843555182	IND131
144865	training	2018-09-20 16:24:28.436231	thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...	Carting	trip-153746066843555182	IND131
144866	training	2018-09-20 16:24:28.436231	thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...	Carting	trip-153746066843555182	IND131

144867 rows × 24 columns

1.b. Handle missing values in the data.

In [17]:
```
# For this problem, I feel forward filling is the right choice.

df = df.fillna(method='ffill')
df.head()
```

Out[17]:

	data	trip_creation_time	route_schedule_uuid	route_type	trip_uuid	source_cent
0	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388121AA
1	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388121AA
2	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388121AA
3	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388121AA
4	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND388121AA

5 rows × 24 columns

In [18]:
```
df.tail()
```

Out[18]:

	data	trip_creation_time	route_schedule_uuid	route_type	trip_uuid	source
144862	training	2018-09-20 16:24:28.436231	thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...	Carting	trip-153746066843555182	IND131(
144863	training	2018-09-20 16:24:28.436231	thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...	Carting	trip-153746066843555182	IND131(
144864	training	2018-09-20 16:24:28.436231	thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...	Carting	trip-153746066843555182	IND131(
144865	training	2018-09-20 16:24:28.436231	thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...	Carting	trip-153746066843555182	IND131(
144866	training	2018-09-20 16:24:28.436231	thanos::sroute:f0569d2f-4e20-4c31-8542-67b86d5...	Carting	trip-153746066843555182	IND131(

5 rows × 24 columns

In [19]:
```
df.isna().sum()
```

Out[19]:
```
data                                0
trip_creation_time                  0
route_schedule_uuid                 0
route_type                          0
trip_uuid                           0
source_center                       0
source_name                         0
destination_center                  0
destination_name                    0
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
```

Inference: Now you can see that there are no null values in any of the columns.

1.c. Try merging the rows using the hint mentioned above.

In [20]:
```
# Cummulative variables: actual_time, osrm_time, osrm_distance

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

segment_cols = ['segment_actual_time', 'segment_osrm_time', 'segment_osrm_distanc

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

df[[col+'_sum' for col in segment_cols]]
```

Out[20]:

	segment_actual_time_sum	segment_osrm_time_sum	segment_osrm_distance_sum
0	14.0	11.0	11.9653
1	24.0	20.0	21.7243
2	40.0	27.0	32.5395
3	61.0	39.0	45.5619
4	67.0	44.0	49.4772
...	...	...	...
144862	92.0	94.0	65.3487
144863	118.0	115.0	82.7212
144864	138.0	149.0	103.4265
144865	155.0	176.0	122.3150
144866	423.0	185.0	131.1238

144867 rows × 3 columns

In [21]:
```
create_segment_dict = {

    'data' : 'first',
    'trip_creation_time' : 'first',
    'route_schedule_uuid' : 'first',
    'route_type' : 'first',
    'trip_uuid' : 'first',

    'source_center' : 'first',
    'source_name' : 'first',

    'destination_center' : 'last',
    'destination_name' : 'last',

    'od_start_time': 'first',
    'od_end_time': 'first',
    'start_scan_to_end_scan': 'first',

    'actual_distance_to_destination': 'last',
    'actual_time': 'last',

    'osrm_time': 'last',
    'osrm_distance': 'last',

    'segment_actual_time_sum': 'last',
    'segment_osrm_time_sum': 'last',
    'segment_osrm_distance_sum': 'last'

}
```

In [22]:
```
segment = df.groupby('segment_key').agg(create_segment_dict).reset_index()
segment = segment.sort_values(by=['segment_key','od_end_time'], ascending=True).r
```

In [23]:
```
segment
```

Out[23]:

	index	segment_key	data	trip_creation_time	route_
0	0	trip-153671041653548748IND209304AAAIND000000ACB	training	2018-09-12 00:00:16.535741	thanos::s
1	1	trip-153671041653548748IND462022AAAIND209304AAA	training	2018-09-12 00:00:16.535741	thanos::s
2	2	trip-153671042288605164IND561203AABIND562101AAA	training	2018-09-12 00:00:22.886430	thanos::s
3	3	trip-153671042288605164IND572101AAAIND561203AAB	training	2018-09-12 00:00:22.886430	thanos::s
4	4	trip-153671043369099517IND000000ACBIND160002AAC	training	2018-09-12 00:00:33.691250	thanos::s
...	...	...	...	...	
26363	26363	trip-153861115439069069IND628204AAAIND627657AAA	test	2018-10-03 23:59:14.390954	thanos::s
26364	26364	trip-153861115439069069IND628613AAAIND627005AAA	test	2018-10-03 23:59:14.390954	thanos::s
26365	26365	trip-153861115439069069IND628801AAAIND628204AAA	test	2018-10-03 23:59:14.390954	thanos::s
26366	26366	trip-153861118270144424IND583119AAAIND583101AAA	test	2018-10-03 23:59:42.701692	thanos::s
26367	26367	trip-153861118270144424IND583201AAAIND583119AAA	test	2018-10-03 23:59:42.701692	thanos::s

26368 rows × 21 columns

In [24]:
```
segment[segment['trip_uuid'] == 'trip-153741093647649320']
```

Out[24]:

	index	segment_key	data	trip_creation_time	route_s
10374	10374	trip-153741093647649320IND388121AAAIND388620AAB	training	2018-09-20 02:35:36.476840	thanos::sı b3
10375	10375	trip-153741093647649320IND388620AABIND388320AAA	training	2018-09-20 02:35:36.476840	thanos::sı b3

2 rows × 21 columns

In [25]:
```
segment.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 26368 entries, 0 to 26367
Data columns (total 21 columns):
 #   Column                          Non-Null Count  Dtype  
---  ------                          --------------  -----  
 0   index                           26368 non-null  int64  
 1   segment_key                     26368 non-null  object 
 2   data                            26368 non-null  object 
 3   trip_creation_time              26368 non-null  object 
 4   route_schedule_uuid             26368 non-null  object 
 5   route_type                      26368 non-null  object 
 6   trip_uuid                       26368 non-null  object 
 7   source_center                   26368 non-null  object 
 8   source_name                     26368 non-null  object 
 9   destination_center              26368 non-null  object 
 10  destination_name                26368 non-null  object 
 11  od_start_time                   26368 non-null  object 
 12  od_end_time                     26368 non-null  object 
 13  start_scan_to_end_scan          26368 non-null  float64
 14  actual_distance_to_destination  26368 non-null  float64
 15  actual_time                     26368 non-null  float64
 16  osrm_time                       26368 non-null  float64
 17  osrm_distance                   26368 non-null  float64
 18  segment_actual_time_sum         26368 non-null  float64
 19  segment_osrm_time_sum           26368 non-null  float64
 20  segment_osrm_distance_sum       26368 non-null  float64
dtypes: float64(8), int64(1), object(12)
memory usage: 4.2+ MB
```

In [26]:
```
create_trip_dict = {

    'data' : 'first',
    'trip_creation_time' : 'first',
    'route_schedule_uuid' : 'first',
    'route_type' : 'first',
    'trip_uuid' : 'first',

    'source_center' : 'first',
    'source_name' : 'first',

    'destination_center' : 'last',
    'destination_name' : 'last',

    'od_start_time': 'sum',
    'od_end_time': 'sum',
    'start_scan_to_end_scan': 'sum',

    'actual_distance_to_destination': 'sum',
    'actual_time': 'sum',

    'osrm_time': 'sum',
    'osrm_distance': 'sum',

    'segment_actual_time_sum': 'sum',
    'segment_osrm_time_sum': 'sum',
    'segment_osrm_distance_sum': 'sum'

}
```

In [27]:
```
trip = df.groupby('trip_uuid').agg(create_trip_dict).reset_index(drop=True)
trip
```

Out[27]:

	data	trip_creation_time	route_schedule_uuid	route_type	trip_uuid	source
0	training	2018-09-12 00:00:16.535741	thanos::sroute:d7c989ba-a29b-4a0b-b2f4-288cdc6...	FTL	trip-153671041653548748	IND462
1	training	2018-09-12 00:00:22.886430	thanos::sroute:3a1b0ab2-bb0b-4c53-8c59-eb2a2c0...	Carting	trip-153671042288605164	IND572
2	training	2018-09-12 00:00:33.691250	thanos::sroute:de5e208e-7641-45e6-8100-4d9fb1e...	FTL	trip-153671043369099517	IND562
3	training	2018-09-12 00:01:00.113710	thanos::sroute:f0176492-a679-4597-8332-bbd1c7f...	Carting	trip-153671046011330457	IND400
4	training	2018-09-12 00:02:09.740725	thanos::sroute:d9f07b12-65e0-4f3b-bec8-df06134...	FTL	trip-153671052974046625	IND583
...	...	...	...	...	...	
14812	test	2018-10-03 23:55:56.258533	thanos::sroute:8a120994-f577-4491-9e4b-b7e4a14...	Carting	trip-153861095625827784	IND160
14813	test	2018-10-03 23:57:23.863155	thanos::sroute:b30e1ec3-3bfa-4bd2-a7fb-3b75769...	Carting	trip-153861104386292051	IND121
14814	test	2018-10-03 23:57:44.429324	thanos::sroute:5609c268-e436-4e0a-8180-3db4a74...	Carting	trip-153861106442901555	IND209
14815	test	2018-10-03 23:59:14.390954	thanos::sroute:c5f2ba2c-8486-4940-8af6-d1d2a6a...	Carting	trip-153861115439069069	IND627
14816	test	2018-10-03 23:59:42.701692	thanos::sroute:412fea14-6d1f-4222-8a5f-a517042...	FTL	trip-153861118270144424	IND583

14817 rows × 19 columns

In [28]:
```
trip[trip['trip_uuid'] == 'trip-153741093647649320']
```

Out[28]:

	data	trip_creation_time	route_schedule_uuid	route_type	trip_uuid	source_c
5919	training	2018-09-20 02:35:36.476840	thanos::sroute:eb7bfc78-b351-4c0e-a951-fa3d5c3...	Carting	trip-153741093647649320	IND38812

In [29]:
```
trip[['actual_distance_to_destination', 'osrm_distance']]
```

Out[29]:

	actual_distance_to_destination	osrm_distance
0	8860.812105	10577.7647
1	240.208306	269.4308
2	68163.502238	89447.2488
3	28.529648	31.6475
4	239.007304	266.2914
...	...	...
14812	141.057373	162.9473
14813	25.130640	26.5333
14814	93.743842	162.8499
14815	355.281673	449.5383
14816	110.239116	127.8020

14817 rows × 2 columns

Recommendation: OSRM is predicting wrong distance. We can tell the team to work on OSRM machine.

In [ ]:
```
```

2> Build some features to prepare the data for actual analysis. Extract features from the below fields:

```
a. Destination Name: Split and extract features out of destination. City
-place-code (State)
b. Source Name: Split and extract features out of destination. City-plac
e-code (State)
c. Trip_creation_time: Extract features like month, year and day etc
```

2.a. Destination Name: Split and extract features out of destination. City-place-code (State)

2.b. Source Name: Split and extract features out of destination. City-place-code (State)

In [30]:
```
def city(a):
    m = a.split("_")
    try:
        return m[0]
    except:
        return ' '

def place(b):
    n = b.split("_")
    try:
        return n[1]
    except:
        return ' '
def code(c):
    o = c.split("_")
    try:
        return o[2]
    except:
        return o[-1]
```

In [31]:
```
trip['des_city'] = trip['destination_name'].apply(city)
trip['des_place'] = trip['destination_name'].apply(place)
trip['des_code'] = trip['destination_name'].apply(code)
trip['sor_city'] = trip['source_name'].apply(city)
trip['sor_place'] = trip['source_name'].apply(place)
trip['sor_code'] = trip['source_name'].apply(code)
```

In [32]:
```
trip.head()
```

Out[32]:

	data	trip_creation_time	route_schedule_uuid	route_type	trip_uuid	source_cen
0	training	2018-09-12 00:00:16.535741	thanos::sroute:d7c989ba-a29b-4a0b-b2f4-288cdc6...	FTL	trip-153671041653548748	IND462022A
1	training	2018-09-12 00:00:22.886430	thanos::sroute:3a1b0ab2-bb0b-4c53-8c59-eb2a2c0...	Carting	trip-153671042288605164	IND572101A
2	training	2018-09-12 00:00:33.691250	thanos::sroute:de5e208e-7641-45e6-8100-4d9fb1e...	FTL	trip-153671043369099517	IND562132A
3	training	2018-09-12 00:01:00.113710	thanos::sroute:f0176492-a679-4597-8332-bbd1c7f...	Carting	trip-153671046011330457	IND400072A
4	training	2018-09-12 00:02:09.740725	thanos::sroute:d9f07b12-65e0-4f3b-bec8-df06134...	FTL	trip-153671052974046625	IND583101A

5 rows × 25 columns

2.c. Trip_creation_time: Extract features like month, year and day etc

In [33]:
```
trip.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14817 entries, 0 to 14816
Data columns (total 25 columns):
 #   Column                          Non-Null Count  Dtype  
---  ------                          --------------  -----  
 0   data                            14817 non-null  object 
 1   trip_creation_time              14817 non-null  object 
 2   route_schedule_uuid             14817 non-null  object 
 3   route_type                      14817 non-null  object 
 4   trip_uuid                       14817 non-null  object 
 5   source_center                   14817 non-null  object 
 6   source_name                     14817 non-null  object 
 7   destination_center              14817 non-null  object 
 8   destination_name                14817 non-null  object 
 9   od_start_time                   14817 non-null  object 
 10  od_end_time                     14817 non-null  object 
 11  start_scan_to_end_scan          14817 non-null  float64
 12  actual_distance_to_destination  14817 non-null  float64
 13  actual_time                     14817 non-null  float64
 14  osrm_time                       14817 non-null  float64
 15  osrm_distance                   14817 non-null  float64
 16  segment_actual_time_sum         14817 non-null  float64
 17  segment_osrm_time_sum           14817 non-null  float64
 18  segment_osrm_distance_sum       14817 non-null  float64
 19  des_city                        14817 non-null  object 
 20  des_place                       14817 non-null  object 
 21  des_code                        14817 non-null  object 
 22  sor_city                        14817 non-null  object 
 23  sor_place                       14817 non-null  object 
 24  sor_code                        14817 non-null  object 
dtypes: float64(8), object(17)
memory usage: 2.8+ MB
```

