In [1]:

```
import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.linear_model import LinearRegression
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
```

In [2]:

```
os.chdir("C:/Users/Debayan Chakraborty/Documents/Edwisor cab project")
```

In [3]:

```
os.getcwd()
```

Out[3]:

```
'C:\\Users\\Debayan Chakraborty\\Documents\\Edwisor cab project'
```

In [4]:

```
train_data = pd.read_csv("train_cab.csv", sep = ",", encoding = "ISO-8859-1")
test_data = pd.read_csv("test.csv", sep = ",", encoding = "ISO-8859-1")
```

In [5]:

```
train_data.head()
```

Out[5]:

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropof
0	4.5	2009-06-15 17:26:21 UTC	-73.844311	40.721319	-73.841610	
1	16.9	2010-01-05 16:52:16 UTC	-74.016048	40.711303	-73.979268	
2	5.7	2011-08-18 00:35:00 UTC	-73.982738	40.761270	-73.991242	
3	7.7	2012-04-21 04:30:42 UTC	-73.987130	40.733143	-73.991567	
4	5.3	2010-03-09 07:51:00 UTC	-73.968095	40.768008	-73.956655	

In [6]:

```
train_data.head(10)
```

Out[6]:

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropof
0	4.5	2009-06-15 17:26:21 UTC	-73.844311	40.721319	-73.841610	
1	16.9	2010-01-05 16:52:16 UTC	-74.016048	40.711303	-73.979268	
2	5.7	2011-08-18 00:35:00 UTC	-73.982738	40.761270	-73.991242	
3	7.7	2012-04-21 04:30:42 UTC	-73.987130	40.733143	-73.991567	
4	5.3	2010-03-09 07:51:00 UTC	-73.968095	40.768008	-73.956655	
5	12.1	2011-01-06 09:50:45 UTC	-74.000964	40.731630	-73.972892	
6	7.5	2012-11-20 20:35:00 UTC	-73.980002	40.751662	-73.973802	
7	16.5	2012-01-04 17:22:00 UTC	-73.951300	40.774138	-73.990095	
8	NaN	2012-12-03 13:10:00 UTC	-74.006462	40.726713	-73.993078	
9	8.9	2009-09-02 01:11:00 UTC	-73.980658	40.733873	-73.991540	

In [7]:

```
test_data.head(10)
```

Out[7]:

	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	pas
0	2015-01-27 13:08:24 UTC	-73.973320	40.763805	-73.981430	40.743835	
1	2015-01-27 13:08:24 UTC	-73.986862	40.719383	-73.998886	40.739201	
2	2011-10-08 11:53:44 UTC	-73.982524	40.751260	-73.979654	40.746139	
3	2012-12-01 21:12:12 UTC	-73.981160	40.767807	-73.990448	40.751635	
4	2012-12-01 21:12:12 UTC	-73.966046	40.789775	-73.988565	40.744427	
5	2012-12-01 21:12:12 UTC	-73.960983	40.765547	-73.979177	40.740053	
6	2011-10-06 12:10:20 UTC	-73.949013	40.773204	-73.959622	40.770893	
7	2011-10-06 12:10:20 UTC	-73.777282	40.646636	-73.985083	40.759368	
8	2011-10-06 12:10:20 UTC	-74.014099	40.709638	-73.995106	40.741365	
9	2014-02-18 15:22:20 UTC	-73.969582	40.765519	-73.980686	40.770725	

In [8]:

```
train_data
```

Out[8]:

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dr
0	4.5	2009-06-15 17:26:21 UTC	-73.844311	40.721319	-73.841610	
1	16.9	2010-01-05 16:52:16 UTC	-74.016048	40.711303	-73.979268	
2	5.7	2011-08-18 00:35:00 UTC	-73.982738	40.761270	-73.991242	
3	7.7	2012-04-21 04:30:42 UTC	-73.987130	40.733143	-73.991567	
4	5.3	2010-03-09 07:51:00 UTC	-73.968095	40.768008	-73.956655	
5	12.1	2011-01-06 09:50:45 UTC	-74.000964	40.731630	-73.972892	
6	7.5	2012-11-20 20:35:00 UTC	-73.980002	40.751662	-73.973802	
7	16.5	2012-01-04 17:22:00 UTC	-73.951300	40.774138	-73.990095	
8	NaN	2012-12-03 13:10:00 UTC	-74.006462	40.726713	-73.993078	
9	8.9	2009-09-02 01:11:00 UTC	-73.980658	40.733873	-73.991540	
10	5.3	2012-04-08 07:30:50 UTC	-73.996335	40.737142	-73.980721	
11	5.5	2012-12-24 11:24:00 UTC	0.000000	0.000000	0.000000	
12	4.1	2009-11-06 01:04:03 UTC	-73.991601	40.744712	-73.983081	
13	7	2013-07-02 19:54:00 UTC	-74.005360	40.728867	-74.008913	
14	7.7	2011-04-05 17:11:05 UTC	-74.001821	40.737547	-73.998060	
15	5	2013-11-23 12:57:00 UTC	0.000000	0.000000	0.000000	
16	12.5	2014-02-19 07:22:00 UTC	-73.986430	40.760465	-73.988990	
17	5.3	2009-07-22 16:08:00 UTC	-73.981060	40.737690	-73.994177	
18	5.3	2010-07-07 14:52:00 UTC	-73.969505	40.784843	-73.958732	
19	4	2014-12-06 20:36:22 UTC	-73.979815	40.751902	-73.979446	
20	10.5	2010-09-07 13:18:00 UTC	-73.985382	40.747858	-73.978377	
21	11.5	2013-02-12 12:15:46 UTC	-73.957954	40.779252	-73.961250	
22	4.5	2009-08-06 18:17:23 UTC	-73.991707	40.770505	-73.985459	
23	4.9	2010-12-06 12:29:00 UTC	-74.000632	40.747473	-73.986672	

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dr
24	6.1	2009-12-10 15:37:00 UTC	-73.969622	40.756973	-73.981152	
25	7.3	2011-06-21 16:15:00 UTC	-73.991875	40.754437	-73.977230	
26	NaN	2011-02-07 20:01:00 UTC	0.000000	0.000000	0.000000	
27	4.5	2011-06-28 19:47:00 UTC	-73.988893	40.760160	-73.986445	
28	9.3	2012-05-04 06:11:20 UTC	-73.989258	40.690835	-74.004133	
29	4.5	2013-08-11 00:52:00 UTC	-73.981020	40.737760	-73.980668	
...	...	...	...	...	...	
16037	6.5	2012-02-27 21:40:50 UTC	-73.992618	40.723878	-73.977073	
16038	5.7	2010-08-31 10:43:42 UTC	-73.990336	40.718973	-73.956060	
16039	12.9	2010-12-11 16:25:00 UTC	-73.936462	40.794292	-73.948747	
16040	6.5	2014-06-16 00:05:19 UTC	-73.980597	40.744267	-73.979330	
16041	11	2014-11-17 21:53:00 UTC	-73.983610	40.747090	-73.961310	
16042	8.5	2015-04-06 21:53:06 UTC	-73.991425	40.749832	-74.000107	
16043	8.5	2011-11-17 10:58:05 UTC	-73.973961	40.764055	-73.986807	
16044	16.5	2013-04-29 03:05:45 UTC	-73.982785	40.731421	-74.011358	
16045	6.5	2013-09-19 23:56:00 UTC	-73.995227	40.733475	-73.984030	
16046	6	2014-04-24 01:48:40 UTC	-73.976298	40.753948	-73.993062	
16047	6.1	2010-03-18 11:09:00 UTC	-73.970733	40.758193	-73.979457	
16048	9.7	2012-07-10 17:32:00 UTC	-73.988040	40.774902	-74.005265	
16049	15.7	2012-07-31 12:27:00 UTC	-74.008657	40.715975	-73.975653	
16050	8.5	2013-01-23 07:36:49 UTC	-73.996715	40.742504	-73.977987	
16051	11.5	2014-10-01 20:05:00 UTC	-73.975540	40.755590	-73.944780	
16052	10	2014-10-03 22:24:00 UTC	-73.987298	40.722007	-74.000267	
16053	4	2014-09-23 09:49:00 UTC	-73.954977	40.788582	-73.964227	
16054	5.3	2009-11-28 15:58:02 UTC	-73.993929	40.756944	-73.993044	

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dr
16055	48.3	2012-09-05 17:34:00 UTC	-73.994077	40.741242	-73.830257	
16056	38.3	2012-12-17 14:59:16 UTC	0.000000	0.000000	0.000000	
16057	5	2013-01-31 15:46:00 UTC	-73.963582	40.774242	-73.956525	
16058	5.5	2014-04-19 14:58:57 UTC	-73.974265	40.756048	-73.980885	
16059	5.3	2010-01-03 18:26:00 UTC	-73.973297	40.743768	-73.986060	
16060	22	2014-10-01 09:15:00 UTC	-73.954582	40.778047	-74.005982	
16061	10.9	2009-05-20 18:56:42 UTC	-73.994191	40.751138	-73.962769	
16062	6.5	2014-12-12 07:41:00 UTC	-74.008820	40.718757	-73.998865	
16063	16.1	2009-07-13 07:58:00 UTC	-73.981310	40.781695	-74.014392	
16064	8.5	2009-11-11 11:19:07 UTC	-73.972507	40.753417	-73.979577	
16065	8.1	2010-05-11 23:53:00 UTC	-73.957027	40.765945	-73.981983	
16066	8.5	2011-12-14 06:24:33 UTC	-74.002111	40.729755	-73.983877	

16067 rows × 7 columns

In [9]:

```
test_data
```

Out[9]:

	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude
0	2015-01-27 13:08:24 UTC	-73.973320	40.763805	-73.981430	40.743835
1	2015-01-27 13:08:24 UTC	-73.986862	40.719383	-73.998886	40.739201
2	2011-10-08 11:53:44 UTC	-73.982524	40.751260	-73.979654	40.746139
3	2012-12-01 21:12:12 UTC	-73.981160	40.767807	-73.990448	40.751635
4	2012-12-01 21:12:12 UTC	-73.966046	40.789775	-73.988565	40.744427
5	2012-12-01 21:12:12 UTC	-73.960983	40.765547	-73.979177	40.740053
6	2011-10-06 12:10:20 UTC	-73.949013	40.773204	-73.959622	40.770893
7	2011-10-06 12:10:20 UTC	-73.777282	40.646636	-73.985083	40.759368
8	2011-10-06 12:10:20 UTC	-74.014099	40.709638	-73.995106	40.741365
9	2014-02-18 15:22:20 UTC	-73.969582	40.765519	-73.980686	40.770725
10	2014-02-18 15:22:20 UTC	-73.989374	40.741973	-73.999300	40.722534
11	2014-02-18 15:22:20 UTC	-74.001614	40.740893	-73.956387	40.767437
12	2010-03-29 20:20:32 UTC	-73.991198	40.739937	-73.997166	40.735269
13	2010-03-29 20:20:32 UTC	-73.982034	40.762723	-74.001867	40.761545
14	2011-10-06 03:59:12 UTC	-73.992455	40.728701	-73.983397	40.750149
15	2011-10-06 03:59:12 UTC	-73.983583	40.746993	-73.951178	40.785903
16	2012-07-15 16:45:04 UTC	-74.006746	40.731721	-74.010204	40.732318
17	2012-07-15 16:45:04 UTC	-73.976446	40.785598	-73.952220	40.772121
18	2012-07-15 16:45:04 UTC	-73.973548	40.763349	-73.972096	40.756417
19	2012-07-15 16:45:04 UTC	-73.970918	40.756025	-73.975954	40.755563
20	2014-10-29 02:09:56 UTC	-73.926071	40.705866	-73.941741	40.714789
21	2014-06-14 13:39:00 UTC	-73.970555	40.764702	-73.949132	40.771800
22	2014-06-14 13:39:00 UTC	-73.989102	40.736360	-73.992767	40.747767
23	2014-06-14 13:39:00 UTC	-74.003525	40.748480	-73.991520	40.762960