In [34]:
```
# Above you can observe that 'trip_creation_time' is 'object' datatype. Lets conv

trip['trip_creation_time'] = pd.to_datetime(trip['trip_creation_time'])
trip.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14817 entries, 0 to 14816
Data columns (total 25 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   data                            14817 non-null  object
 1   trip_creation_time              14817 non-null  datetime64[ns]
 2   route_schedule_uuid             14817 non-null  object
 3   route_type                      14817 non-null  object
 4   trip_uuid                       14817 non-null  object
 5   source_center                   14817 non-null  object
 6   source_name                     14817 non-null  object
 7   destination_center              14817 non-null  object
 8   destination_name                14817 non-null  object
 9   od_start_time                   14817 non-null  object
 10  od_end_time                     14817 non-null  object
 11  start_scan_to_end_scan          14817 non-null  float64
 12  actual_distance_to_destination  14817 non-null  float64
 13  actual_time                     14817 non-null  float64
 14  osrm_time                       14817 non-null  float64
 15  osrm_distance                   14817 non-null  float64
 16  segment_actual_time_sum         14817 non-null  float64
 17  segment_osrm_time_sum           14817 non-null  float64
 18  segment_osrm_distance_sum       14817 non-null  float64
 19  des_city                        14817 non-null  object
 20  des_place                       14817 non-null  object
 21  des_code                        14817 non-null  object
 22  sor_city                        14817 non-null  object
 23  sor_place                       14817 non-null  object
 24  sor_code                        14817 non-null  object
dtypes: datetime64[ns](1), float64(8), object(16)
memory usage: 2.8+ MB
```

In [35]:
```
ts = trip['trip_creation_time'][1]
ts
```

Out[35]:
```
Timestamp('2018-09-12 00:00:22.886430')
```

In [36]:
```
trip['tc_year'] = trip['trip_creation_time'].dt.year
trip['tc_month'] = trip['trip_creation_time'].dt.month
trip['tc_day'] = trip['trip_creation_time'].dt.day
```

In [37]:
```
trip.head()
```

Out[37]:

	data	trip_creation_time	route_schedule_uuid	route_type	trip_uuid	source_cen
0	training	2018-09-12 00:00:16.535741	thanos::sroute:d7c989ba-a29b-4a0b-b2f4-288cdc6...	FTL	trip-153671041653548748	IND462022A
1	training	2018-09-12 00:00:22.886430	thanos::sroute:3a1b0ab2-bb0b-4c53-8c59-eb2a2c0...	Carting	trip-153671042288605164	IND572101A
2	training	2018-09-12 00:00:33.691250	thanos::sroute:de5e208e-7641-45e6-8100-4d9fb1e...	FTL	trip-153671043369099517	IND562132A
3	training	2018-09-12 00:01:00.113710	thanos::sroute:f0176492-a679-4597-8332-bbd1c7f...	Carting	trip-153671046011330457	IND400072A
4	training	2018-09-12 00:02:09.740725	thanos::sroute:d9f07b12-65e0-4f3b-bec8-df06134...	FTL	trip-153671052974046625	IND583101A

5 rows × 28 columns

In [ ]:

In [ ]:

3> In-depth analysis and feature engineering:

a. Calculate the time taken between od_start_time and od_end_time and keep it as a feature. Drop the original columns, if required.

b. Compare the difference between Point a. and start_scan_to_end_scan. Do hypothesis testing/ Visual analysis to check.

c. Do hypothesis testing/ visual analysis between actual_time aggregated value and OSRM time aggregated value (aggregated values are the values you'll get after merging the rows on the basis of trip_uuid).

d. Do hypothesis testing/ visual analysis between actual_time aggregated value and segment actual time aggregated value (aggregated values are the values you'll get after merging the rows on the basis of trip_uuid).

e. Do hypothesis testing/ visual analysis between osrm distance aggregated value and segment osrm distance aggregated value (aggregated values are the values you'll get after merging the rows on the basis of trip_uuid).

f. Do hypothesis testing/ visual analysis between osrm time aggregated value and segment osrm time aggregated value (aggregated values are the values you'll get after merging the rows on the basis of trip_uuid).

g. Find outliers in the numerical variables (you might find outliers in almost all the variables), and check it using visual analysis.

h. Handle the outliers using the IQR method.

i. Do one-hot encoding of categorical variables (like route_type).

j. Normalize/ Standardize the numerical features using MinMaxScaler or StandardScaler.

2.a. Calculate the time taken between od_start_time and od_end_time and keep it as a feature. Drop the original columns, if required.

In [41]:
```
trip['od_start_time'] = pd.to_datetime(trip['od_start_time'], utc=True)
trip['od_end_time'] = pd.to_datetime(trip['od_end_time'], utc=True)
trip.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14817 entries, 0 to 14816
Data columns (total 28 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   data                            14817 non-null  object
 1   trip_creation_time              14817 non-null  datetime64[ns]
 2   route_schedule_uuid             14817 non-null  object
 3   route_type                      14817 non-null  object
 4   trip_uuid                       14817 non-null  object
 5   source_center                   14817 non-null  object
 6   source_name                     14817 non-null  object
 7   destination_center              14817 non-null  object
 8   destination_name                14817 non-null  object
 9   od_start_time                   14817 non-null  datetime64[ns, UTC]
 10  od_end_time                     14817 non-null  datetime64[ns, UTC]
 11  start_scan_to_end_scan          14817 non-null  float64
 12  actual_distance_to_destination  14817 non-null  float64
 13  actual_time                     14817 non-null  float64
 14  osrm_time                       14817 non-null  float64
 15  osrm_distance                   14817 non-null  float64
 16  segment_actual_time_sum         14817 non-null  float64
 17  segment_osrm_time_sum           14817 non-null  float64
 18  segment_osrm_distance_sum       14817 non-null  float64
 19  des_city                        14817 non-null  object
 20  des_place                       14817 non-null  object
 21  des_code                        14817 non-null  object
 22  sor_city                        14817 non-null  object
 23  sor_place                       14817 non-null  object
 24  sor_code                        14817 non-null  object
 25  tc_year                         14817 non-null  int64
 26  tc_month                        14817 non-null  int64
 27  tc_day                          14817 non-null  int64
dtypes: datetime64[ns, UTC](2), datetime64[ns](1), float64(8), int64(3), object
(14)
memory usage: 3.2+ MB
```

In [43]:
```
trip['od_time_diff'] = trip['od_end_time'] - trip['od_start_time']
trip['od_time_diff'] = trip['od_time_diff'].dt.total_seconds()/(60)
trip.iloc[:, 9:]
```

Out[43]:

	od_start_time	od_end_time	start_scan_to_end_scan	actual_distance_to_des
0	2018-09-13 04:39:46.858469+00:00	2018-09-13 02:40:23.123744+00:00	43659.0	8860
1	2018-09-12 14:03:09.655591+00:00	2018-09-12 15:01:59.598855+00:00	906.0	240
2	2018-09-12 17:40:17.106733+00:00	2018-09-15 07:34:55.442454+00:00	248631.0	68163
3	2018-09-12 12:01:00.113710+00:00	2018-09-12 13:41:29.809822+00:00	200.0	28
4	2018-09-12 15:54:43.114421+00:00	2018-09-13 00:00:30.683231+00:00	1586.0	239
...	...	...	...	
14812	2018-10-03 08:56:10.943956+00:00	2018-10-04 10:41:25.409035+00:00	876.0	141
14813	2018-10-04 02:57:23.863155+00:00	2018-10-04 04:57:59.294434+00:00	120.0	25
14814	2018-10-03 06:51:27.075797+00:00	2018-10-04 10:59:51.621332+00:00	1263.0	93
14815	2018-10-03 08:16:39.894872+00:00	2018-10-04 09:47:45.162682+00:00	1315.0	355
14816	2018-10-04 07:58:40.726547+00:00	2018-10-04 12:46:09.166940+00:00	706.0	110

14817 rows × 20 columns

In [44]:
```
trip.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14817 entries, 0 to 14816
Data columns (total 29 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   data                            14817 non-null  object
 1   trip_creation_time              14817 non-null  datetime64[ns]
 2   route_schedule_uuid             14817 non-null  object
 3   route_type                      14817 non-null  object
 4   trip_uuid                       14817 non-null  object
 5   source_center                   14817 non-null  object
 6   source_name                     14817 non-null  object
 7   destination_center              14817 non-null  object
 8   destination_name                14817 non-null  object
 9   od_start_time                   14817 non-null  datetime64[ns, UTC]
 10  od_end_time                     14817 non-null  datetime64[ns, UTC]
 11  start_scan_to_end_scan          14817 non-null  float64
 12  actual_distance_to_destination  14817 non-null  float64
 13  actual_time                     14817 non-null  float64
 14  osrm_time                       14817 non-null  float64
 15  osrm_distance                   14817 non-null  float64
 16  segment_actual_time_sum         14817 non-null  float64
 17  segment_osrm_time_sum           14817 non-null  float64
 18  segment_osrm_distance_sum       14817 non-null  float64
 19  des_city                        14817 non-null  object
 20  des_place                       14817 non-null  object
 21  des_code                        14817 non-null  object
 22  sor_city                        14817 non-null  object
 23  sor_place                       14817 non-null  object
 24  sor_code                        14817 non-null  object
 25  tc_year                         14817 non-null  int64
 26  tc_month                        14817 non-null  int64
 27  tc_day                          14817 non-null  int64
 28  od_time_diff                    14817 non-null  float64
dtypes: datetime64[ns, UTC](2), datetime64[ns](1), float64(9), int64(3), object
(14)
memory usage: 3.3+ MB
```

2.g. Find outliers in the numerical variables (you might find outliers in almost all the variables), and check it using visual analysis.

In [45]:
```
from pandas.api.types import is_numeric_dtype
numerical_cols = []
for col in trip.columns:
    if is_numeric_dtype(trip[col].dtype):
        numerical_cols.append(col)
```

In [46]:
```
numerical_cols
```

Out[46]:
```
['start_scan_to_end_scan',
 'actual_distance_to_destination',
 'actual_time',
 'osrm_time',
 'osrm_distance',
 'segment_actual_time_sum',
 'segment_osrm_time_sum',
 'segment_osrm_distance_sum',
 'tc_year',
 'tc_month',
 'tc_day',
 'od_time_diff']
```

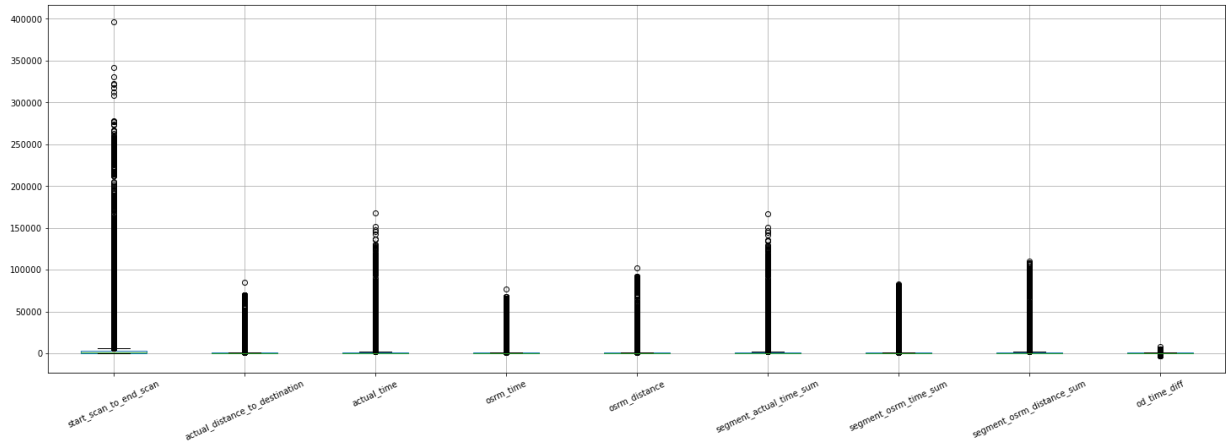
In [47]:
```
numerical_cols = ['start_scan_to_end_scan',
 'actual_distance_to_destination',
 'actual_time',
 'osrm_time',
 'osrm_distance',
 'segment_actual_time_sum',
 'segment_osrm_time_sum',
 'segment_osrm_distance_sum',
 'od_time_diff']
```

In [48]:
```
numerical_cols
```

Out[48]:
```
['start_scan_to_end_scan',
 'actual_distance_to_destination',
 'actual_time',
 'osrm_time',
 'osrm_distance',
 'segment_actual_time_sum',
 'segment_osrm_time_sum',
 'segment_osrm_distance_sum',
 'od_time_diff']
```

In [49]:
```
trip[numerical_cols].boxplot(rot=25, figsize=(25,8))
```

Out[49]: <AxesSubplot:>



2.h. Handle the outliers using the IQR method.

In [50]:
```
Q1 = trip[numerical_cols].quantile(0.25)
Q3 = trip[numerical_cols].quantile(0.75)
IQR = Q3 - Q1
print(IQR)
```

```
start_scan_to_end_scan            2418.000000
actual_distance_to_destination     414.359022
actual_time                        921.000000
osrm_time                          454.000000
osrm_distance                      541.938800
segment_actual_time_sum            912.000000
segment_osrm_time_sum              491.000000
segment_osrm_distance_sum          568.307800
od_time_diff                       446.872346
dtype: float64
```

In [51]:
```
print(trip[numerical_cols] < (Q1 - 1.5 * IQR)) or (trip[numerical_cols] > (Q3 + 1
```

```
       start_scan_to_end_scan  actual_distance_to_destination  actual_time  \
0                       False                           False        False
1                       False                           False        False
2                       False                           False        False
3                       False                           False        False
4                       False                           False        False
...                       ...                             ...          ...
14812                   False                           False        False
14813                   False                           False        False
14814                   False                           False        False
14815                   False                           False        False
14816                   False                           False        False

       osrm_time  osrm_distance  segment_actual_time_sum  \
0          False          False                    False
1          False          False                    False
2          False          False                    False
3          False          False                    False
4          False          False                    False
...          ...            ...                      ...
14812      False          False                    False
14813      False          False                    False
14814      False          False                    False
14815      False          False                    False
14816      False          False                    False

       segment_osrm_time_sum  segment_osrm_distance_sum  od_time_diff
0                      False                      False         False
1                      False                      False         False
2                      False                      False         False
3                      False                      False         False
4                      False                      False         False
...                      ...                        ...           ...
14812                  False                      False         False
14813                  False                      False         False
14814                  False                      False         False
14815                  False                      False         False
14816                  False                      False         False

[14817 rows x 9 columns]
```

Out[51]:

	start_scan_to_end_scan	actual_distance_to_destination	actual_time	osrm_time	osrm_dis
0	True	True	True	True	
1	False	False	False	False	
2	True	True	True	True	
3	False	False	False	False	
4	False	False	False	False	
...	...	...	...	...	
14812	False	False	False	False	
14813	False	False	False	False	

	start_scan_to_end_scan	actual_distance_to_destination	actual_time	osrm_time	osrm_dis
14814	False	False	False	False	
14815	False	False	False	False	
14816	False	False	False	False	

14817 rows × 9 columns

In [52]:
```
trip = trip[~((trip[numerical_cols] < (Q1 - 1.5 * IQR)) |(trip[numerical_cols] >
```