	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude
24	2014-06-14 13:39:00 UTC	-73.990352	40.759992	-74.015665	40.711682
25	2014-06-14 13:39:00 UTC	-73.989482	40.757450	-74.000850	40.762705
26	2014-06-14 13:39:00 UTC	-73.870785	40.773722	-73.741922	40.689945
27	2014-06-14 13:39:00 UTC	-73.992682	40.733877	-73.938852	40.808220
28	2014-06-14 13:39:00 UTC	-73.954020	40.778705	-73.950277	40.768810
29	2014-06-14 13:39:00 UTC	-73.972742	40.743432	-74.007125	40.710192
...	...	...	...	...	...
9884	2013-09-25 22:00:00 UTC	-73.790022	40.643817	-73.735688	40.773400
9885	2013-09-25 22:00:00 UTC	-74.007878	40.722762	-73.965740	40.754505
9886	2013-09-25 22:00:00 UTC	-73.978852	40.752837	-73.941152	40.812722
9887	2013-09-25 22:00:00 UTC	-73.959087	40.783282	-73.978802	40.785655
9888	2013-09-25 22:00:00 UTC	-73.956488	40.767512	-73.956488	40.767512
9889	2013-09-25 22:00:00 UTC	-73.966650	40.714675	-73.971912	40.693667
9890	2013-09-25 22:00:00 UTC	-73.976602	40.754152	-73.993297	40.730887
9891	2013-09-25 22:00:00 UTC	-73.987185	40.760505	-73.938755	40.799507
9892	2013-09-25 22:00:00 UTC	-73.969175	40.757770	-73.952318	40.781030
9893	2013-09-25 22:00:00 UTC	-73.949657	40.796197	-73.911755	40.827672
9894	2013-09-25 22:00:00 UTC	-74.002267	40.730415	-73.990360	40.756807
9895	2013-09-25 22:00:00 UTC	-73.985840	40.731167	-73.953883	40.653937
9896	2013-09-25 22:00:00 UTC	-73.955490	40.776862	-73.982162	40.769302
9897	2015-02-20 11:08:29 UTC	-73.965782	40.805538	-73.982384	40.761600
9898	2015-01-12 15:36:37 UTC	-73.979042	40.777515	-73.983658	40.781082
9899	2015-06-07 00:38:14 UTC	-73.983238	40.764874	-73.922928	40.743458
9900	2015-04-12 21:56:22 UTC	-73.962952	40.772480	-73.976051	40.786289
9901	2015-04-10 11:56:54 UTC	-73.977943	40.762753	-73.976219	40.776451

	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude
9902	2015-06-25 01:01:46 UTC	-73.905525	40.752655	-73.864151	40.737091
9903	2015-05-29 10:02:42 UTC	-73.988403	40.738731	-73.992340	40.759193
9904	2015-06-30 20:03:50 UTC	-73.776848	40.645035	-73.955460	40.652458
9905	2015-02-27 19:36:02 UTC	-73.989647	40.767406	-73.941177	40.845696
9906	2015-06-15 01:00:06 UTC	-73.988052	40.720776	-73.991043	40.718346
9907	2015-02-03 09:00:58 UTC	-73.863457	40.769611	-73.980995	40.763241
9908	2015-05-19 13:58:11 UTC	-73.987968	40.718922	-73.982124	40.732956
9909	2015-05-10 12:37:51 UTC	-73.968124	40.796997	-73.955643	40.780388
9910	2015-01-12 17:05:51 UTC	-73.945511	40.803600	-73.960213	40.776371
9911	2015-04-19 20:44:15 UTC	-73.991600	40.726608	-73.789742	40.647011
9912	2015-01-31 01:05:19 UTC	-73.985573	40.735432	-73.939178	40.801731
9913	2015-01-18 14:06:23 UTC	-73.988022	40.754070	-74.000282	40.759220

9914 rows × 6 columns

In [10]:

```
train_data.shape
```

Out[10]:

```
(16067, 7)
```

In [11]:

```
test_data.shape
```

Out[11]:

```
(9914, 6)
```

In [12]:

```
train_data.describe()
```

Out[12]:

	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_count
count	16067.000000	16067.000000	16067.000000	16067.000000	16012.000000
mean	-72.462787	39.914725	-72.462328	39.897906	2.625070
std	10.578384	6.826587	10.575062	6.187087	60.844122
min	-74.438233	-74.006893	-74.429332	-74.006377	0.000000
25%	-73.992156	40.734927	-73.991182	40.734651	1.000000
50%	-73.981698	40.752603	-73.980172	40.753567	1.000000
75%	-73.966838	40.767381	-73.963643	40.768013	2.000000
max	40.766125	401.083332	40.802437	41.366138	5345.000000

In [13]:

```
train_data.dtypes
```

Out[13]:

```
fare_amount          object
pickup_datetime      object
pickup_longitude    float64
pickup_latitude     float64
dropoff_longitude   float64
dropoff_latitude    float64
passenger_count     float64
dtype: object
```

In [14]:

```
test_data.describe()
```

Out[14]:

	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_count
count	9914.000000	9914.000000	9914.000000	9914.000000	9914.000000
mean	-73.974722	40.751041	-73.973657	40.751743	1.671273
std	0.042774	0.033541	0.039072	0.035435	1.278747
min	-74.252193	40.573143	-74.263242	40.568973	1.000000
25%	-73.992501	40.736125	-73.991247	40.735254	1.000000
50%	-73.982326	40.753051	-73.980015	40.754065	1.000000
75%	-73.968013	40.767113	-73.964059	40.768757	2.000000
max	-72.986532	41.709555	-72.990963	41.696683	6.000000

In [15]:

```
test_data.dtypes
```

Out[15]:

```
pickup_datetime       object
pickup_longitude     float64
pickup_latitude      float64
dropoff_longitude    float64
dropoff_latitude     float64
passenger_count        int64
dtype: object
```

In [16]:

```
train_data.dropna(subset= ["pickup_datetime"])
```

Out[16]:

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dr
0	4.5	2009-06-15 17:26:21 UTC	-73.844311	40.721319	-73.841610	
1	16.9	2010-01-05 16:52:16 UTC	-74.016048	40.711303	-73.979268	
2	5.7	2011-08-18 00:35:00 UTC	-73.982738	40.761270	-73.991242	
3	7.7	2012-04-21 04:30:42 UTC	-73.987130	40.733143	-73.991567	
4	5.3	2010-03-09 07:51:00 UTC	-73.968095	40.768008	-73.956655	
5	12.1	2011-01-06 09:50:45 UTC	-74.000964	40.731630	-73.972892	
6	7.5	2012-11-20 20:35:00 UTC	-73.980002	40.751662	-73.973802	
7	16.5	2012-01-04 17:22:00 UTC	-73.951300	40.774138	-73.990095	
8	NaN	2012-12-03 13:10:00 UTC	-74.006462	40.726713	-73.993078	
9	8.9	2009-09-02 01:11:00 UTC	-73.980658	40.733873	-73.991540	
10	5.3	2012-04-08 07:30:50 UTC	-73.996335	40.737142	-73.980721	
11	5.5	2012-12-24 11:24:00 UTC	0.000000	0.000000	0.000000	
12	4.1	2009-11-06 01:04:03 UTC	-73.991601	40.744712	-73.983081	
13	7	2013-07-02 19:54:00 UTC	-74.005360	40.728867	-74.008913	
14	7.7	2011-04-05 17:11:05 UTC	-74.001821	40.737547	-73.998060	
15	5	2013-11-23 12:57:00 UTC	0.000000	0.000000	0.000000	
16	12.5	2014-02-19 07:22:00 UTC	-73.986430	40.760465	-73.988990	
17	5.3	2009-07-22 16:08:00 UTC	-73.981060	40.737690	-73.994177	
18	5.3	2010-07-07 14:52:00 UTC	-73.969505	40.784843	-73.958732	
19	4	2014-12-06 20:36:22 UTC	-73.979815	40.751902	-73.979446	
20	10.5	2010-09-07 13:18:00 UTC	-73.985382	40.747858	-73.978377	
21	11.5	2013-02-12 12:15:46 UTC	-73.957954	40.779252	-73.961250	
22	4.5	2009-08-06 18:17:23 UTC	-73.991707	40.770505	-73.985459	
23	4.9	2010-12-06 12:29:00 UTC	-74.000632	40.747473	-73.986672	

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dr
24	6.1	2009-12-10 15:37:00 UTC	-73.969622	40.756973	-73.981152	
25	7.3	2011-06-21 16:15:00 UTC	-73.991875	40.754437	-73.977230	
26	NaN	2011-02-07 20:01:00 UTC	0.000000	0.000000	0.000000	
27	4.5	2011-06-28 19:47:00 UTC	-73.988893	40.760160	-73.986445	
28	9.3	2012-05-04 06:11:20 UTC	-73.989258	40.690835	-74.004133	
29	4.5	2013-08-11 00:52:00 UTC	-73.981020	40.737760	-73.980668	
...	...	...	...	...	...	
16037	6.5	2012-02-27 21:40:50 UTC	-73.992618	40.723878	-73.977073	
16038	5.7	2010-08-31 10:43:42 UTC	-73.990336	40.718973	-73.956060	
16039	12.9	2010-12-11 16:25:00 UTC	-73.936462	40.794292	-73.948747	
16040	6.5	2014-06-16 00:05:19 UTC	-73.980597	40.744267	-73.979330	
16041	11	2014-11-17 21:53:00 UTC	-73.983610	40.747090	-73.961310	
16042	8.5	2015-04-06 21:53:06 UTC	-73.991425	40.749832	-74.000107	
16043	8.5	2011-11-17 10:58:05 UTC	-73.973961	40.764055	-73.986807	
16044	16.5	2013-04-29 03:05:45 UTC	-73.982785	40.731421	-74.011358	
16045	6.5	2013-09-19 23:56:00 UTC	-73.995227	40.733475	-73.984030	
16046	6	2014-04-24 01:48:40 UTC	-73.976298	40.753948	-73.993062	
16047	6.1	2010-03-18 11:09:00 UTC	-73.970733	40.758193	-73.979457	
16048	9.7	2012-07-10 17:32:00 UTC	-73.988040	40.774902	-74.005265	
16049	15.7	2012-07-31 12:27:00 UTC	-74.008657	40.715975	-73.975653	
16050	8.5	2013-01-23 07:36:49 UTC	-73.996715	40.742504	-73.977987	
16051	11.5	2014-10-01 20:05:00 UTC	-73.975540	40.755590	-73.944780	
16052	10	2014-10-03 22:24:00 UTC	-73.987298	40.722007	-74.000267	
16053	4	2014-09-23 09:49:00 UTC	-73.954977	40.788582	-73.964227	
16054	5.3	2009-11-28 15:58:02 UTC	-73.993929	40.756944	-73.993044	