In [53]:
```
trip = trip.reset_index(drop=True)
```

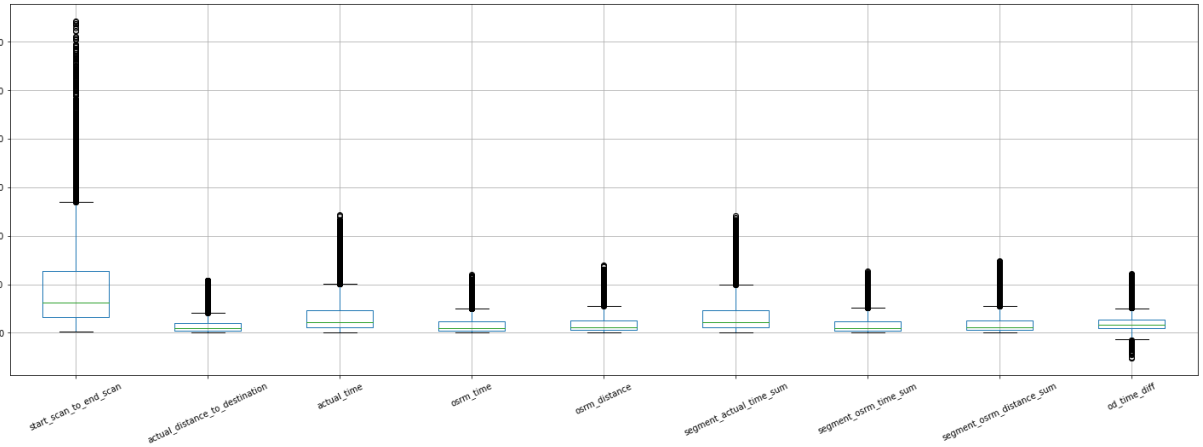
In [54]:
```
trip.iloc[5:10, 9:]
```

Out[54]:

	od_start_time	od_end_time	start_scan_to_end_scan	actual_distance_to_destinat
5	2018-09-12 13:42:40.156332+00:00	2018-09-12 15:00:55.163423+00:00	292.0	41.8348
6	2018-09-12 14:31:39.246238+00:00	2018-09-12 17:16:28.581141+00:00	560.0	44.0847
7	2018-09-12 12:06:39.565253+00:00	2018-09-12 12:55:59.568645+00:00	98.0	19.2826
8	2018-09-12 14:17:04.815916+00:00	2018-09-12 15:30:02.142126+00:00	144.0	23.4967
9	2018-09-12 00:11:40.783923+00:00	2018-09-12 00:50:10.814399+00:00	38.0	9.3965

In [55]:
```
trip[numerical_cols].boxplot(rot=25, figsize=(25,8))
```

Out[55]: <AxesSubplot:>



In [56]:
```
trip.iloc[:,9:]
```

Out[56]:

	od_start_time	od_end_time	start_scan_to_end_scan	actual_distance_to_des
0	2018-09-12 14:03:09.655591+00:00	2018-09-12 15:01:59.598855+00:00	906.0	240
1	2018-09-12 12:01:00.113710+00:00	2018-09-12 13:41:29.809822+00:00	200.0	28
2	2018-09-12 15:54:43.114421+00:00	2018-09-13 00:00:30.683231+00:00	1586.0	239
3	2018-09-12 14:12:10.755603+00:00	2018-09-12 15:13:03.432532+00:00	249.0	34
4	2018-09-12 00:04:22.011653+00:00	2018-09-12 01:42:22.349694+00:00	98.0	9
...	...	...	...	
10565	2018-10-04 02:54:54.039992+00:00	2018-10-04 05:33:37.635402+00:00	392.0	90
10566	2018-10-04 06:09:14.276831+00:00	2018-10-04 07:07:24.591271+00:00	116.0	24
10567	2018-10-04 02:55:18.430664+00:00	2018-10-04 05:23:31.389882+00:00	176.0	27
10568	2018-10-04 02:57:23.863155+00:00	2018-10-04 04:57:59.294434+00:00	120.0	25
10569	2018-10-04 07:58:40.726547+00:00	2018-10-04 12:46:09.166940+00:00	706.0	110

10570 rows × 20 columns

2.i. Do one-hot encoding of categorical variables (like route_type)

In [57]:
```
trip['route_type'].unique()
```

Out[57]:
```
array(['Carting', 'FTL'], dtype=object)
```

In [58]:
```
trip['route_type'].value_counts()
```

Out[58]:
```
Carting    8070
FTL        2500
Name: route_type, dtype: int64
```

In [59]:
```
trip = pd.get_dummies(trip, columns = ['route_type'])
trip
```

Out[59]:

	data	trip_creation_time	route_schedule_uuid	trip_uuid	source_center	
0	training	2018-09-12 00:00:22.886430	thanos::sroute:3a1b0ab2-bb0b-4c53-8c59-eb2a2c0...	trip-153671042288605164	IND572101AAA	
1	training	2018-09-12 00:01:00.113710	thanos::sroute:f0176492-a679-4597-8332-bbd1c7f...	trip-153671046011330457	IND400072AAB	Mu
2	training	2018-09-12 00:02:09.740725	thanos::sroute:d9f07b12-65e0-4f3b-bec8-df06134...	trip-153671052974046625	IND583101AAA	
3	training	2018-09-12 00:02:34.161600	thanos::sroute:9bf03170-d0a2-4a3f-aa4d-9aaab3d...	trip-153671055416136166	IND600116AAB	
4	training	2018-09-12 00:04:22.011653	thanos::sroute:a97698cc-846e-41a7-916b-88b1741...	trip-153671066201138152	IND600044AAD	C
...	...	...	...	...	...	
10565	test	2018-10-03 23:54:54.039992	thanos::sroute:233c5ce2-a1e2-4550-945c-28c357c...	trip-153861089403973335	IND390022AAA	Vac
10566	test	2018-10-03 23:55:01.637939	thanos::sroute:9bf03170-d0a2-4a3f-aa4d-9aaab3d...	trip-153861090163768194	IND600056AAA	
10567	test	2018-10-03 23:55:18.430664	thanos::sroute:f0176492-a679-4597-8332-bbd1c7f...	trip-153861091843037040	IND400072AAB	Mu
10568	test	2018-10-03 23:57:23.863155	thanos::sroute:b30e1ec3-3bfa-4bd2-a7fb-3b75769...	trip-153861104386292051	IND121004AAB	
10569	test	2018-10-03 23:59:42.701692	thanos::sroute:412fea14-6d1f-4222-8a5f-a517042...	trip-153861118270144424	IND583201AAA	

10570 rows × 30 columns

2.j. Normalize/ Standardize the numerical features using MinMaxScaler or StandardScaler.

In [60]:
```
# StandardScaler
```

In [61]:
```
from sklearn.preprocessing import StandardScaler
```

In [62]:
```
scaler = StandardScaler()
scaler.fit(trip[numerical_cols])
```

Out[62]:
```
StandardScaler()
```

In [63]:
```
trip[numerical_cols] = scaler.transform(trip[numerical_cols])
```

In [64]:
```
trip[numerical_cols]
```

Out[64]:

	start_scan_to_end_scan	actual_distance_to_destination	actual_time	osrm_time	osrm_distan
0	-0.086920	0.427751	0.074806	0.179972	0.2944
1	-0.766343	-0.675358	-0.728837	-0.783608	-0.7165
2	0.567482	0.421492	0.472824	0.164430	0.2811
3	-0.719187	-0.644726	-0.703485	-0.752525	-0.6886
4	-0.864503	-0.776608	-0.875875	-0.840594	-0.7999
...	...	...	...	...	
10565	-0.581570	-0.351385	-0.571657	-0.322540	-0.2405
10566	-0.847180	-0.694732	-0.761794	-0.809511	-0.7412
10567	-0.789439	-0.678816	-0.792215	-0.783608	-0.7182
10568	-0.843331	-0.693071	-0.853059	-0.809511	-0.7382
10569	-0.279391	-0.249550	-0.049416	-0.358804	-0.3077

10570 rows × 9 columns

In [65]:
```
trip[numerical_cols].describe()
```

Out[65]:

	start_scan_to_end_scan	actual_distance_to_destination	actual_time	osrm_time	osrm_d
count	1.057000e+04	1.057000e+04	1.057000e+04	1.057000e+04	1.0570
mean	-1.669011e-16	8.746814e-18	4.219858e-17	-1.689493e-17	2.9425
std	1.000047e+00	1.000047e+00	1.000047e+00	1.000047e+00	1.0000
min	-9.337924e-01	-7.771193e-01	-9.139027e-01	-8.768580e-01	-8.1251
25%	-6.556718e-01	-6.012275e-01	-6.527822e-01	-6.592753e-01	-6.1458
50%	-3.621534e-01	-3.792705e-01	-3.954645e-01	-3.898873e-01	-3.9879
75%	2.640992e-01	1.815260e-01	2.548015e-01	2.835828e-01	2.4268
max	5.234904e+00	4.816376e+00	5.218625e+00	5.277623e+00	5.0619

In [66]:
```
trip.iloc[:, 9:]
```

Out[66]:

	od_end_time	start_scan_to_end_scan	actual_distance_to_destination	actual_time	c
0	2018-09-12 15:01:59.598855+00:00	-0.086920	0.427751	0.074806	
1	2018-09-12 13:41:29.809822+00:00	-0.766343	-0.675358	-0.728837	
2	2018-09-13 00:00:30.683231+00:00	0.567482	0.421492	0.472824	
3	2018-09-12 15:13:03.432532+00:00	-0.719187	-0.644726	-0.703485	
4	2018-09-12 01:42:22.349694+00:00	-0.864503	-0.776608	-0.875875	
...	...	...	...	...	
10565	2018-10-04 05:33:37.635402+00:00	-0.581570	-0.351385	-0.571657	
10566	2018-10-04 07:07:24.591271+00:00	-0.847180	-0.694732	-0.761794	
10567	2018-10-04 05:23:31.389882+00:00	-0.789439	-0.678816	-0.792215	
10568	2018-10-04 04:57:59.294434+00:00	-0.843331	-0.693071	-0.853059	
10569	2018-10-04 12:46:09.166940+00:00	-0.279391	-0.249550	-0.049416	

10570 rows × 21 columns

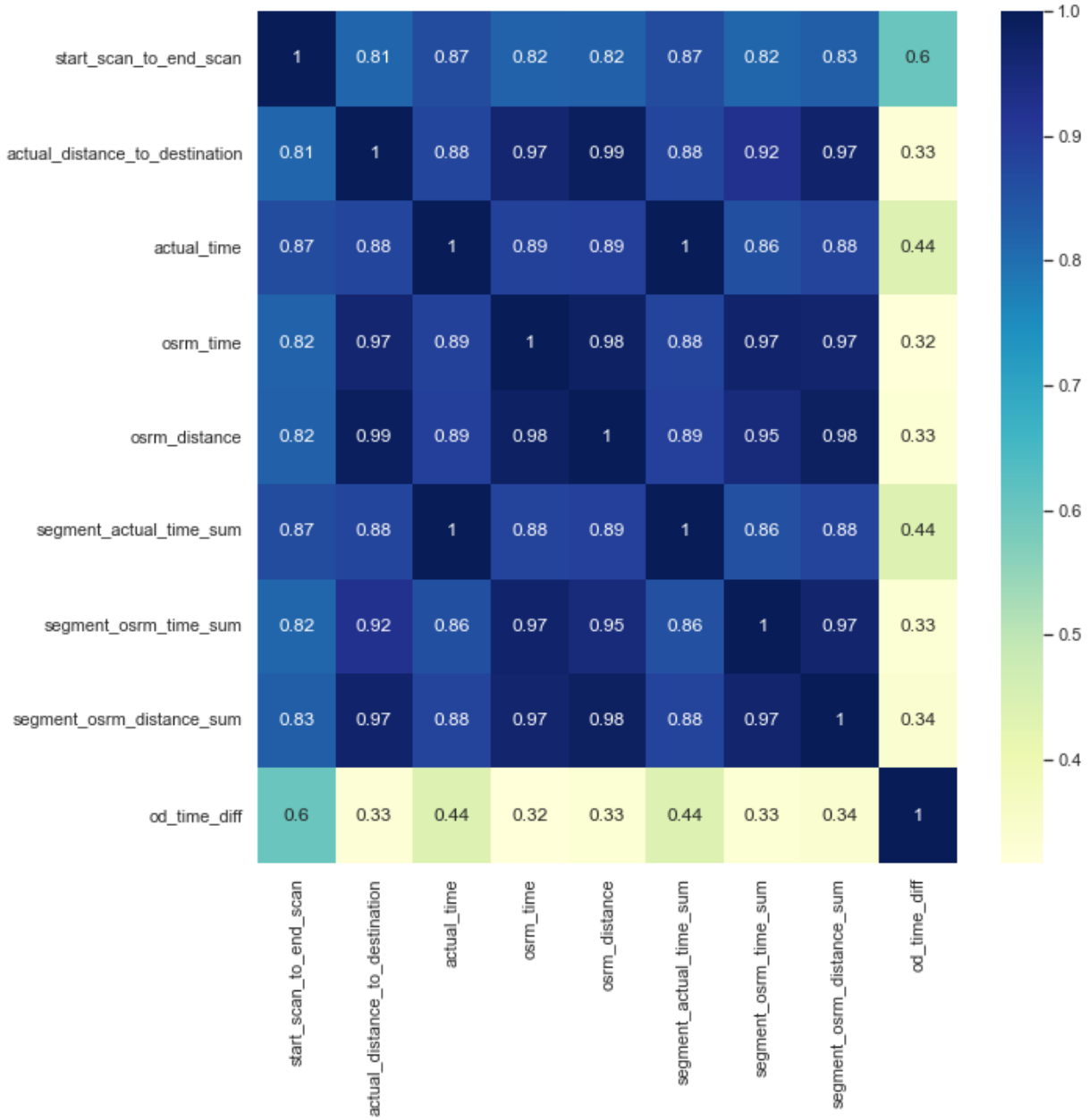
2.b. Compare the difference between Point a. and start_scan_to_end_scan. Do hypothesis testing/ Visual analysis to check.

Hypothesis Testing: start_scan_to_end_scan v/s od_time_diff

```
ho: start_scan_to_end_scan != od_time_diff
ha: start_scan_to_end_scan == od_time_diff
```

In [67]:
```
sns.set(rc = {'figure.figsize':(10,10)})
sns.heatmap(trip[numerical_cols].corr(), cmap="YlGnBu", annot=True)
```

Out[67]: <AxesSubplot:>



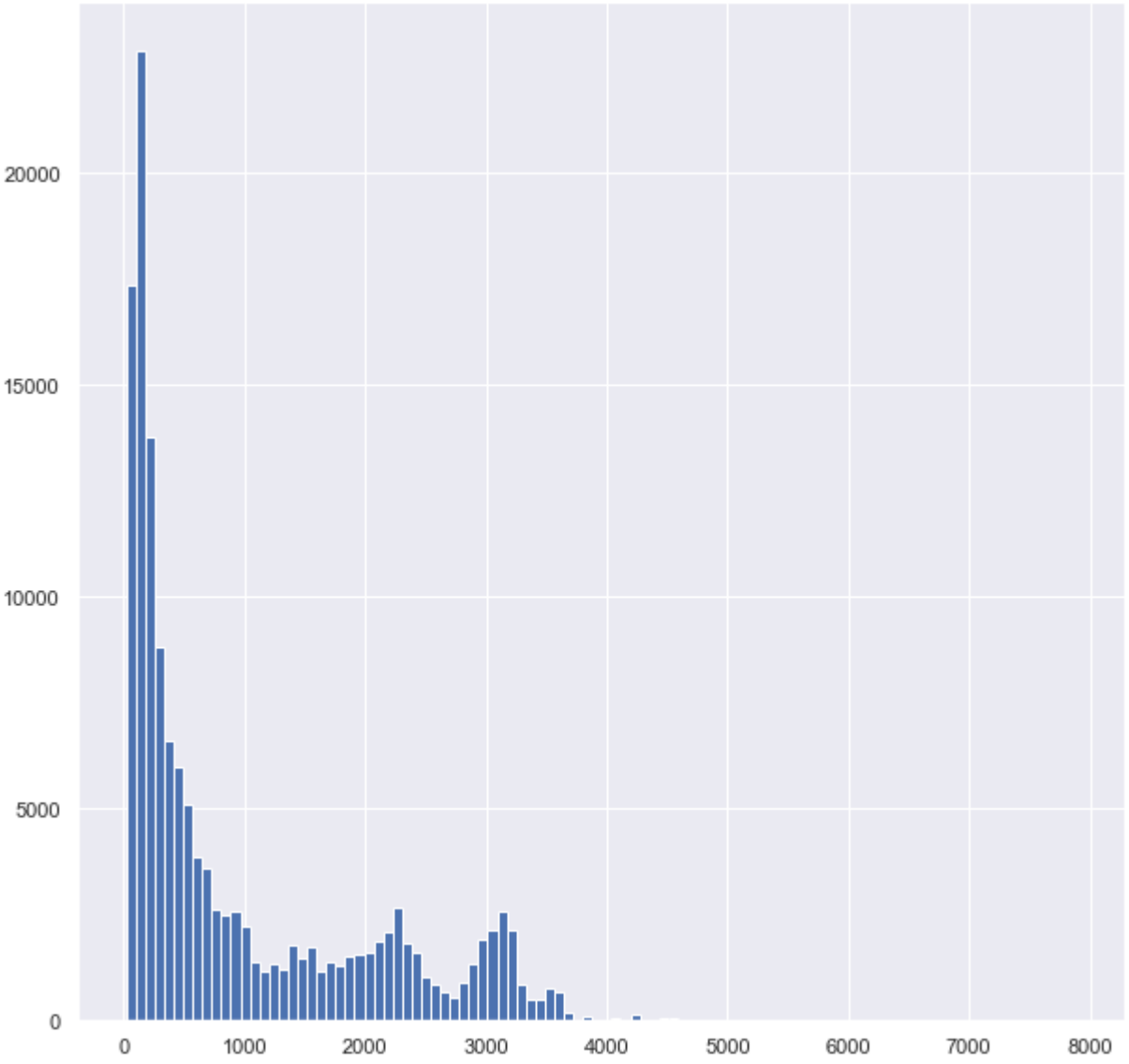
In [68]:
```
trip[['start_scan_to_end_scan', 'od_time_diff']].corr()
```

Out[68]:

	start_scan_to_end_scan	od_time_diff
start_scan_to_end_scan	1.00000	0.60486
od_time_diff	0.60486	1.00000

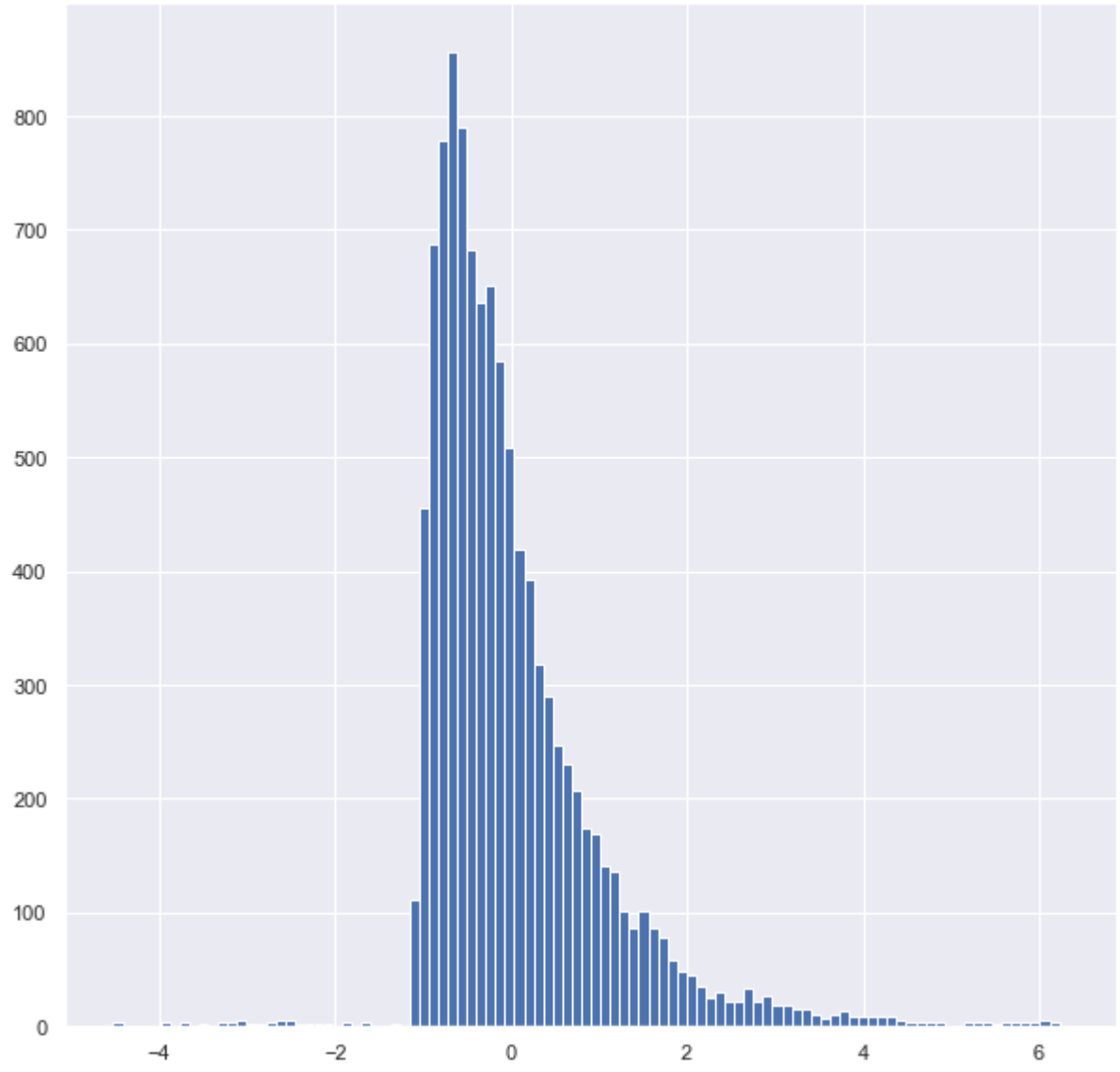
In [69]:
```
df["start_scan_to_end_scan"].hist(bins=100)
```

Out[69]: <AxesSubplot:>

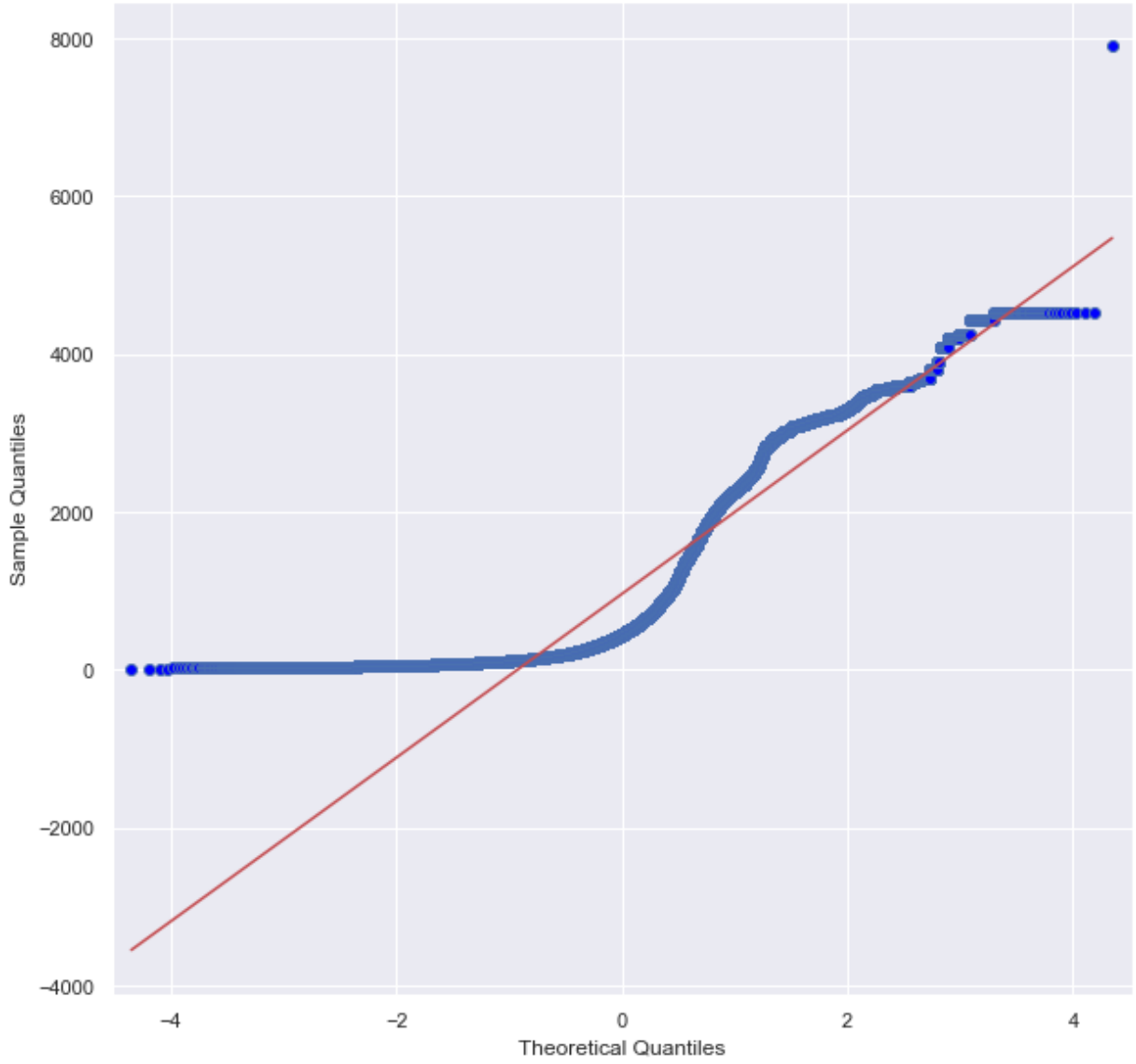


In [70]:
```
trip["od_time_diff"].hist(bins=100)
```

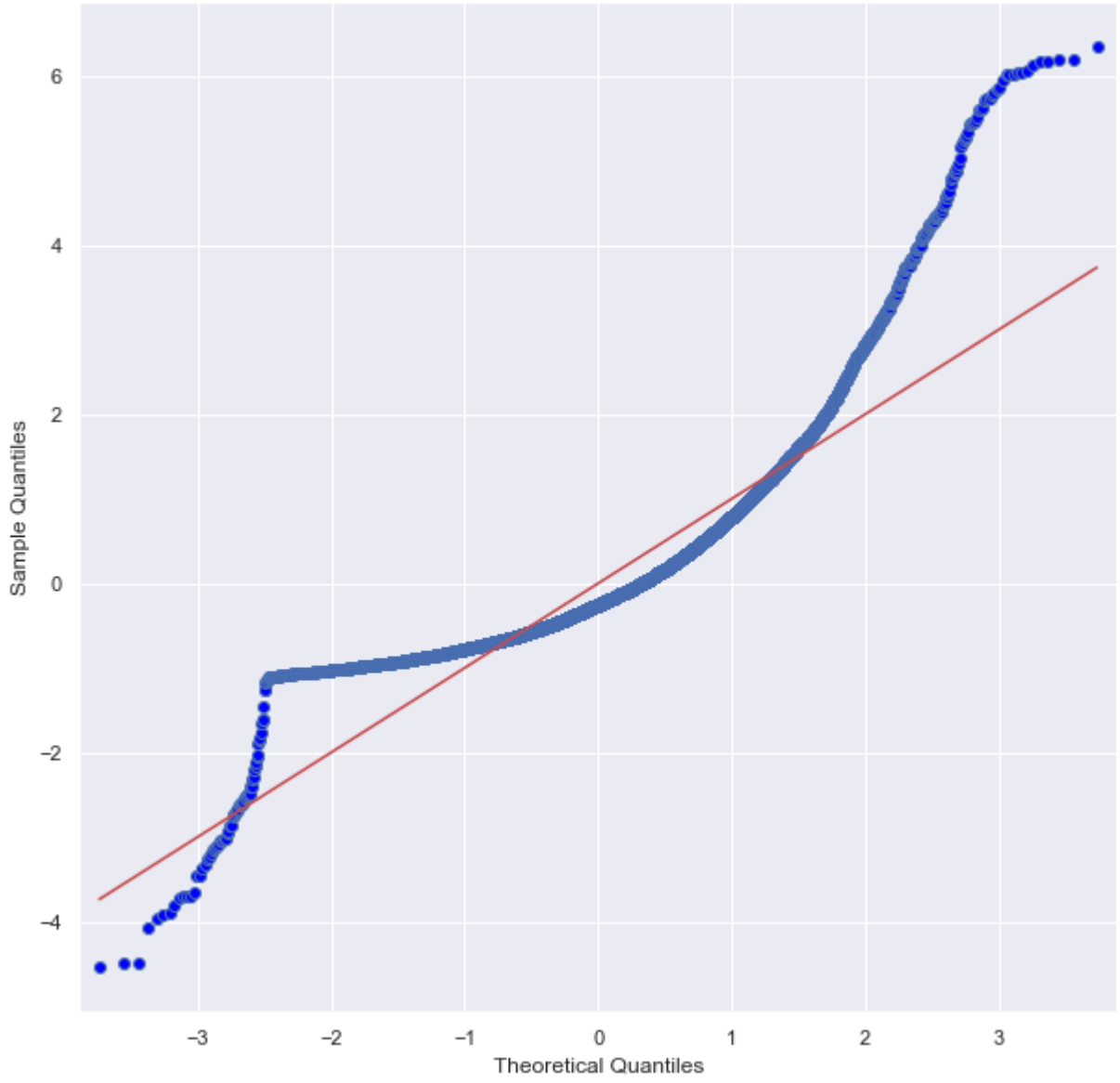
Out[70]: <AxesSubplot:>



In [71]:
```
sm.qqplot(df["start_scan_to_end_scan"], line ='s')
py.show()
```



In [72]:
```
sm.qqplot(trip["od_time_diff"], line ='s')
py.show()
```



In [73]:
```
var1 = trip.start_scan_to_end_scan.sample(1000)
var2 = trip.od_time_diff.sample(1000)
```

In [74]:
```
f, p = stats.ttest_ind(var1, var2, alternative='two-sided')
print(f, p)
```

```
-0.6005843362500483 0.5481849909004831
```

Inference: pvalue>0.05, so we accepts the ho.