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	di
16055	48.3	2012-09-05 17:34:00 UTC	-73.994077	40.741242	-73.830257	
16056	38.3	2012-12-17 14:59:16 UTC	0.000000	0.000000	0.000000	
16057	5	2013-01-31 15:46:00 UTC	-73.963582	40.774242	-73.956525	
16058	5.5	2014-04-19 14:58:57 UTC	-73.974265	40.756048	-73.980885	
16059	5.3	2010-01-03 18:26:00 UTC	-73.973297	40.743768	-73.986060	
16060	22	2014-10-01 09:15:00 UTC	-73.954582	40.778047	-74.005982	
16061	10.9	2009-05-20 18:56:42 UTC	-73.994191	40.751138	-73.962769	
16062	6.5	2014-12-12 07:41:00 UTC	-74.008820	40.718757	-73.998865	
16063	16.1	2009-07-13 07:58:00 UTC	-73.981310	40.781695	-74.014392	
16064	8.5	2009-11-11 11:19:07 UTC	-73.972507	40.753417	-73.979577	
16065	8.1	2010-05-11 23:53:00 UTC	-73.957027	40.765945	-73.981983	
16066	8.5	2011-12-14 06:24:33 UTC	-74.002111	40.729755	-73.983877	

16067 rows × 7 columns

In [17]:

```
#Applying necessary data type conversions#

train_data['pickup_datetime'] =  pd.to_datetime(train_data['pickup_datetime'],errors =
"coerce")
```

In [18]:

```
#Converting the pasenger count to factor/object #
train_data['passenger_count'] = train_data['passenger_count'].astype(object)
```

In [19]:

```
train_data.dtypes
```

Out[19]:

```
fare_amount                       object
pickup_datetime      datetime64[ns, UTC]
pickup_longitude                 float64
pickup_latitude                  float64
dropoff_longitude                float64
dropoff_latitude                 float64
passenger_count                   object
dtype: object
```

In [20]:

```
sns.set()
```

In [21]:

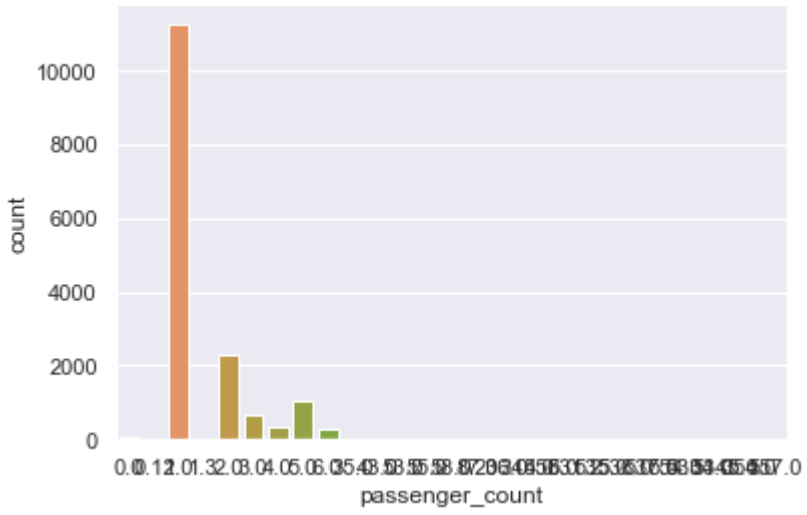
```
%matplotlib inline
```

In [22]:

```
plt.figure
sns.countplot(x='passenger_count', data = train_data)
```

Out[22]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13b250f28>
```



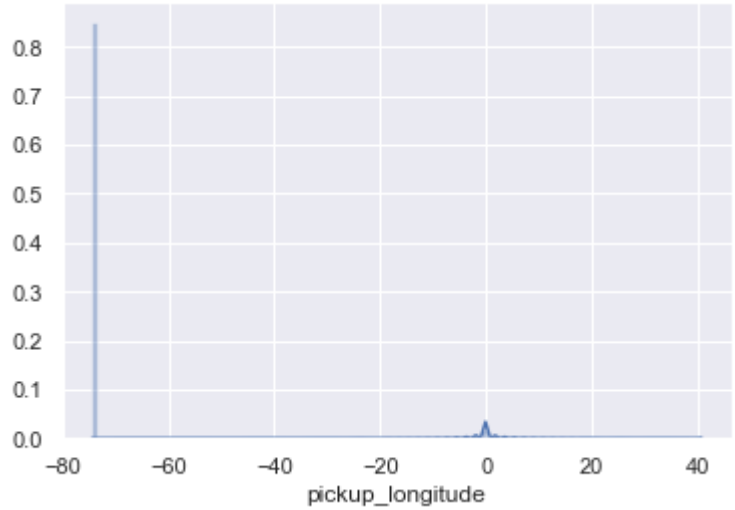
In [23]:

```
#From the above visualization it can be understood that there are numerous outlier pres
ent in the data#
#Hence we need to remove the unnecessary values and then proceed for data visualization
#
##Meanwhile let us see some other visualizations to get some idea##

plt.figure
sns.distplot(train_data['pickup_longitude'], bins = 100)
```

Out[23]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13b324860>
```

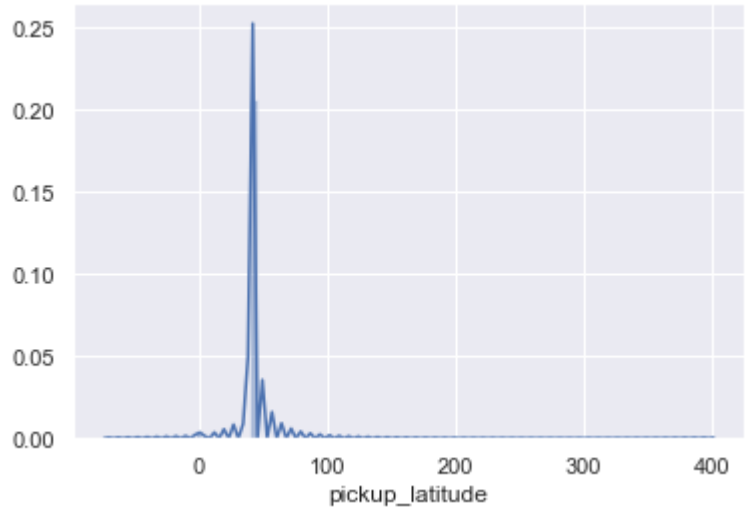


In [24]:

```
sns.distplot(train_data['pickup_latitude'], bins = 100)
```

Out[24]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13b49c668>
```

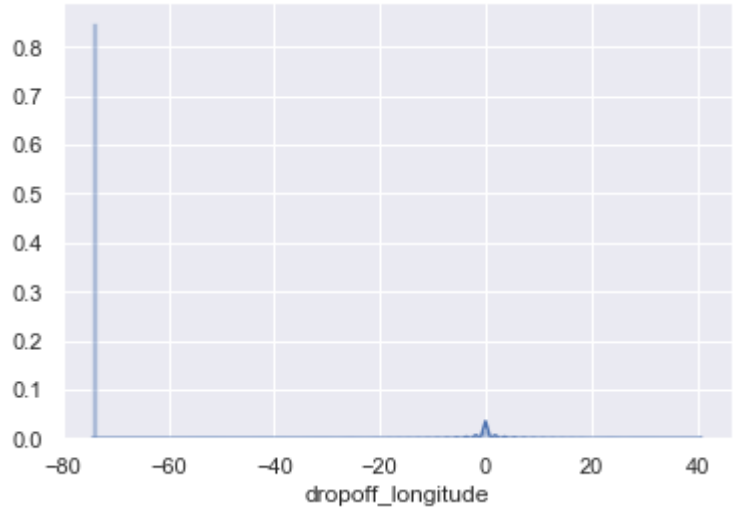


In [25]:

```
sns.distplot(train_data['dropoff_longitude'], bins = 100)
```

Out[25]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13b828ba8>
```

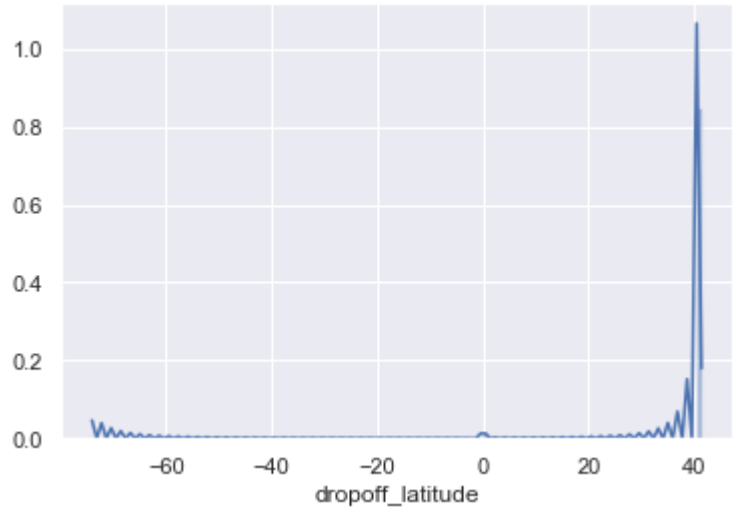


In [26]:

```
sns.distplot(train_data['dropoff_latitude'], bins = 100)
```

Out[26]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13b9412b0>
```



In [27]:

```
#Changing the datatype of fare_amount to float to obtain visualization#
train_data['fare_amount'] = pd.to_numeric(train_data['fare_amount'], errors = 'coerce')
```

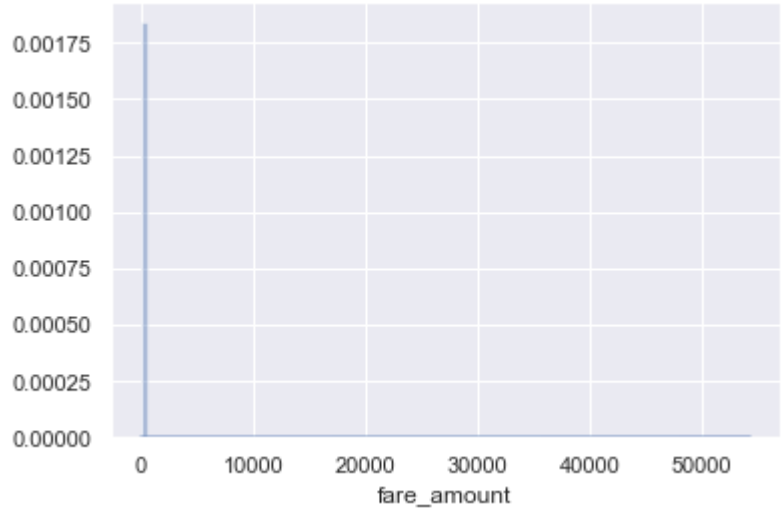
In [28]:

```
#Now applying the visualization on fareamount#
sns.distplot(train_data['fare_amount'], bins = 100)
```

```
D:\anaconda\lib\site-packages\numpy\lib\histograms.py:824: RuntimeWarning:
invalid value encountered in greater_equal
  keep = (tmp_a >= first_edge)
D:\anaconda\lib\site-packages\numpy\lib\histograms.py:825: RuntimeWarning:
invalid value encountered in less_equal
  keep &= (tmp_a <= last_edge)
D:\anaconda\lib\site-packages\statsmodels\nonparametric\kde.py:448: Runtim
eWarning: invalid value encountered in greater
  X = X[np.logical_and(X > clip[0], X < clip[1])] # won't work for two col
umns.
D:\anaconda\lib\site-packages\statsmodels\nonparametric\kde.py:448: Runtim
eWarning: invalid value encountered in less
  X = X[np.logical_and(X > clip[0], X < clip[1])] # won't work for two col
umns.
```

Out[28]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13ba9ab38>
```