2.c. Do hypothesis testing/ visual analysis between actual_time aggregated value and OSRM time aggregated value (aggregated values are the values you'll get after merging the rows on the basis of trip_uuid)

Hypothesis Testing: actual_time v/s osrm_time

```
ho: actual_time != osrm_time
ha: actual_time == osrm_time
```

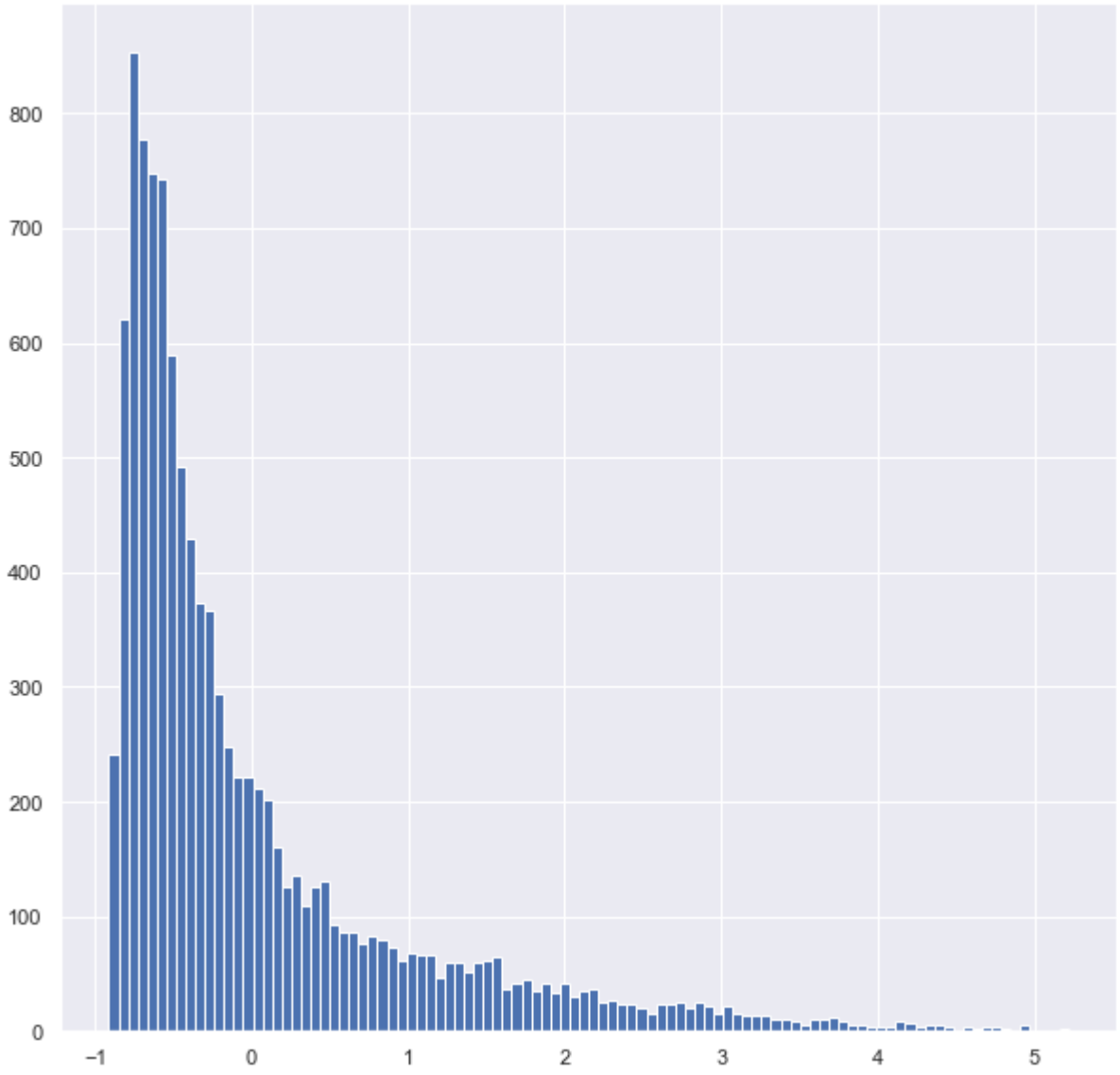
In [75]:
```
trip[['actual_time', 'osrm_time']].corr()
```

Out[75]:

	actual_time	osrm_time
actual_time	1.000000	0.886344
osrm_time	0.886344	1.000000

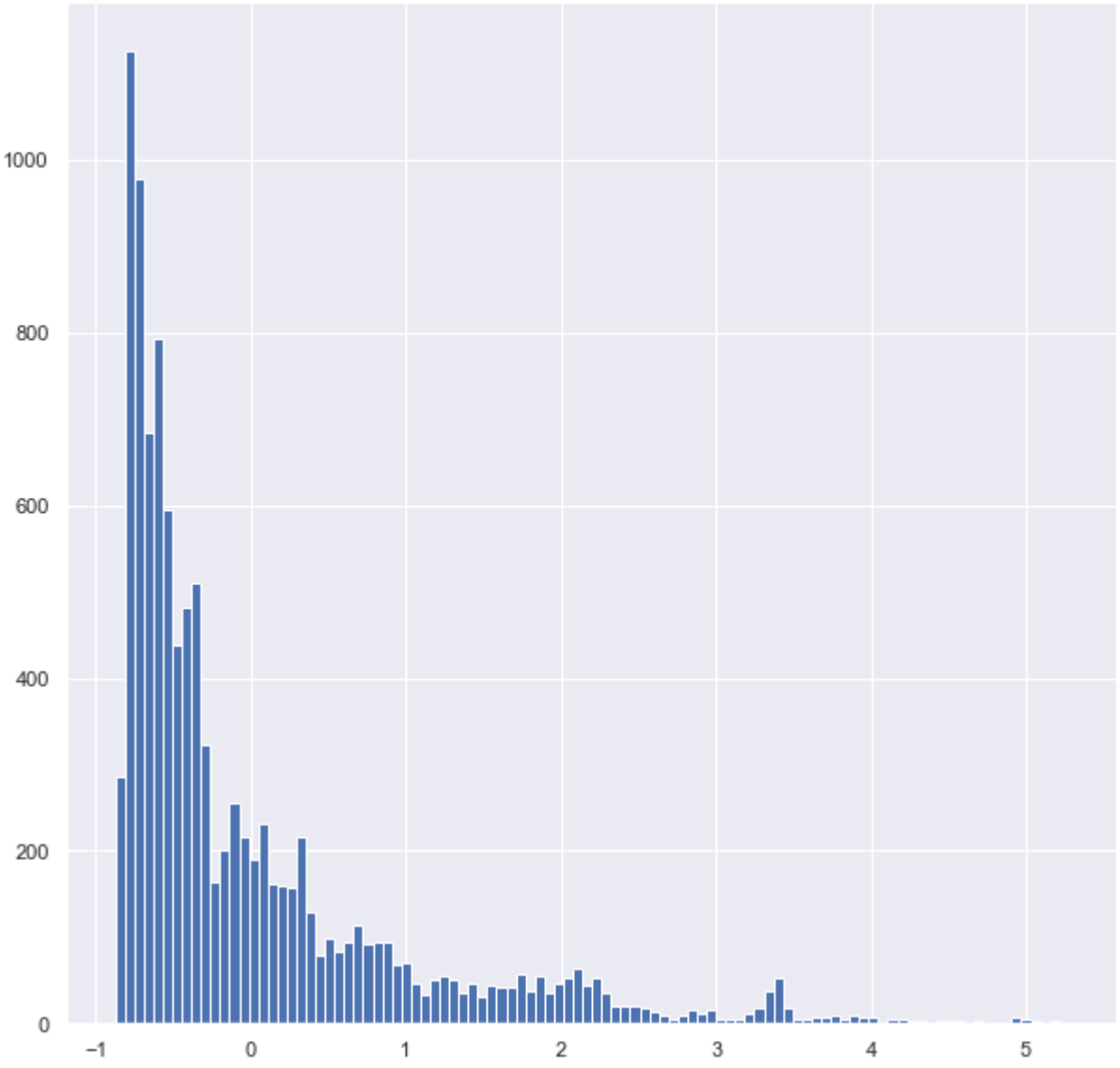
In [76]:
```
trip["actual_time"].hist(bins=100)
```

Out[76]: <AxesSubplot:>

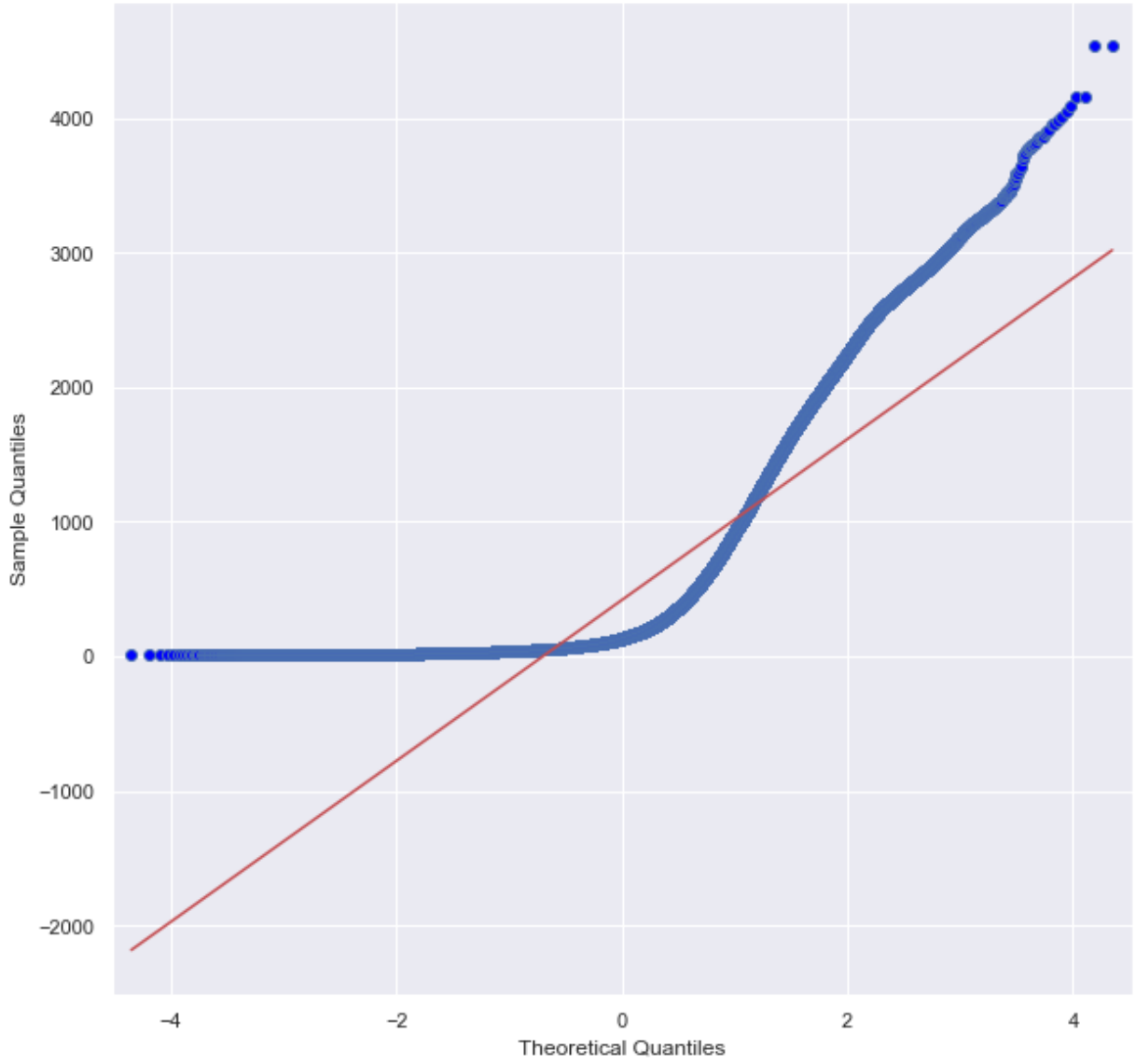


In [77]:
```
trip["osrm_time"].hist(bins=100)
```

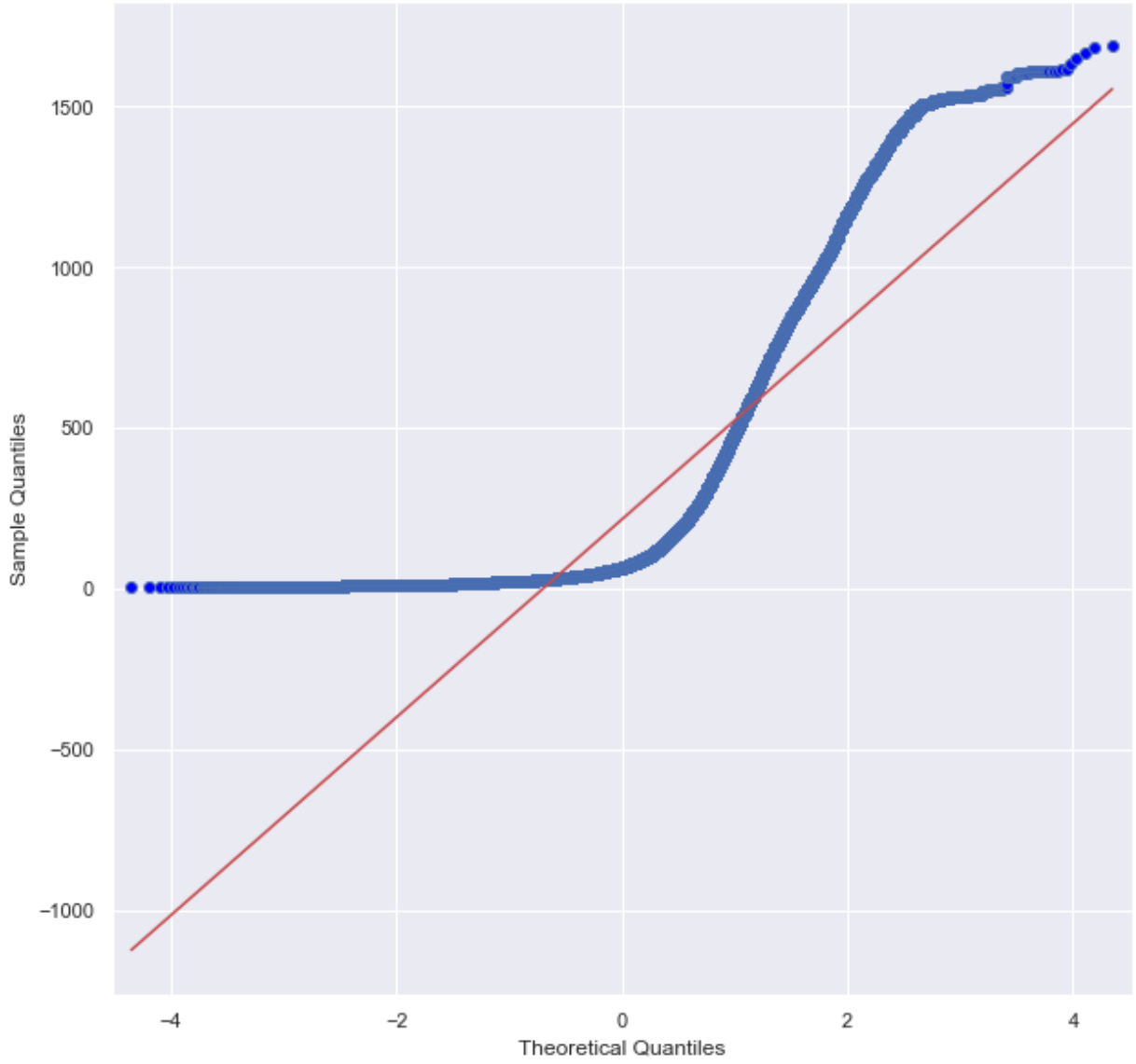
Out[77]: <AxesSubplot:>



In [78]:
```
sm.qqplot(df["actual_time"], line ='s')
py.show()
```



In [79]:
```
sm.qqplot(df["osrm_time"], line ='s')
py.show()
```



In [80]:
```
var1 = trip.actual_time.sample(1000)
var2 = trip.osrm_time.sample(1000)
f, p = stats.ttest_ind(var1, var2, alternative='two-sided')
print(f, p)
```

```
-0.5047130881826578 0.6138160256512971
```

Inference: pvalue>0.05, so we accept the ho.

2.d. Do hypothesis testing/ visual analysis between actual_time aggregated value and segment actual time aggregated value (aggregated values are the values you'll get after merging the rows on the basis of trip_uuid)

Hypothesis Testing: actual_time v/s segment_actual_time

```
ho: actual_time != segment_actual_time
ha: actual_time == segment_actual_time
```

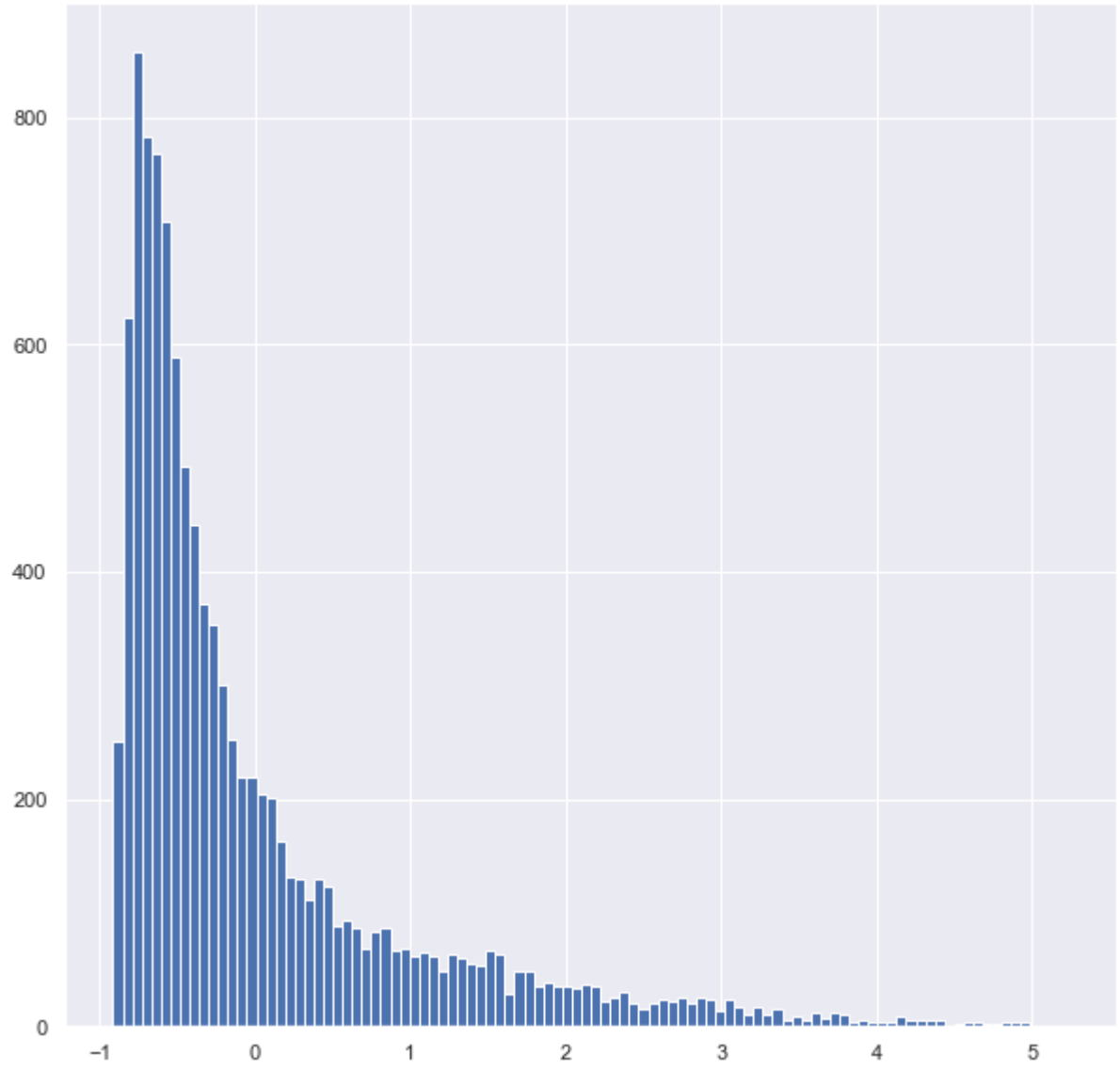
In [81]:
```
trip[['actual_time', 'segment_actual_time_sum']].corr()
```

Out[81]:

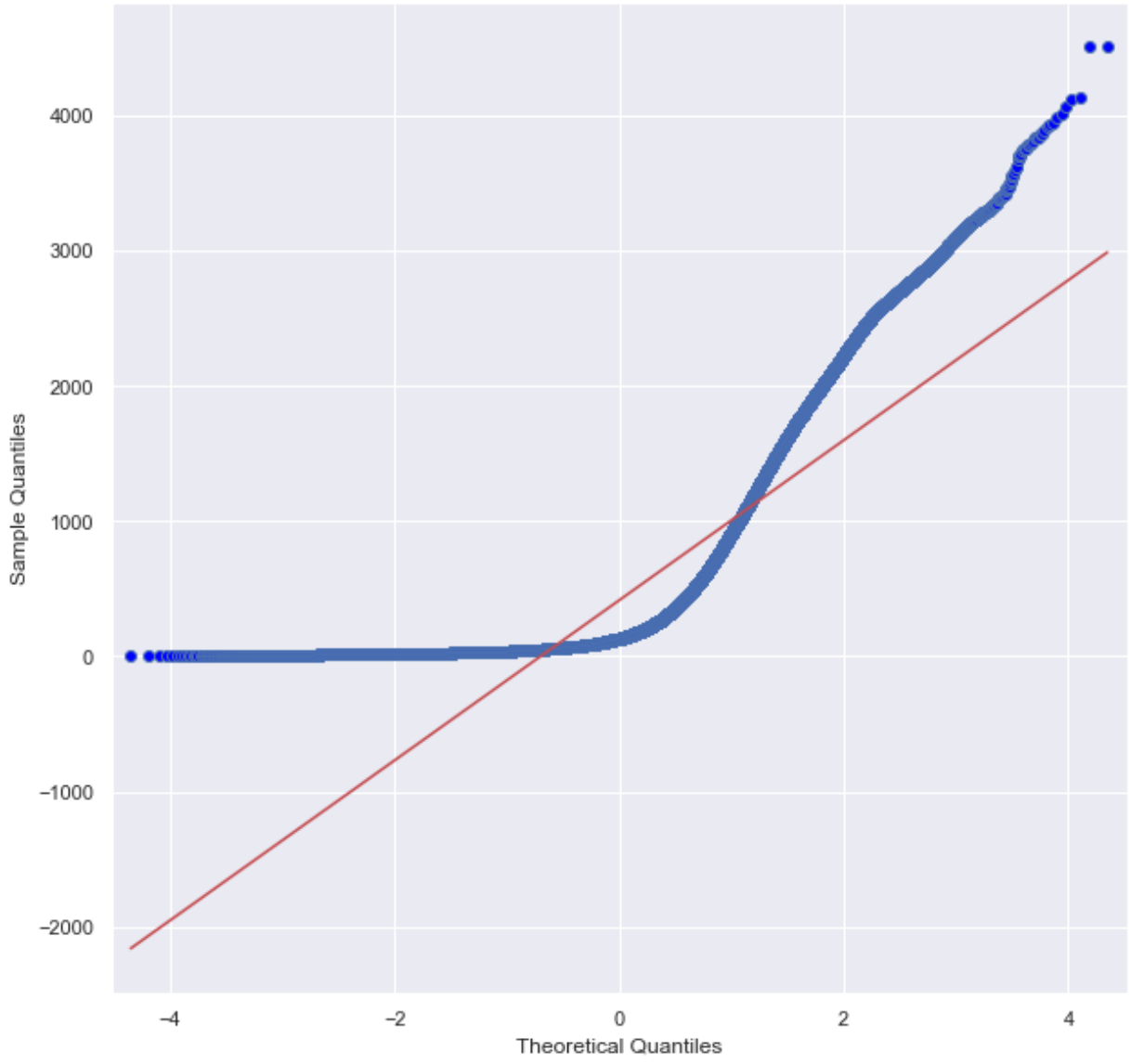
	actual_time	segment_actual_time_sum
actual_time	1.000000	0.999932
segment_actual_time_sum	0.999932	1.000000

In [82]:
```
trip["segment_actual_time_sum"].hist(bins=100)
```

Out[82]: <AxesSubplot:>



In [83]:
```
sm.qqplot(df["segment_actual_time_sum"], line ='s')
py.show()
```



In [84]:
```
var1 = trip.actual_time.sample(1000)
var2 = trip.segment_actual_time_sum.sample(1000)
f, p = stats.ttest_ind(var1, var2, alternative='two-sided')
print(f, p)
```

```
-2.2784913478192315 0.022802442911417916
```

Inference: pvalue>0.05, so we accept the ho.

2.e. Do hypothesis testing/ visual analysis between osrm distance aggregated value and segment osrm distance aggregated value (aggregated values are the values you'll get after merging the rows on the basis of trip_uuid)

Hypothesis Testing: osrm_distance v/s segment_osrm_distance

```
ho: osrm_distance != segment_osrm_distance
ha: osrm_distance == segment_osrm_distance
```

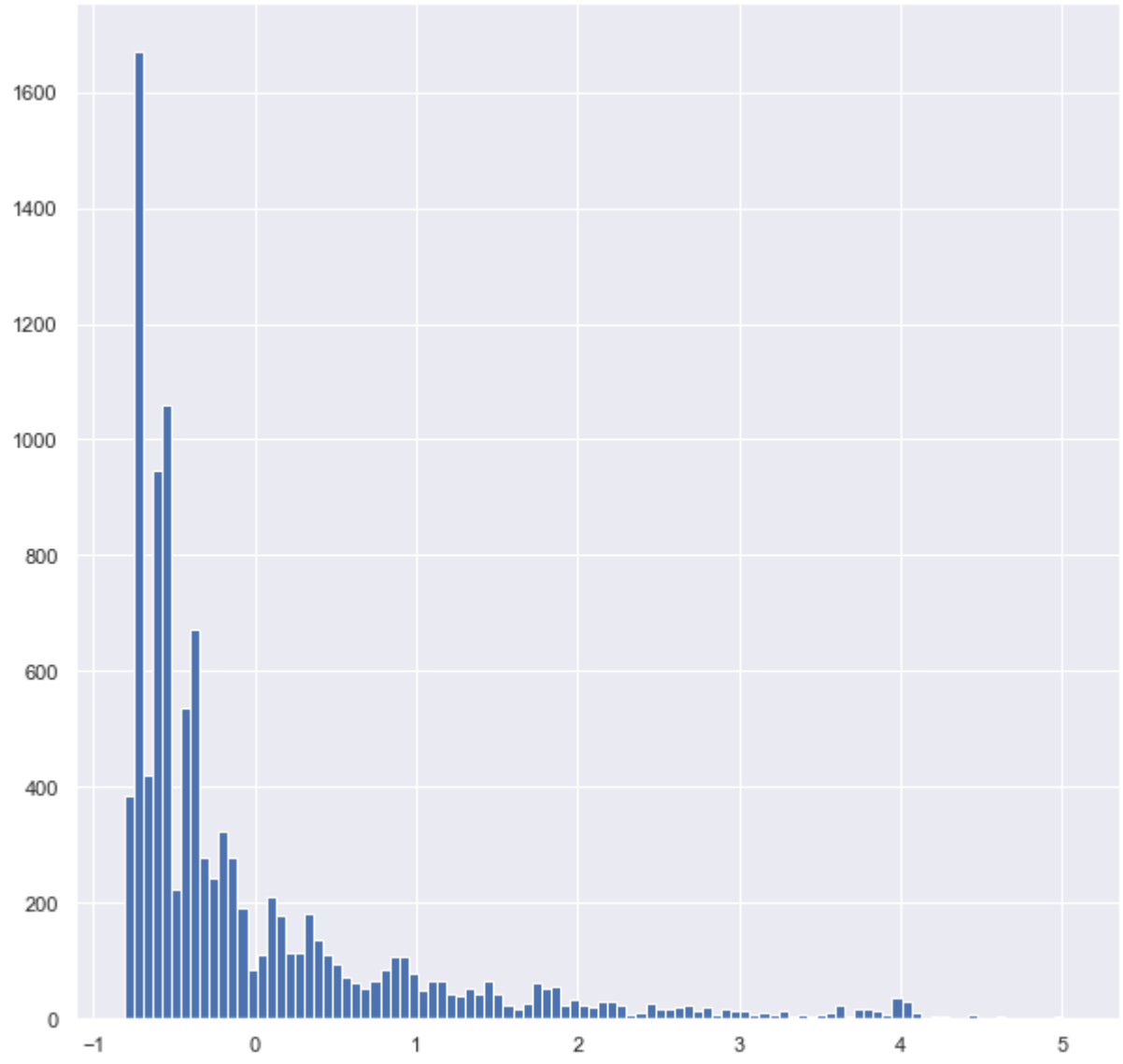
In [85]:
```
trip[['osrm_distance', 'segment_osrm_distance_sum']].corr()
```