In [29]:

```
#Missing value and outlier analysis#
#While creating the visualization for passenger_count we observed that there are many o
utliers present,
#hence we need to remove those outliers in following steps#

train_data['passenger_count']
```

Out[29]:

```
0          1
1          1
2          2
3          1
4          1
5          1
6          1
7          1
8          1
9          2
10         1
11         3
12         2
13         1
14         2
15         1
16         1
17         1
18         1
19         1
20         1
21         1
22         1
23         1
24         1
25         3
26         1
27         3
28         1
29         2
         ...
16037      1
16038      1
16039      5
16040      1
16041      1
16042      2
16043      2
16044      1
16045      2
16046      1
16047      1
16048      1
16049      4
16050      1
16051      2
16052      5
16053      1
16054      1
16055      1
16056      1
16057      6
16058      2
16059      3
16060      1
16061      1
16062      1
16063      2
16064      1
```

```
16065      1
16066    NaN
Name: passenger_count, Length: 16067, dtype: object
```

In [30]:

```
train_data['passenger_count'].sort_values (ascending = False)
```

Out[30]:

```
1146      5345
293       5334
8985       557
971        554
8506       537
1200       536
356        535
8715     531.2
263        456
386        354
1107       345
233        236
8571        87
8445        58
413         55
8406        53
1007        53
1242        43
8631        43
1043        35
4592         6
5675         6
10840        6
13041        6
13129        6
4595         6
11636        6
1077         6
8171         6
4873         6
          ...
734        NaN
773        NaN
788        NaN
842        NaN
899        NaN
941        NaN
1361       NaN
1399       NaN
1400       NaN
1459       NaN
1748       NaN
1790       NaN
1851       NaN
1921       NaN
1984       NaN
1987       NaN
2104       NaN
2230       NaN
2378       NaN
7787       NaN
7805       NaN
7847       NaN
7892       NaN
7937       NaN
8007       NaN
8076       NaN
8139       NaN
8259       NaN
```

```
8306       NaN
16066      NaN
Name: passenger_count, Length: 16067, dtype: object
```

In [31]:

```
train_data['passenger_count'].sort_values (ascending = True)
```

Out[31]:

```
4248       0
8661       0
11803      0
3034       0
4344       0
5557       0
3413       0
13379      0
7520       0
4114       0
6575       0
3481       0
15554      0
13742      0
5058       0
13714      0
5161       0
5688       0
7640       0
15286      0
4354       0
5277       0
1160       0
14196      0
11462      0
5517       0
314        0
10642      0
9965       0
3489       0
          ...
734      NaN
773      NaN
788      NaN
842      NaN
899      NaN
941      NaN
1361     NaN
1399     NaN
1400     NaN
1459     NaN
1748     NaN
1790     NaN
1851     NaN
1921     NaN
1984     NaN
1987     NaN
2104     NaN
2230     NaN
2378     NaN
7787     NaN
7805     NaN
7847     NaN
7892     NaN
7937     NaN
8007     NaN
8076     NaN
8139     NaN
8259     NaN
```

```
8306     NaN
16066    NaN
Name: passenger_count, Length: 16067, dtype: object
```

In [32]:

```
#By performing the sort operation we found that there are way too more extreme values t
hat we imagined#
#By viewing the data on descending order we found there are few entries having value mo
re than 6#
#By viewing the data on ascending order we found many entries having 0 value#
#Many NA values were also found#

train_data = train_data.drop(train_data[train_data['passenger_count']<1].index, axis=0)
```

In [33]:

```
train_data = train_data.drop(train_data[train_data['passenger_count']>6].index, axis=0)
```

In [34]:

```
train_data = train_data.drop(train_data[train_data['passenger_count'].isnull()].index,
axis=0)
```

In [35]:

```
print(train_data['passenger_count'].isnull().sum())
```

```
0
```

In [36]:

```
train_data.shape
```

Out[36]:

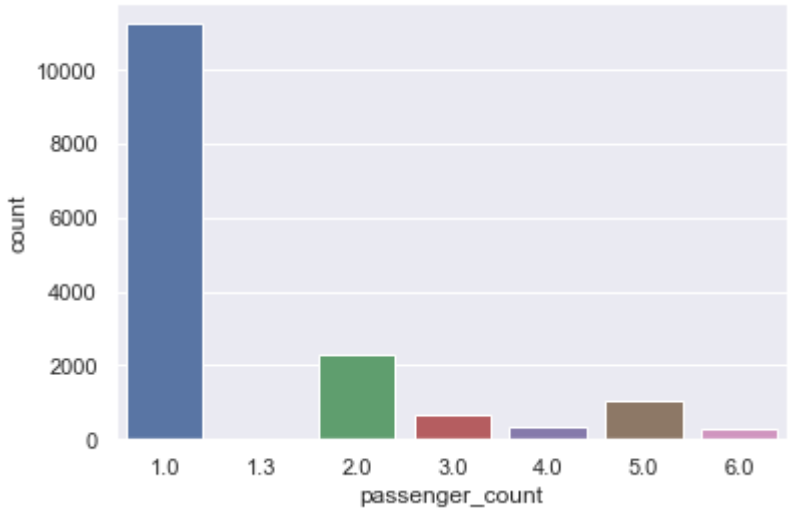
```
(15934, 7)
```

In [37]:

```
#Now we will plot the bar chart again after outlier removal#
plt.figure
sns.countplot(x='passenger_count', data = train_data)
```

Out[37]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13cbbdfd0>
```



In [38]:

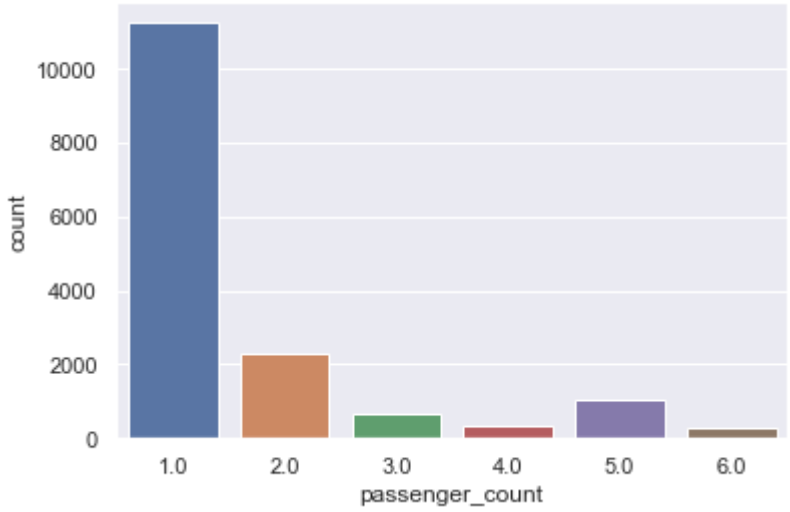
```
#It seems there is an entry on value 1.3 tht we need to remove#
train_data = train_data.drop(train_data[train_data['passenger_count']== 1.3].index, axi
s=0)
```

In [39]:

```
plt.figure
sns.countplot(x='passenger_count', data = train_data)
```

Out[39]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13cc84b00>
```



In [40]:

```
#Hurray now we have got a clear visualization without any outliers and missing values#
```

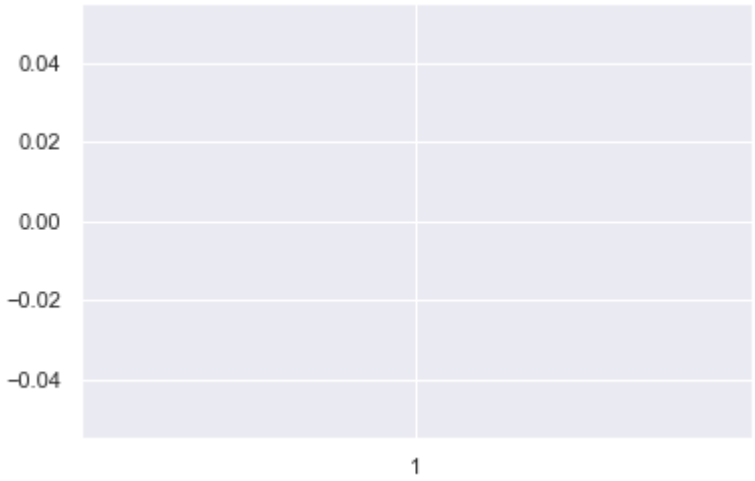
In [41]:

```
#Using boxplot for detrmining the outliers for rest of the variables#
%matplotlib inline
plt.boxplot(train_data['fare_amount'])
```

```
D:\anaconda\lib\site-packages\numpy\lib\function_base.py:3826: RuntimeWarn
ing: Invalid value encountered in percentile
  interpolation=interpolation)
D:\anaconda\lib\site-packages\matplotlib\cbook\__init__.py:1246: RuntimeWa
rning: invalid value encountered in less_equal
  wiskhi = np.compress(x <= hival, x)
D:\anaconda\lib\site-packages\matplotlib\cbook\__init__.py:1253: RuntimeWa
rning: invalid value encountered in greater_equal
  wisklo = np.compress(x >= loval, x)
D:\anaconda\lib\site-packages\matplotlib\cbook\__init__.py:1261: RuntimeWa
rning: invalid value encountered in less
  np.compress(x < stats['whislo'], x),
D:\anaconda\lib\site-packages\matplotlib\cbook\__init__.py:1262: RuntimeWa
rning: invalid value encountered in greater
  np.compress(x > stats['whishi'], x)
```

Out[41]:

```
{'whiskers': [<matplotlib.lines.Line2D at 0xd13cd0eda0>,
  <matplotlib.lines.Line2D at 0xd13cd9b438>],
 'caps': [<matplotlib.lines.Line2D at 0xd13cd9b7b8>,
  <matplotlib.lines.Line2D at 0xd13cd9bb38>],
 'boxes': [<matplotlib.lines.Line2D at 0xd13cd0e828>],
 'medians': [<matplotlib.lines.Line2D at 0xd13cd9be80>],
 'fliers': [<matplotlib.lines.Line2D at 0xd13cd9bf98>],
 'means': []}
```

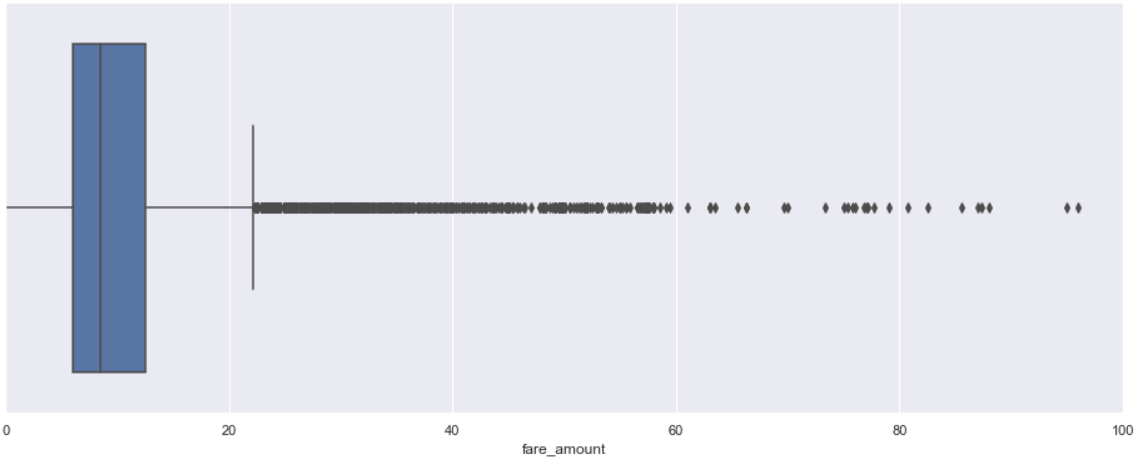


In [42]:

```
plt.figure(figsize=(16,6))
plt.xlim(0,100)
sns.boxplot(x=train_data['fare_amount'],data=train_data)
```

Out[42]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13cdb8ac8>
```

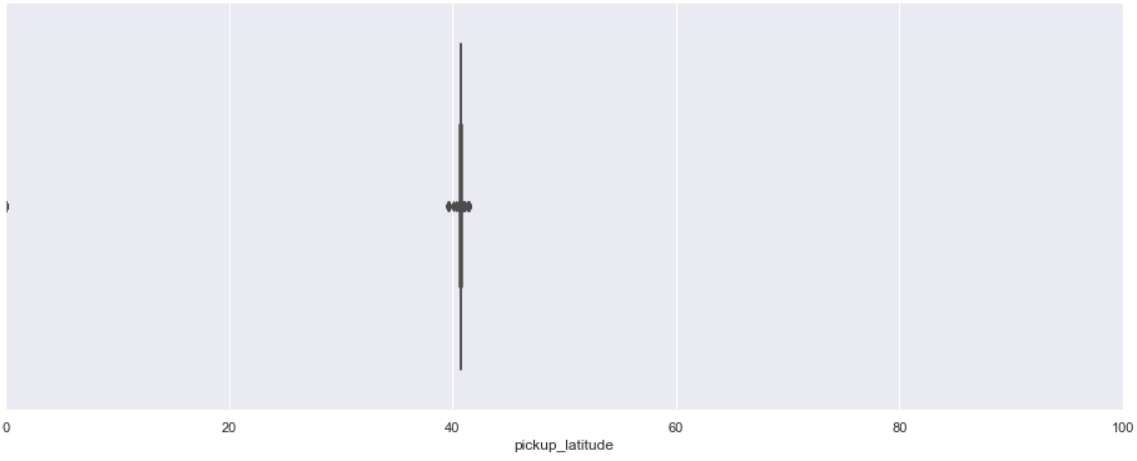


In [43]:

```
plt.figure(figsize=(16,6))
plt.xlim(0,100)
sns.boxplot(x=train_data['pickup_latitude'],data=train_data)
```

Out[43]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13ce15b70>
```



In [44]:

```
#############################################################################################
##
# We first tried to remove the outliers by the below formula of dropping outlier values
#

#But it didn't turn out to be helpful as we still found outlers in our dataset#
#Hence we chose to manually remove the outliers in the dataset and not by following ste
p#

#cnames = ["fare_amount","pickup_longitude", "pickup_latitude", "dropoff_longitude", "d
ropoff_latitude"]

#for i in cnames:

#   print (i)
#   q75, q25 = np.percentile(train_data.loc[:,i], [75 ,25])
#   print(q75,q25)
#   iqr = q75 - q25
#   min = q25 - (iqr*1.5)
#   max = q75 + (iqr*1.5)
#   print(min)
#   print(max)
#   train_data = train_data.drop(train_data[train_data.loc[:,i]<min].index)
#   train_data = train_data.drop(train_data[train_data.loc[:,i]>max].index)##
#############################################################################
```

Outlier removal operation for re

In [45]:

```
train_data.isnull().sum()
```

Out[45]:

```
fare_amount          24
pickup_datetime       1
pickup_longitude      0
pickup_latitude       0
dropoff_longitude     0
dropoff_latitude      0
passenger_count       0
dtype: int64
```

In [46]:

```
!pip install fancyimpute
from fancyimpute import KNN
train_data = pd.DataFrame(KNN(k = 3).complete(train_data), columns = train_data.columns
)
```

```
Collecting fancyimpute
Requirement already satisfied: numpy>=1.10 in d:\anaconda\lib\site-package
s (from fancyimpute) (1.16.2)
Collecting cvxpy>=1.0.6 (from fancyimpute)
  Using cached https://files.pythonhosted.org/packages/d9/ed/90e0a13ad7ac4
e7cdc2aeaefed26cebb4922f205bb778199268863fa2fbe/cvxpy-1.0.25.tar.gz
Requirement already satisfied: scikit-learn>=0.21.2 in d:\anaconda\lib\sit
e-packages (from fancyimpute) (0.21.3)
Requirement already satisfied: keras>=2.0.0 in d:\anaconda\lib\site-packag
es (from fancyimpute) (2.3.1)
Requirement already satisfied: tensorflow in d:\anaconda\lib\site-packages
(from fancyimpute) (2.0.0)
Requirement already satisfied: knnimpute in d:\anaconda\lib\site-packages
(from fancyimpute) (0.1.0)
Requirement already satisfied: scipy in d:\anaconda\lib\site-packages (fro
m fancyimpute) (1.2.1)
Requirement already satisfied: osqp>=0.4.1 in d:\anaconda\lib\site-package
s (from cvxpy>=1.0.6->fancyimpute) (0.6.1)
Collecting ecos>=2 (from cvxpy>=1.0.6->fancyimpute)
  Using cached https://files.pythonhosted.org/packages/b9/3a/59aa93b573a22
fda44402383aeddcc2a081c31e61080af3da9d11855c77a/ecos-2.0.7.post1.tar.gz
Collecting scs>=1.1.3 (from cvxpy>=1.0.6->fancyimpute)
  Using cached https://files.pythonhosted.org/packages/f2/6e/dbdd778c64c19
20ae357a2013ea655d65a1f8b60f397d6e5549e4aafe8ec/scs-2.1.1-2.tar.gz
Collecting multiprocess (from cvxpy>=1.0.6->fancyimpute)
Requirement already satisfied: six in d:\anaconda\lib\site-packages (from
cvxpy>=1.0.6->fancyimpute) (1.12.0)
Requirement already satisfied: joblib>=0.11 in d:\anaconda\lib\site-packag
es (from scikit-learn>=0.21.2->fancyimpute) (0.14.0)
Requirement already satisfied: keras-preprocessing>=1.0.5 in d:\anaconda\l
ib\site-packages (from keras>=2.0.0->fancyimpute) (1.1.0)
Requirement already satisfied: keras-applications>=1.0.6 in d:\anaconda\li
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Building wheels for collected packages: cvxpy, ecos, scs
  Building wheel for cvxpy (setup.py): started
  Building wheel for cvxpy (setup.py): still running...
  Building wheel for cvxpy (setup.py): finished with status 'error'
  Complete output from command D:\anaconda\python.exe -u -c "import setupt
ools, tokenize;__file__='C:\\Users\\DEBAYA~1\\AppData\\Local\\Temp\\pip-in
stall-9utb3knj\\cvxpy\\setup.py';f=getattr(tokenize, 'open', open)(__file_
_);code=f.read().replace('\r\n', '\n');f.close();exec(compile(code, __file
__, 'exec'))" bdist_wheel -d C:\Users\DEBAYA~1\AppData\Local\Temp\pip-whee
l-rdr87gbj --python-tag cp37:
  running bdist_wheel
  running build
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alizers\quad_over_lin_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dc
p2cone\atom_canonicalizers\sigma_max_canon.py build\lib.win-amd64-3.7\cvxp
y\reductions\dcp2cone\atom_canonicalizers\__init__.py build\lib.win-amd64-
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nicalizers\eye_minus_inv_canon.py build\lib.win-amd64-3.7\cvxpy\reductions
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y\reductions\dgp2dcp\atom_canonicalizers\prod_canon.py build\lib.win-amd64
-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers\quad_form_canon.py build
\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers\quad_over_
lin_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_canonic
alizers\sum_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom
_canonicalizers\trace_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dg
p2dcp\atom_canonicalizers\zero_constr_canon.py build\lib.win-amd64-3.7\cvx
py\reductions\dgp2dcp\atom_canonicalizers\__init__.py build\lib.win-amd64-
3.7\cvxpy\reductions\eliminate_pwl\atom_canonicalizers\abs_canon.py build
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mum_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\eliminate_pwl\atom_c
anonicalizers\max_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\elimin
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nicalizers\quad_form_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\qp2
quad_form\atom_canonicalizers\quad_over_lin_canon.py build\lib.win-amd64-
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b.win-amd64-3.7\cvxpy\reductions\solvers\conic_solvers\cbc_conif.py build
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cos_bb_conif.py build\lib.win-amd64-3.7\cvxpy\reductions\solvers\conic_sol
vers\ecos_conif.py build\lib.win-amd64-3.7\cvxpy\reductions\solvers\conic_
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ic_solvers\glpk_mi_conif.py build\lib.win-amd64-3.7\cvxpy\reductions\solve
rs\conic_solvers\gurobi_conif.py build\lib.win-amd64-3.7\cvxpy\reductions
\solvers\conic_solvers\mosek_conif.py build\lib.win-amd64-3.7\cvxpy\reduct
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ductions\solvers\conic_solvers\super_scs_conif.py build\lib.win-amd64-3.7
\cvxpy\reductions\solvers\conic_solvers\xpress_conif.py build\lib.win-amd6
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-3.7\cvxpy\reductions\solvers\qp_solvers\osqp_qpif.py build\lib.win-amd64-
3.7\cvxpy\reductions\solvers\qp_solvers\qp_solver.py build\lib.win-amd64-
3.7\cvxpy\reductions\solvers\qp_solvers\__init__.py
  Skipping optional fixer: buffer
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  Fixing build\lib.win-amd64-3.7\cvxpy\error.py build\lib.win-amd64-3.7\cv
xpy\settings.py build\lib.win-amd64-3.7\cvxpy\__init__.py build\lib.win-am
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py build\lib.win-amd64-3.7\cvxpy\atoms\cummax.py build\lib.win-amd64-3.7\c
vxpy\atoms\dist_ratio.py build\lib.win-amd64-3.7\cvxpy\atoms\eye_minus_in
v.py build\lib.win-amd64-3.7\cvxpy\atoms\gen_lambda_max.py build\lib.win-a
md64-3.7\cvxpy\atoms\geo_mean.py build\lib.win-amd64-3.7\cvxpy\atoms\harmo
nic_mean.py build\lib.win-amd64-3.7\cvxpy\atoms\lambda_max.py build\lib.wi
n-amd64-3.7\cvxpy\atoms\lambda_min.py build\lib.win-amd64-3.7\cvxpy\atoms
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p.py build\lib.win-amd64-3.7\cvxpy\atoms\matrix_frac.py build\lib.win-amd6
4-3.7\cvxpy\atoms\max.py build\lib.win-amd64-3.7\cvxpy\atoms\min.py build
\lib.win-amd64-3.7\cvxpy\atoms\mixed_norm.py build\lib.win-amd64-3.7\cvxpy
\atoms\norm.py build\lib.win-amd64-3.7\cvxpy\atoms\norm1.py build\lib.win-
amd64-3.7\cvxpy\atoms\norm_inf.py build\lib.win-amd64-3.7\cvxpy\atoms\norm
_nuc.py build\lib.win-amd64-3.7\cvxpy\atoms\one_minus_pos.py build\lib.win
```