Out[85]:

	osrm_distance	segment_osrm_distance_sum
osrm_distance	1.000000	0.984596
segment_osrm_distance_sum	0.984596	1.000000

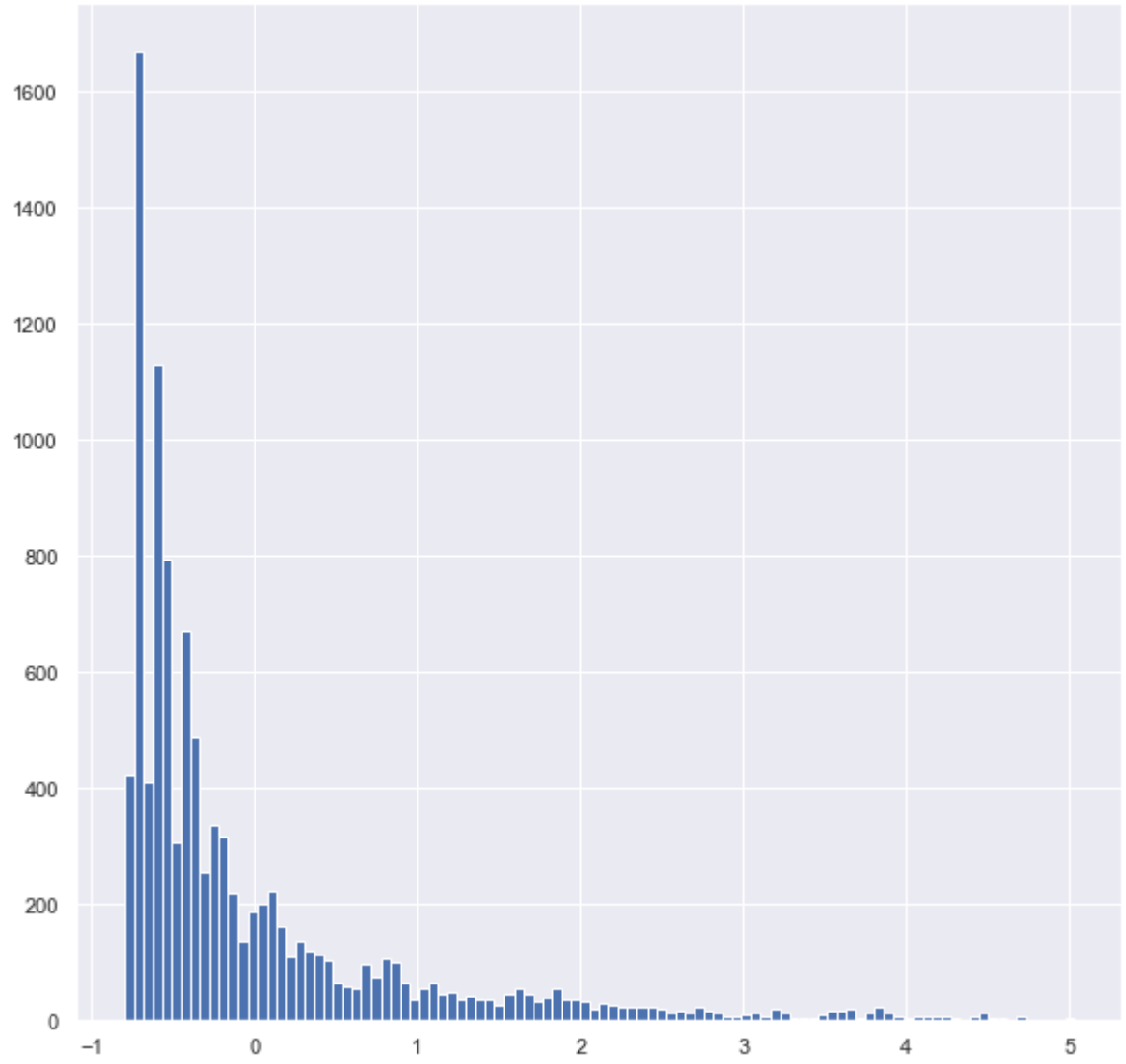
In [86]:
```
trip["osrm_distance"].hist(bins=100)
```

Out[86]: <AxesSubplot:>

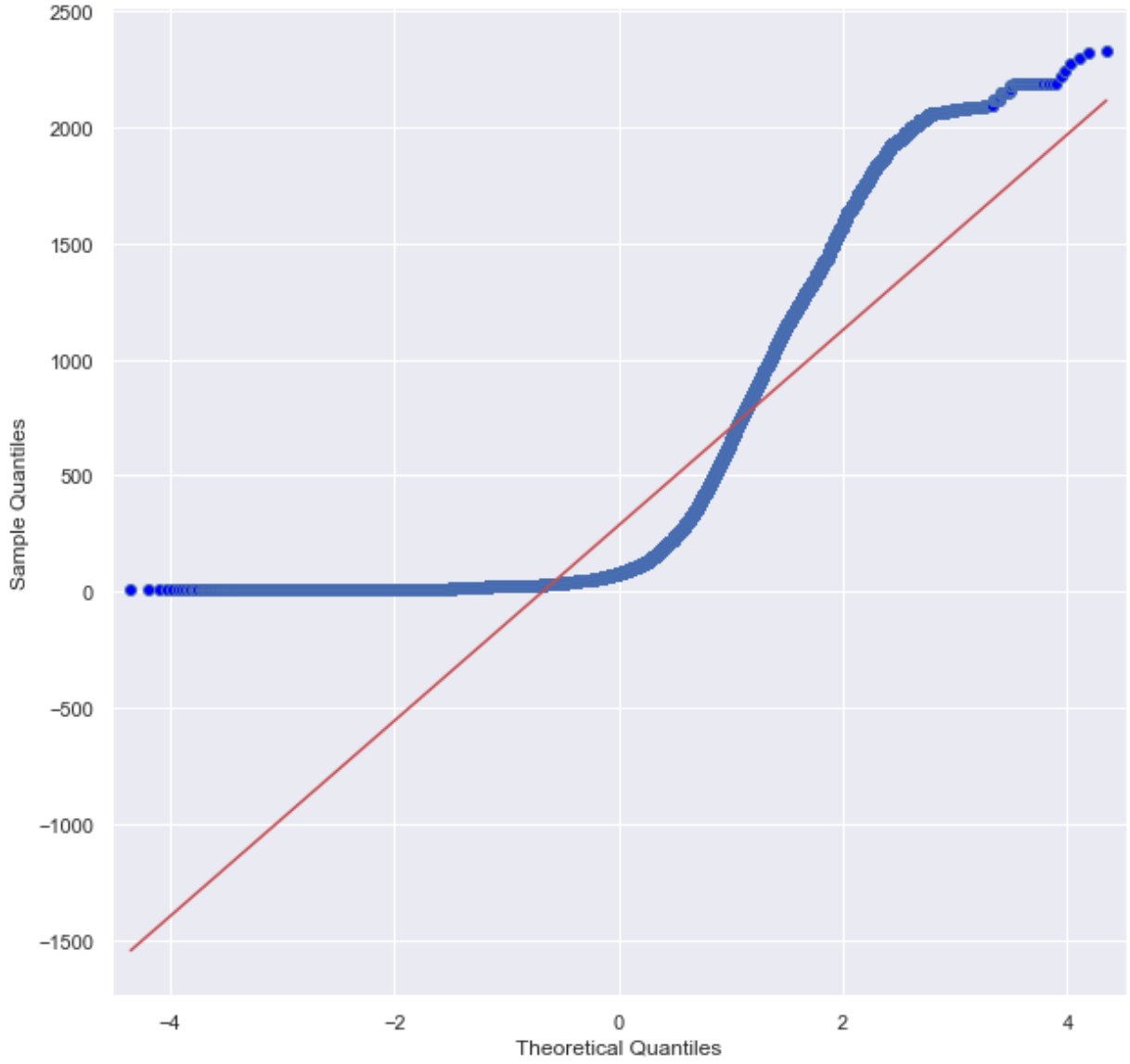


In [87]:
```
trip["segment_osrm_distance_sum"].hist(bins=100)
```

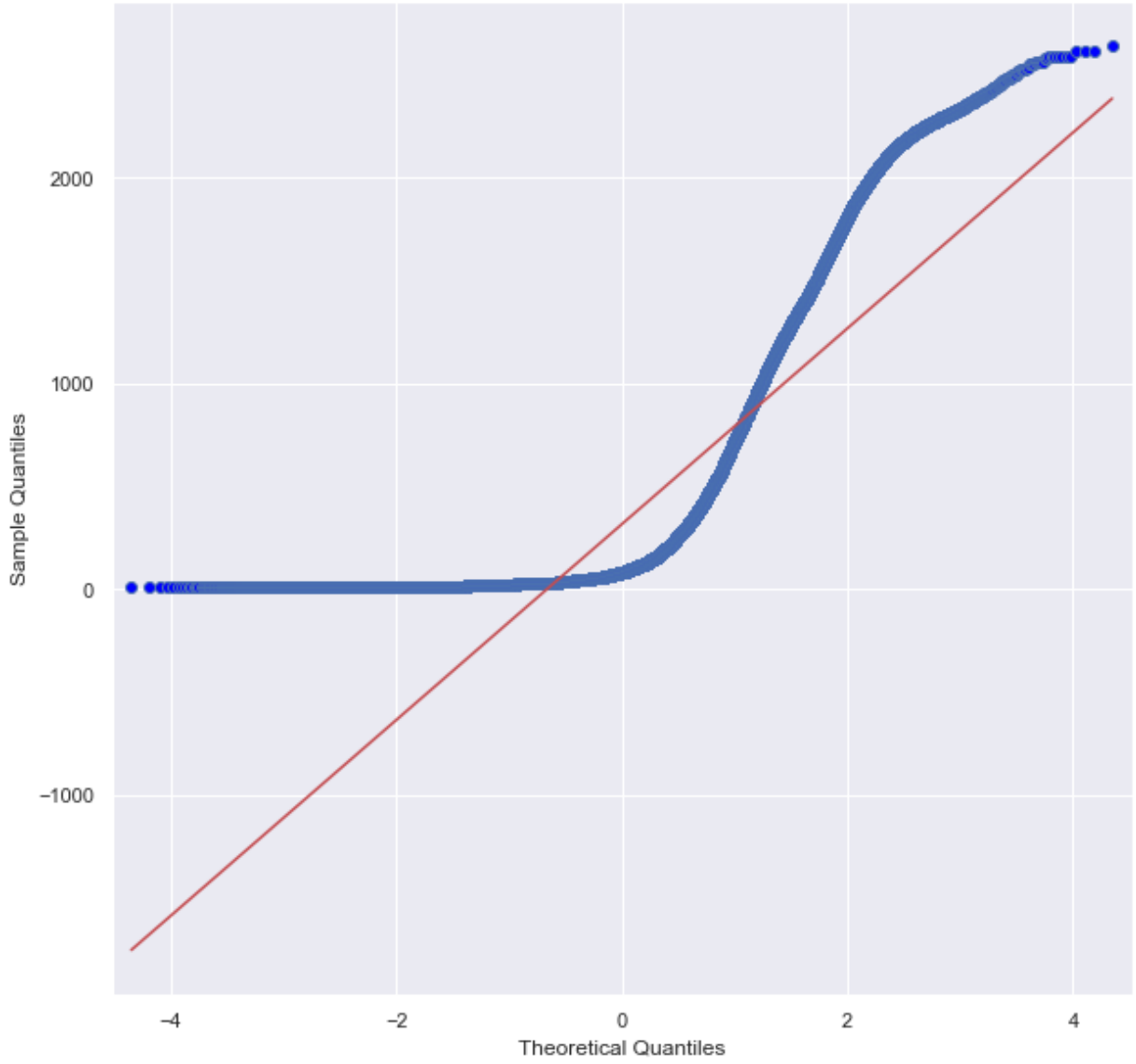
Out[87]: <AxesSubplot:>



In [88]:
```
sm.qqplot(df["osrm_distance"], line ='s')
py.show()
```



In [89]:
```
sm.qqplot(df["segment_osrm_distance_sum"], line ='s')
py.show()
```



In [90]:
```
var1 = trip.osrm_distance.sample(1000)
var2 = trip.segment_osrm_distance_sum.sample(1000)
f, p = stats.ttest_ind(var1, var2, alternative='two-sided')
print(f, p)
```

```
-0.047937294574998776 0.9617710077990738
```

Inference: pvalue>0.05, so we accespt the ho.