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-amd64-3.7\cvxpy\atoms\pf_eigenvalue.py build\lib.win-amd64-3.7\cvxpy\atom
s\pnorm.py build\lib.win-amd64-3.7\cvxpy\atoms\prod.py build\lib.win-amd64
-3.7\cvxpy\atoms\quad_form.py build\lib.win-amd64-3.7\cvxpy\atoms\quad_ove
r_lin.py build\lib.win-amd64-3.7\cvxpy\atoms\sigma_max.py build\lib.win-am
d64-3.7\cvxpy\atoms\sign.py build\lib.win-amd64-3.7\cvxpy\atoms\sum_larges
t.py build\lib.win-amd64-3.7\cvxpy\atoms\sum_smallest.py build\lib.win-amd
64-3.7\cvxpy\atoms\sum_squares.py build\lib.win-amd64-3.7\cvxpy\atoms\tota
l_variation.py build\lib.win-amd64-3.7\cvxpy\atoms\__init__.py build\lib.w
in-amd64-3.7\cvxpy\constraints\constraint.py build\lib.win-amd64-3.7\cvxpy
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\test_monotonicity.py build\lib.win-amd64-3.7\cvxpy\tests\test_mosek_coni
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xpy\tests\test_objectives.py build\lib.win-amd64-3.7\cvxpy\tests\test_prob
lem.py build\lib.win-amd64-3.7\cvxpy\tests\test_qp.py build\lib.win-amd64-
3.7\cvxpy\tests\test_quadratic.py build\lib.win-amd64-3.7\cvxpy\tests\test
_quad_form.py build\lib.win-amd64-3.7\cvxpy\tests\test_scs.py build\lib.wi
n-amd64-3.7\cvxpy\tests\test_semidefinite_vars.py build\lib.win-amd64-3.7
\cvxpy\tests\test_shape.py build\lib.win-amd64-3.7\cvxpy\tests\test_sign.p
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y build\lib.win-amd64-3.7\cvxpy\tests\test_solvers.py build\lib.win-amd64-
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tilities\__init__.py build\lib.win-amd64-3.7\cvxpy\atoms\affine\add_expr.p
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e\diag.py build\lib.win-amd64-3.7\cvxpy\atoms\affine\diff.py build\lib.win
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s\affine\imag.py build\lib.win-amd64-3.7\cvxpy\atoms\affine\index.py build
\lib.win-amd64-3.7\cvxpy\atoms\affine\kron.py build\lib.win-amd64-3.7\cvxp
y\atoms\affine\promote.py build\lib.win-amd64-3.7\cvxpy\atoms\affine\real.
py build\lib.win-amd64-3.7\cvxpy\atoms\affine\reshape.py build\lib.win-amd
64-3.7\cvxpy\atoms\affine\sum.py build\lib.win-amd64-3.7\cvxpy\atoms\affin
e\trace.py build\lib.win-amd64-3.7\cvxpy\atoms\affine\transpose.py build\l
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ffine\vec.py build\lib.win-amd64-3.7\cvxpy\atoms\affine\vstack.py build\li
b.win-amd64-3.7\cvxpy\atoms\affine\wraps.py build\lib.win-amd64-3.7\cvxpy
\atoms\affine\__init__.py build\lib.win-amd64-3.7\cvxpy\atoms\elementwise
\abs.py build\lib.win-amd64-3.7\cvxpy\atoms\elementwise\ceil.py build\lib.
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\log1p.py build\lib.win-amd64-3.7\cvxpy\atoms\elementwise\logistic.py buil
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s\elementwise\neg.py build\lib.win-amd64-3.7\cvxpy\atoms\elementwise\pos.p
y build\lib.win-amd64-3.7\cvxpy\atoms\elementwise\power.py build\lib.win-a
md64-3.7\cvxpy\atoms\elementwise\scalene.py build\lib.win-amd64-3.7\cvxpy
\atoms\elementwise\sqrt.py build\lib.win-amd64-3.7\cvxpy\atoms\elementwise
\square.py build\lib.win-amd64-3.7\cvxpy\atoms\elementwise\__init__.py bui
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amd64-3.7\cvxpy\cvxcore\python\cvxcore.py build\lib.win-amd64-3.7\cvxpy\cv
xcore\python\__init__.py build\lib.win-amd64-3.7\cvxpy\expressions\constan
ts\callback_param.py build\lib.win-amd64-3.7\cvxpy\expressions\constants\c
onstant.py build\lib.win-amd64-3.7\cvxpy\expressions\constants\parameter.p
y build\lib.win-amd64-3.7\cvxpy\expressions\constants\__init__.py build\li
b.win-amd64-3.7\cvxpy\interface\numpy_interface\matrix_interface.py build
\lib.win-amd64-3.7\cvxpy\interface\numpy_interface\ndarray_interface.py bu
ild\lib.win-amd64-3.7\cvxpy\interface\numpy_interface\sparse_matrix_interf
ace.py build\lib.win-amd64-3.7\cvxpy\interface\numpy_interface\__init__.py
build\lib.win-amd64-3.7\cvxpy\reductions\complex2real\complex2real.py buil
```

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d\lib.win-amd64-3.7\cvxpy\reductions\complex2real\__init__.py build\lib.wi
n-amd64-3.7\cvxpy\reductions\dcp2cone\cone_matrix_stuffing.py build\lib.wi
n-amd64-3.7\cvxpy\reductions\dcp2cone\dcp2cone.py build\lib.win-amd64-3.7
\cvxpy\reductions\dcp2cone\__init__.py build\lib.win-amd64-3.7\cvxpy\reduc
tions\dgp2dcp\dgp2dcp.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp
\util.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\__init__.py buil
d\lib.win-amd64-3.7\cvxpy\reductions\dqcp2dcp\dqcp2dcp.py build\lib.win-am
d64-3.7\cvxpy\reductions\dqcp2dcp\inverse.py build\lib.win-amd64-3.7\cvxpy
\reductions\dqcp2dcp\sets.py build\lib.win-amd64-3.7\cvxpy\reductions\dqcp
2dcp\tighten.py build\lib.win-amd64-3.7\cvxpy\reductions\dqcp2dcp\__init_
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d\lib.win-amd64-3.7\cvxpy\reductions\qp2quad_form\qp2symbolic_qp.py build
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\cvxpy\reductions\solvers\compr_matrix.py build\lib.win-amd64-3.7\cvxpy\re
ductions\solvers\constant_solver.py build\lib.win-amd64-3.7\cvxpy\reductio
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ermediate_chain.py build\lib.win-amd64-3.7\cvxpy\reductions\solvers\kktsol
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b.win-amd64-3.7\cvxpy\reductions\solvers\solving_chain.py build\lib.win-am
d64-3.7\cvxpy\reductions\solvers\utilities.py build\lib.win-amd64-3.7\cvxp
y\reductions\solvers\__init__.py build\lib.win-amd64-3.7\cvxpy\reductions
\complex2real\atom_canonicalizers\abs_canon.py build\lib.win-amd64-3.7\cvx
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zers\matrix_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\complex2real
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ons\complex2real\atom_canonicalizers\param_canon.py build\lib.win-amd64-3.
7\cvxpy\reductions\complex2real\atom_canonicalizers\pnorm_canon.py build\l
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tom_canonicalizers\variable_canon.py build\lib.win-amd64-3.7\cvxpy\reducti
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\cvxpy\reductions\complex2real\atom_canonicalizers\__init__.py build\lib.w
in-amd64-3.7\cvxpy\reductions\dcp2cone\atom_canonicalizers\cumsum_canon.py
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_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dcp2cone\atom_canonical
izers\exp_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dcp2cone\atom_
canonicalizers\geo_mean_canon.py build\lib.win-amd64-3.7\cvxpy\reductions
\dcp2cone\atom_canonicalizers\huber_canon.py build\lib.win-amd64-3.7\cvxpy
\reductions\dcp2cone\atom_canonicalizers\indicator_canon.py build\lib.win-
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ild\lib.win-amd64-3.7\cvxpy\reductions\dcp2cone\atom_canonicalizers\lambda
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icalizers\lambda_sum_largest_canon.py build\lib.win-amd64-3.7\cvxpy\reduct
ions\dcp2cone\atom_canonicalizers\log1p_canon.py build\lib.win-amd64-3.7\c
vxpy\reductions\dcp2cone\atom_canonicalizers\logistic_canon.py build\lib.w
in-amd64-3.7\cvxpy\reductions\dcp2cone\atom_canonicalizers\log_canon.py bu
ild\lib.win-amd64-3.7\cvxpy\reductions\dcp2cone\atom_canonicalizers\log_de
t_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dcp2cone\atom_canonica
lizers\log_sum_exp_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dcp2c
one\atom_canonicalizers\matrix_frac_canon.py build\lib.win-amd64-3.7\cvxpy
\reductions\dcp2cone\atom_canonicalizers\normNuc_canon.py build\lib.win-am
d64-3.7\cvxpy\reductions\dcp2cone\atom_canonicalizers\pnorm_canon.py build
\lib.win-amd64-3.7\cvxpy\reductions\dcp2cone\atom_canonicalizers\power_can
on.py build\lib.win-amd64-3.7\cvxpy\reductions\dcp2cone\atom_canonicalizer
s\quad_form_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dcp2cone\ato
```

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m_canonicalizers\quad_over_lin_canon.py build\lib.win-amd64-3.7\cvxpy\redu
ctions\dcp2cone\atom_canonicalizers\sigma_max_canon.py build\lib.win-amd64
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ld\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers\constant
_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicali
zers\div_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_ca
nonicalizers\exp_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp
\atom_canonicalizers\eye_minus_inv_canon.py build\lib.win-amd64-3.7\cvxpy
\reductions\dgp2dcp\atom_canonicalizers\geo_mean_canon.py build\lib.win-am
d64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers\log_canon.py build\li
b.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers\mulexpression
_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicali
zers\mul_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_ca
nonicalizers\nonpos_constr_canon.py build\lib.win-amd64-3.7\cvxpy\reductio
ns\dgp2dcp\atom_canonicalizers\norm1_canon.py build\lib.win-amd64-3.7\cvxp
y\reductions\dgp2dcp\atom_canonicalizers\norm_inf_canon.py build\lib.win-a
md64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers\one_minus_pos_canon.
py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers\pa
rameter_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_can
onicalizers\pf_eigenvalue_canon.py build\lib.win-amd64-3.7\cvxpy\reduction
s\dgp2dcp\atom_canonicalizers\pnorm_canon.py build\lib.win-amd64-3.7\cvxpy
\reductions\dgp2dcp\atom_canonicalizers\power_canon.py build\lib.win-amd64
-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers\prod_canon.py build\lib.
win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers\quad_form_cano
n.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers
\quad_over_lin_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\dgp2dcp\a
tom_canonicalizers\sum_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\d
gp2dcp\atom_canonicalizers\trace_canon.py build\lib.win-amd64-3.7\cvxpy\re
ductions\dgp2dcp\atom_canonicalizers\zero_constr_canon.py build\lib.win-am
d64-3.7\cvxpy\reductions\dgp2dcp\atom_canonicalizers\__init__.py build\li
b.win-amd64-3.7\cvxpy\reductions\eliminate_pwl\atom_canonicalizers\abs_can
on.py build\lib.win-amd64-3.7\cvxpy\reductions\eliminate_pwl\atom_canonica
lizers\maximum_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\eliminate
_pwl\atom_canonicalizers\max_canon.py build\lib.win-amd64-3.7\cvxpy\reduct
ions\eliminate_pwl\atom_canonicalizers\minimum_canon.py build\lib.win-amd6
4-3.7\cvxpy\reductions\eliminate_pwl\atom_canonicalizers\min_canon.py buil
d\lib.win-amd64-3.7\cvxpy\reductions\eliminate_pwl\atom_canonicalizers\nor
m1_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\eliminate_pwl\atom_ca
nonicalizers\norm_inf_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\el
iminate_pwl\atom_canonicalizers\sum_largest_canon.py build\lib.win-amd64-
3.7\cvxpy\reductions\eliminate_pwl\atom_canonicalizers\__init__.py build\l
ib.win-amd64-3.7\cvxpy\reductions\qp2quad_form\atom_canonicalizers\huber_c
anon.py build\lib.win-amd64-3.7\cvxpy\reductions\qp2quad_form\atom_canonic
alizers\power_canon.py build\lib.win-amd64-3.7\cvxpy\reductions\qp2quad_fo
rm\atom_canonicalizers\quad_form_canon.py build\lib.win-amd64-3.7\cvxpy\re
ductions\qp2quad_form\atom_canonicalizers\quad_over_lin_canon.py build\li
b.win-amd64-3.7\cvxpy\reductions\qp2quad_form\atom_canonicalizers\__init_
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nif.py build\lib.win-amd64-3.7\cvxpy\reductions\solvers\conic_solvers\coni
c_solver.py build\lib.win-amd64-3.7\cvxpy\reductions\solvers\conic_solvers
\cplex_conif.py build\lib.win-amd64-3.7\cvxpy\reductions\solvers\conic_sol
vers\cvxopt_conif.py build\lib.win-amd64-3.7\cvxpy\reductions\solvers\coni
c_solvers\ecos_bb_conif.py build\lib.win-amd64-3.7\cvxpy\reductions\solver
s\conic_solvers\ecos_conif.py build\lib.win-amd64-3.7\cvxpy\reductions\sol
vers\conic_solvers\glpk_conif.py build\lib.win-amd64-3.7\cvxpy\reductions
\solvers\conic_solvers\glpk_mi_conif.py build\lib.win-amd64-3.7\cvxpy\redu
ctions\solvers\conic_solvers\gurobi_conif.py build\lib.win-amd64-3.7\cvxpy
\reductions\solvers\conic_solvers\mosek_conif.py build\lib.win-amd64-3.7\c
vxpy\reductions\solvers\conic_solvers\nag_conif.py build\lib.win-amd64-3.7
\cvxpy\reductions\solvers\conic_solvers\scs_conif.py build\lib.win-amd64-
```

```
3.7\cvxpy\reductions\solvers\conic_solvers\super_scs_conif.py build\lib.wi
n-amd64-3.7\cvxpy\reductions\solvers\conic_solvers\xpress_conif.py build\l
ib.win-amd64-3.7\cvxpy\reductions\solvers\conic_solvers\__init__.py build
\lib.win-amd64-3.7\cvxpy\reductions\solvers\lp_solvers\cbc_lpif.py build\l
ib.win-amd64-3.7\cvxpy\reductions\solvers\lp_solvers\__init__.py build\li
b.win-amd64-3.7\cvxpy\reductions\solvers\qp_solvers\cplex_qpif.py build\li
b.win-amd64-3.7\cvxpy\reductions\solvers\qp_solvers\gurobi_qpif.py build\l
ib.win-amd64-3.7\cvxpy\reductions\solvers\qp_solvers\osqp_qpif.py build\li
b.win-amd64-3.7\cvxpy\reductions\solvers\qp_solvers\qp_solver.py build\li
b.win-amd64-3.7\cvxpy\reductions\solvers\qp_solvers\__init__.py
  Skipping optional fixer: buffer
  Skipping optional fixer: idioms
  Skipping optional fixer: set_literal
  Skipping optional fixer: ws_comma
  running build_ext
  building '_cvxcore' extension
  error: Microsoft Visual C++ 14.0 is required. Get it with "Microsoft Vis
ual C++ Build Tools": https://visualstudio.microsoft.com/downloads/

  ----------------------------------------
  Running setup.py clean for cvxpy
  Building wheel for ecos (setup.py): started
  Building wheel for ecos (setup.py): finished with status 'error'
  Complete output from command D:\anaconda\python.exe -u -c "import setupt
ools, tokenize;__file__='C:\\Users\\DEBAYA~1\\AppData\\Local\\Temp\\pip-in
stall-9utb3knj\\ecos\\setup.py';f=getattr(tokenize, 'open', open)(__file_
_);code=f.read().replace('\r\n', '\n');f.close();exec(compile(code, __file
__, 'exec'))" bdist_wheel -d C:\Users\DEBAYA~1\AppData\Local\Temp\pip-whee
l-rtto6qzo --python-tag cp37:
  running bdist_wheel
  running build
  running build_py
  creating build
  creating build\lib.win-amd64-3.7
  creating build\lib.win-amd64-3.7\ecos
  copying src\ecos\ecos.py -> build\lib.win-amd64-3.7\ecos
  copying src\ecos\version.py -> build\lib.win-amd64-3.7\ecos
  copying src\ecos\__init__.py -> build\lib.win-amd64-3.7\ecos
  running build_ext
  building '_ecos' extension
  error: Microsoft Visual C++ 14.0 is required. Get it with "Microsoft Vis
ual C++ Build Tools": https://visualstudio.microsoft.com/downloads/

  ----------------------------------------
  Running setup.py clean for ecos
  Building wheel for scs (setup.py): started
  Building wheel for scs (setup.py): finished with status 'error'
  Complete output from command D:\anaconda\python.exe -u -c "import setupt
ools, tokenize;__file__='C:\\Users\\DEBAYA~1\\AppData\\Local\\Temp\\pip-in
stall-9utb3knj\\scs\\setup.py';f=getattr(tokenize, 'open', open)(__file_
_);code=f.read().replace('\r\n', '\n');f.close();exec(compile(code, __file
__, 'exec'))" bdist_wheel -d C:\Users\DEBAYA~1\AppData\Local\Temp\pip-whee
l-hq8gblr8 --python-tag cp37:
  Namespace(blas64=False, extraverbose=False, float32=False, gpu=False, in
t32=False, scs=False)
  D:\anaconda\lib\site-packages\setuptools\dist.py:484: UserWarning: The v
ersion specified ('2.1.1_2') is an invalid version, this may not work as e
xpected with newer versions of setuptools, pip, and PyPI. Please see PEP 4
40 for more details.
    "details." % self.metadata.version
  running bdist_wheel
```

```
    running build
    running build_py
    creating build
    creating build\lib.win-amd64-3.7
    creating build\lib.win-amd64-3.7\scs
    copying src\__init__.py -> build\lib.win-amd64-3.7\scs
    running build_ext
    mkl_info:
        libraries = ['mkl_rt']
        library_dirs = ['D:/anaconda\\Library\\lib']
        define_macros = [('SCIPY_MKL_H', None), ('HAVE_CBLAS', None)]
        include_dirs = ['C:\\Program Files (x86)\\IntelSWTools\\compilers_an
  d_libraries_2019.0.117\\windows\\mkl', 'C:\\Program Files (x86)\\IntelSWTo
  ols\\compilers_and_libraries_2019.0.117\\windows\\mkl\\include', 'C:\\Prog
  ram Files (x86)\\IntelSWTools\\compilers_and_libraries_2019.0.117\\windows
  \\mkl\\lib', 'D:/anaconda\\Library\\include']
    blas_mkl_info:
        libraries = ['mkl_rt']
        library_dirs = ['D:/anaconda\\Library\\lib']
        define_macros = [('SCIPY_MKL_H', None), ('HAVE_CBLAS', None)]
        include_dirs = ['C:\\Program Files (x86)\\IntelSWTools\\compilers_an
  d_libraries_2019.0.117\\windows\\mkl', 'C:\\Program Files (x86)\\IntelSWTo
  ols\\compilers_and_libraries_2019.0.117\\windows\\mkl\\include', 'C:\\Prog
  ram Files (x86)\\IntelSWTools\\compilers_and_libraries_2019.0.117\\windows
  \\mkl\\lib', 'D:/anaconda\\Library\\include']
    blas_opt_info:
        libraries = ['mkl_rt']
        library_dirs = ['D:/anaconda\\Library\\lib']
        define_macros = [('SCIPY_MKL_H', None), ('HAVE_CBLAS', None)]
        include_dirs = ['C:\\Program Files (x86)\\IntelSWTools\\compilers_an
  d_libraries_2019.0.117\\windows\\mkl', 'C:\\Program Files (x86)\\IntelSWTo
  ols\\compilers_and_libraries_2019.0.117\\windows\\mkl\\include', 'C:\\Prog
  ram Files (x86)\\IntelSWTools\\compilers_and_libraries_2019.0.117\\windows
  \\mkl\\lib', 'D:/anaconda\\Library\\include']
    lapack_mkl_info:
        libraries = ['mkl_rt']
        library_dirs = ['D:/anaconda\\Library\\lib']
        define_macros = [('SCIPY_MKL_H', None), ('HAVE_CBLAS', None)]
        include_dirs = ['C:\\Program Files (x86)\\IntelSWTools\\compilers_an
  d_libraries_2019.0.117\\windows\\mkl', 'C:\\Program Files (x86)\\IntelSWTo
  ols\\compilers_and_libraries_2019.0.117\\windows\\mkl\\include', 'C:\\Prog
  ram Files (x86)\\IntelSWTools\\compilers_and_libraries_2019.0.117\\windows
  \\mkl\\lib', 'D:/anaconda\\Library\\include']
    lapack_opt_info:
        libraries = ['mkl_rt']
        library_dirs = ['D:/anaconda\\Library\\lib']
        define_macros = [('SCIPY_MKL_H', None), ('HAVE_CBLAS', None)]
        include_dirs = ['C:\\Program Files (x86)\\IntelSWTools\\compilers_an
  d_libraries_2019.0.117\\windows\\mkl', 'C:\\Program Files (x86)\\IntelSWTo
  ols\\compilers_and_libraries_2019.0.117\\windows\\mkl\\include', 'C:\\Prog
  ram Files (x86)\\IntelSWTools\\compilers_and_libraries_2019.0.117\\windows
  \\mkl\\lib', 'D:/anaconda\\Library\\include']
    Could not locate executable g77
    Could not locate executable f77
    Could not locate executable ifort
    Could not locate executable ifl
    Could not locate executable f90
    Could not locate executable DF
    Could not locate executable efl
    Could not locate executable gfortran
    Could not locate executable f95
```

```
    Could not locate executable g95
    Could not locate executable efort
    Could not locate executable efc
    Could not locate executable flang
    don't know how to compile Fortran code on platform 'nt'
    D:\anaconda\lib\site-packages\numpy\distutils\system_info.py:638: UserWa
  rning:
        Atlas (http://math-atlas.sourceforge.net/) libraries not found.
        Directories to search for the libraries can be specified in the
        numpy/distutils/site.cfg file (section [atlas]) or by setting
        the ATLAS environment variable.
      self.calc_info()
    D:\anaconda\lib\site-packages\numpy\distutils\system_info.py:638: UserWa
  rning:
        Blas (http://www.netlib.org/blas/) libraries not found.
        Directories to search for the libraries can be specified in the
        numpy/distutils/site.cfg file (section [blas]) or by setting
        the BLAS environment variable.
      self.calc_info()
    D:\anaconda\lib\site-packages\numpy\distutils\system_info.py:638: UserWa
  rning:
        Blas (http://www.netlib.org/blas/) sources not found.
        Directories to search for the sources can be specified in the
        numpy/distutils/site.cfg file (section [blas_src]) or by setting
        the BLAS_SRC environment variable.
      self.calc_info()
    D:\anaconda\lib\site-packages\numpy\distutils\system_info.py:638: UserWa
  rning:
        Lapack (http://www.netlib.org/lapack/) libraries not found.
        Directories to search for the libraries can be specified in the
        numpy/distutils/site.cfg file (section [lapack]) or by setting
        the LAPACK environment variable.
      self.calc_info()
    D:\anaconda\lib\site-packages\numpy\distutils\system_info.py:638: UserWa
  rning:
        Lapack (http://www.netlib.org/lapack/) sources not found.
        Directories to search for the sources can be specified in the
        numpy/distutils/site.cfg file (section [lapack_src]) or by setting
        the LAPACK_SRC environment variable.
      self.calc_info()
    error: Microsoft Visual C++ 14.0 is required. Get it with "Microsoft Vis
  ual C++ Build Tools": https://visualstudio.microsoft.com/downloads/
    {}
    {}

    ----------------------------------------
    Running setup.py clean for scs
  Failed to build cvxpy ecos scs
  Installing collected packages: ecos, scs, dill, multiprocess, cvxpy, fancy
  impute
    Running setup.py install for ecos: started
      Running setup.py install for ecos: finished with status 'error'
      Complete output from command D:\anaconda\python.exe -u -c "import setu
  ptools, tokenize;__file__='C:\\Users\\DEBAYA~1\\AppData\\Local\\Temp\\pip-
  install-9utb3knj\\ecos\\setup.py';f=getattr(tokenize, 'open', open)(__file
  __);code=f.read().replace('\r\n', '\n');f.close();exec(compile(code, __fil
  e__, 'exec'))" install --record C:\Users\DEBAYA~1\AppData\Local\Temp\pip-r
  ecord-ch95zjdb\install-record.txt --single-version-externally-managed --co
  mpile:
      running install
      running build
```

```
    running build_py
    creating build
    creating build\lib.win-amd64-3.7
    creating build\lib.win-amd64-3.7\ecos
    copying src\ecos\ecos.py -> build\lib.win-amd64-3.7\ecos
    copying src\ecos\version.py -> build\lib.win-amd64-3.7\ecos
    copying src\ecos\__init__.py -> build\lib.win-amd64-3.7\ecos
    running build_ext
    building '_ecos' extension
    error: Microsoft Visual C++ 14.0 is required. Get it with "Microsoft V
isual C++ Build Tools": https://visualstudio.microsoft.com/downloads/

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


  Failed building wheel for cvxpy
  Failed building wheel for ecos
  Failed building wheel for scs
Command "D:\anaconda\python.exe -u -c "import setuptools, tokenize;__file_
_='C:\\Users\\DEBAYA~1\\AppData\\Local\\Temp\\pip-install-9utb3knj\\ecos
\\setup.py';f=getattr(tokenize, 'open', open)(__file__);code=f.read().repl
ace('\r\n', '\n');f.close();exec(compile(code, __file__, 'exec'))" install
--record C:\Users\DEBAYA~1\AppData\Local\Temp\pip-record-ch95zjdb\install-
record.txt --single-version-externally-managed --compile" failed with erro
r code 1 in C:\Users\DEBAYA~1\AppData\Local\Temp\pip-install-9utb3knj\ecos
\
```

```
---------------------------------------------------------------------------
-
ModuleNotFoundError                       Traceback (most recent call las
t)
<ipython-input-46-3464ad58c814> in <module>
      1 get_ipython().system('pip install fancyimpute')
----> 2 from fancyimpute import KNN
      3 train_data = pd.DataFrame(KNN(k = 3).complete(train_data), columns
= train_data.columns)

ModuleNotFoundError: No module named 'fancyimpute'
```

In [47]:

```
#Dropping NA values#
train_data = train_data.drop(train_data[train_data['fare_amount'].isnull()].index, axis
=0)
train_data = train_data.drop(train_data[train_data['pickup_datetime'].isnull()].index,
axis=0)
```

In [48]:

```
train_data.isnull().sum()
```

Out[48]:

```
fare_amount          0
pickup_datetime      0
pickup_longitude     0
pickup_latitude      0
dropoff_longitude    0
dropoff_latitude     0
passenger_count      0
dtype: int64
```

In [49]:

```
train_data
```

Out[49]:

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dr
0	4.5	2009-06-15 17:26:21+00:00	-73.844311	40.721319	-73.841610	
1	16.9	2010-01-05 16:52:16+00:00	-74.016048	40.711303	-73.979268	
2	5.7	2011-08-18 00:35:00+00:00	-73.982738	40.761270	-73.991242	
3	7.7	2012-04-21 04:30:42+00:00	-73.987130	40.733143	-73.991567	
4	5.3	2010-03-09 07:51:00+00:00	-73.968095	40.768008	-73.956655	
5	12.1	2011-01-06 09:50:45+00:00	-74.000964	40.731630	-73.972892	
6	7.5	2012-11-20 20:35:00+00:00	-73.980002	40.751662	-73.973802	
7	16.5	2012-01-04 17:22:00+00:00	-73.951300	40.774138	-73.990095	
9	8.9	2009-09-02 01:11:00+00:00	-73.980658	40.733873	-73.991540	
10	5.3	2012-04-08 07:30:50+00:00	-73.996335	40.737142	-73.980721	
11	5.5	2012-12-24 11:24:00+00:00	0.000000	0.000000	0.000000	
12	4.1	2009-11-06 01:04:03+00:00	-73.991601	40.744712	-73.983081	
13	7.0	2013-07-02 19:54:00+00:00	-74.005360	40.728867	-74.008913	
14	7.7	2011-04-05 17:11:05+00:00	-74.001821	40.737547	-73.998060	
15	5.0	2013-11-23 12:57:00+00:00	0.000000	0.000000	0.000000	
16	12.5	2014-02-19 07:22:00+00:00	-73.986430	40.760465	-73.988990	
17	5.3	2009-07-22 16:08:00+00:00	-73.981060	40.737690	-73.994177	
18	5.3	2010-07-07 14:52:00+00:00	-73.969505	40.784843	-73.958732	
19	4.0	2014-12-06 20:36:22+00:00	-73.979815	40.751902	-73.979446	
20	10.5	2010-09-07 13:18:00+00:00	-73.985382	40.747858	-73.978377	
21	11.5	2013-02-12 12:15:46+00:00	-73.957954	40.779252	-73.961250	
22	4.5	2009-08-06 18:17:23+00:00	-73.991707	40.770505	-73.985459	
23	4.9	2010-12-06 12:29:00+00:00	-74.000632	40.747473	-73.986672	
24	6.1	2009-12-10 15:37:00+00:00	-73.969622	40.756973	-73.981152	

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dr
25	7.3	2011-06-21 16:15:00+00:00	-73.991875	40.754437	-73.977230	
27	4.5	2011-06-28 19:47:00+00:00	-73.988893	40.760160	-73.986445	
28	9.3	2012-05-04 06:11:20+00:00	-73.989258	40.690835	-74.004133	
29	4.5	2013-08-11 00:52:00+00:00	-73.981020	40.737760	-73.980668	
30	5.5	2014-02-19 16:03:00+00:00	-73.976075	40.752422	-73.981082	
32	31.9	2009-01-09 16:10:00+00:00	-73.873027	40.773883	-73.984545	
...	...	...	...	...	...	
16036	10.5	2010-08-17 11:34:00+00:00	-73.990103	40.729750	-73.978462	
16037	6.5	2012-02-27 21:40:50+00:00	-73.992618	40.723878	-73.977073	
16038	5.7	2010-08-31 10:43:42+00:00	-73.990336	40.718973	-73.956060	
16039	12.9	2010-12-11 16:25:00+00:00	-73.936462	40.794292	-73.948747	
16040	6.5	2014-06-16 00:05:19+00:00	-73.980597	40.744267	-73.979330	
16041	11.0	2014-11-17 21:53:00+00:00	-73.983610	40.747090	-73.961310	
16042	8.5	2015-04-06 21:53:06+00:00	-73.991425	40.749832	-74.000107	
16043	8.5	2011-11-17 10:58:05+00:00	-73.973961	40.764055	-73.986807	
16044	16.5	2013-04-29 03:05:45+00:00	-73.982785	40.731421	-74.011358	
16045	6.5	2013-09-19 23:56:00+00:00	-73.995227	40.733475	-73.984030	
16046	6.0	2014-04-24 01:48:40+00:00	-73.976298	40.753948	-73.993062	
16047	6.1	2010-03-18 11:09:00+00:00	-73.970733	40.758193	-73.979457	
16048	9.7	2012-07-10 17:32:00+00:00	-73.988040	40.774902	-74.005265	
16049	15.7	2012-07-31 12:27:00+00:00	-74.008657	40.715975	-73.975653	
16050	8.5	2013-01-23 07:36:49+00:00	-73.996715	40.742504	-73.977987	
16051	11.5	2014-10-01 20:05:00+00:00	-73.975540	40.755590	-73.944780	
16052	10.0	2014-10-03 22:24:00+00:00	-73.987298	40.722007	-74.000267	
16053	4.0	2014-09-23 09:49:00+00:00	-73.954977	40.788582	-73.964227	

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	di
16054	5.3	2009-11-28 15:58:02+00:00	-73.993929	40.756944	-73.993044	
16055	48.3	2012-09-05 17:34:00+00:00	-73.994077	40.741242	-73.830257	
16056	38.3	2012-12-17 14:59:16+00:00	0.000000	0.000000	0.000000	
16057	5.0	2013-01-31 15:46:00+00:00	-73.963582	40.774242	-73.956525	
16058	5.5	2014-04-19 14:58:57+00:00	-73.974265	40.756048	-73.980885	
16059	5.3	2010-01-03 18:26:00+00:00	-73.973297	40.743768	-73.986060	
16060	22.0	2014-10-01 09:15:00+00:00	-73.954582	40.778047	-74.005982	
16061	10.9	2009-05-20 18:56:42+00:00	-73.994191	40.751138	-73.962769	
16062	6.5	2014-12-12 07:41:00+00:00	-74.008820	40.718757	-73.998865	
16063	16.1	2009-07-13 07:58:00+00:00	-73.981310	40.781695	-74.014392	
16064	8.5	2009-11-11 11:19:07+00:00	-73.972507	40.753417	-73.979577	
16065	8.1	2010-05-11 23:53:00+00:00	-73.957027	40.765945	-73.981983	

15908 rows × 7 columns

In [50]:

```
train_data.shape
```

Out[50]:

```
(15908, 7)
```

In [51]:

```
train_data['fare_amount']
```

Out[51]:

```
0         4.5
1        16.9
2         5.7
3         7.7
4         5.3
5        12.1
6         7.5
7        16.5
9         8.9
10        5.3
11        5.5
12        4.1
13        7.0
14        7.7
15        5.0
16       12.5
17        5.3
18        5.3
19        4.0
20       10.5
21       11.5
22        4.5
23        4.9
24        6.1
25        7.3
27        4.5
28        9.3
29        4.5
30        5.5
32       31