2.f. Do hypothesis testing/ visual analysis between osrm time aggregated value and segment osrm time aggregated value (aggregated values are the values you'll get after merging the rows on the basis of trip_uuid)

Hypothesis Testing: osrm_time v/s segment_osrm_time

```
ho: osrm_time != segment_osrm_time
ha: osrm_time == segment_osrm_time
```

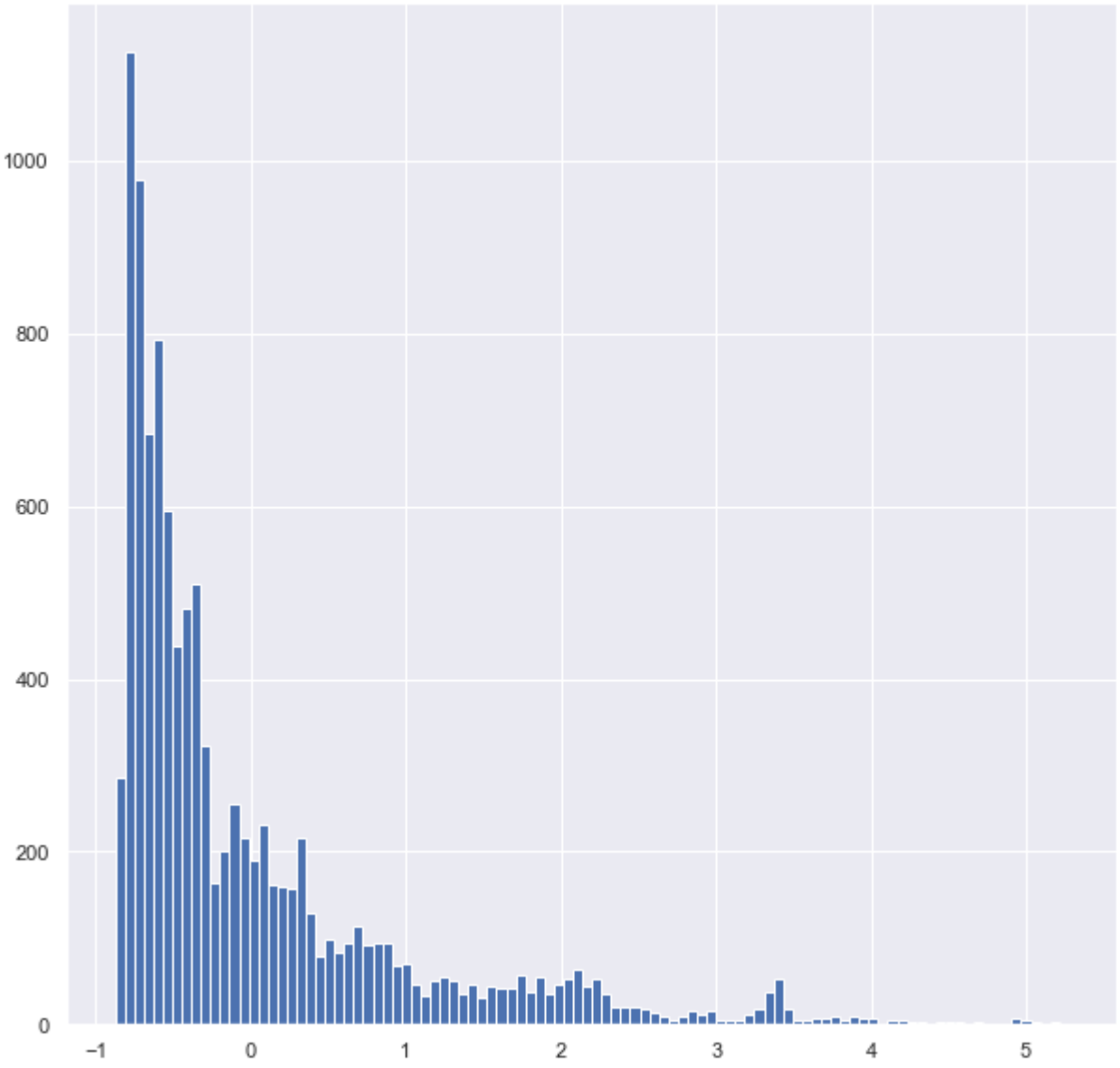
In [91]:
```
trip[['osrm_time', 'segment_osrm_time_sum']].corr()
```

Out[91]:

	osrm_time	segment_osrm_time_sum
osrm_time	1.000000	0.972809
segment_osrm_time_sum	0.972809	1.000000

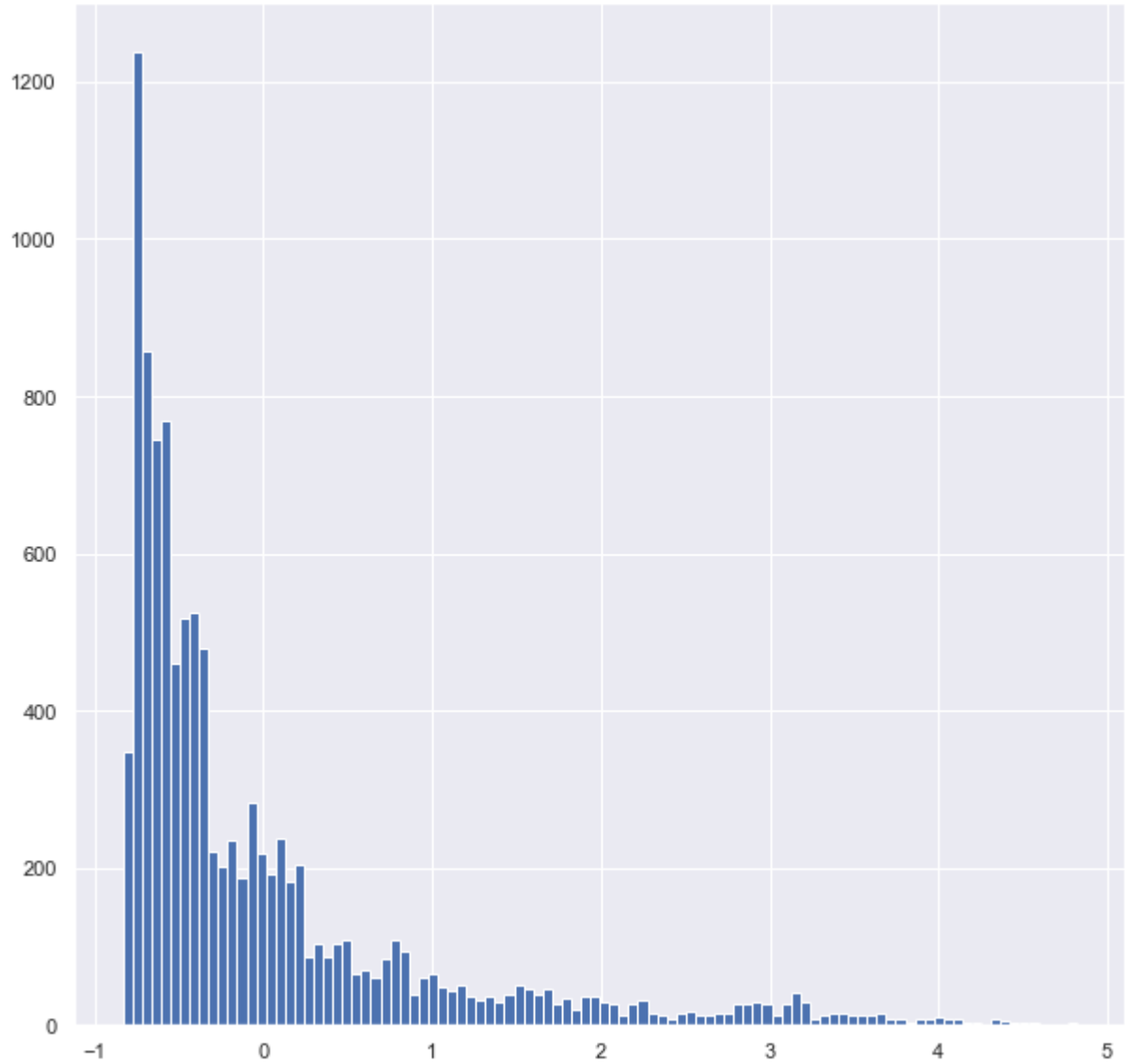
In [92]:
```
trip["osrm_time"].hist(bins=100)
```

Out[92]: <AxesSubplot:>

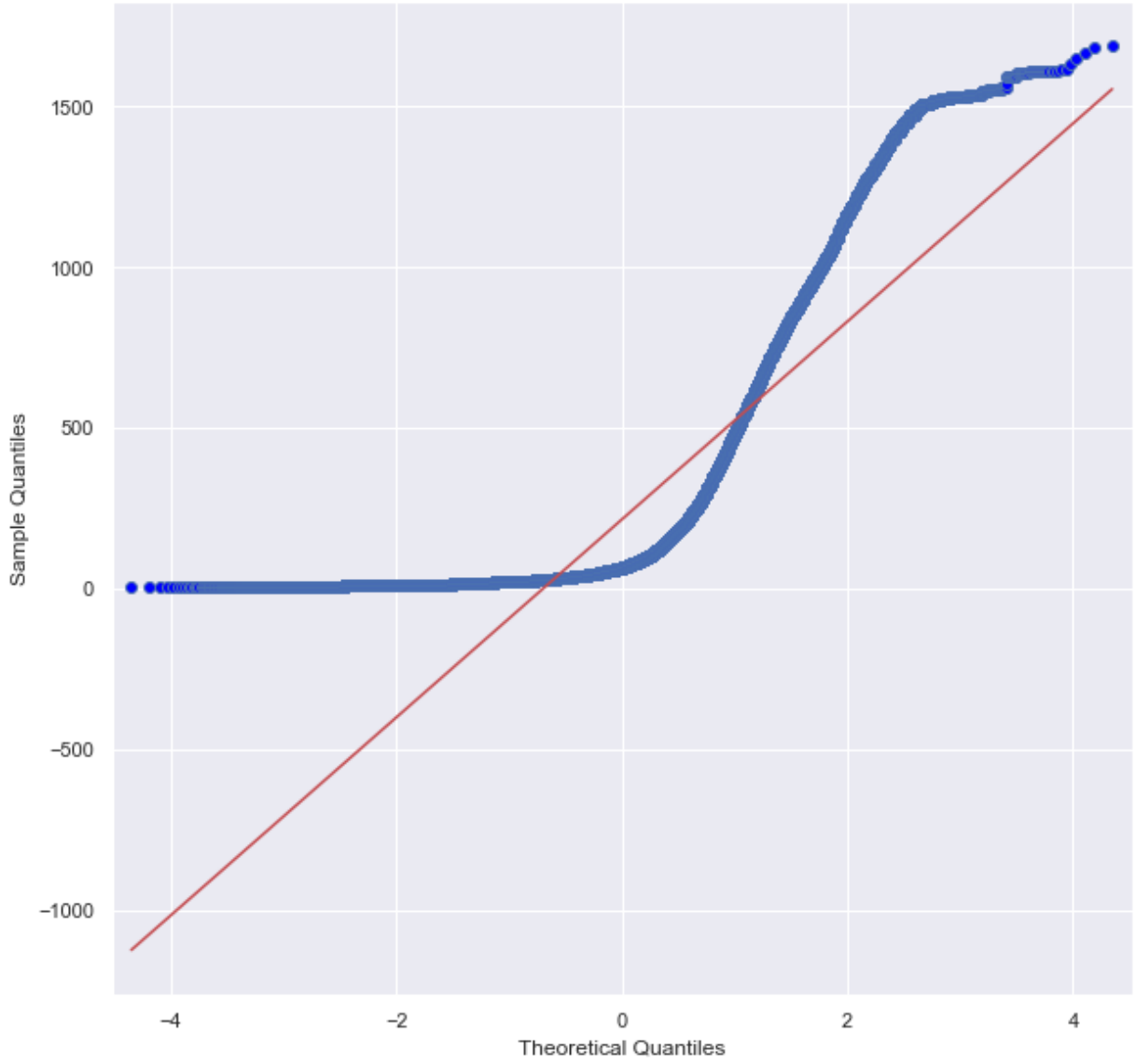


In [93]:
```
trip["segment_osrm_time_sum"].hist(bins=100)
```

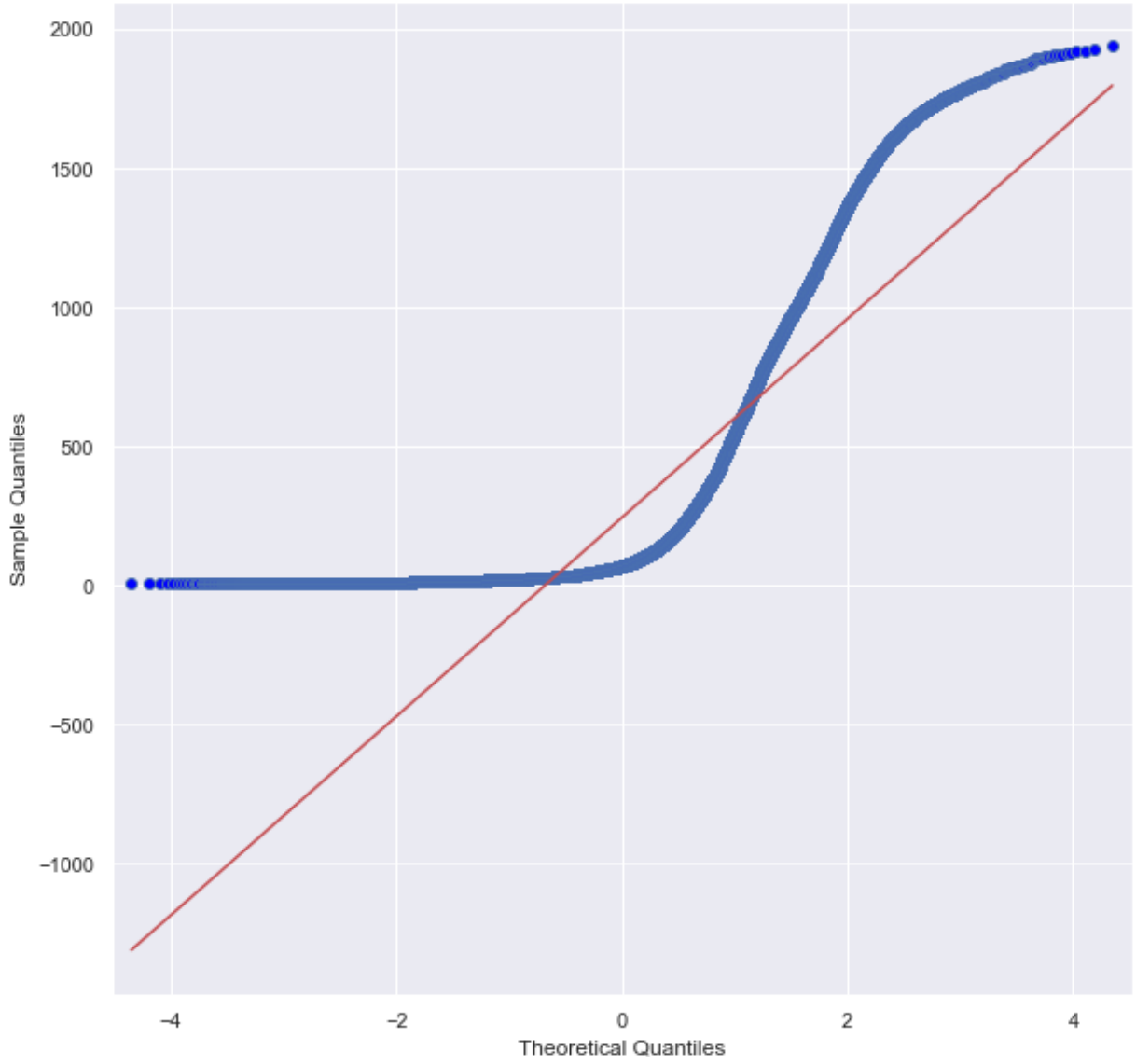
Out[93]: <AxesSubplot:>



In [94]:
```
sm.qqplot(df["osrm_time"], line ='s')
py.show()
```



In [95]:
```
sm.qqplot(df["segment_osrm_time_sum"], line ='s')
py.show()
```



In [96]:
```
var1 = trip.osrm_time.sample(1000)
var2 = trip.segment_osrm_time_sum.sample(1000)
f, p = stats.ttest_ind(var1, var2, alternative='two-sided')
print(f, p)
```

```
-0.04470745136059461 0.9643449618721716
```

Inference: pvalue> 0.05, so we accepts the ho.

In [ ]: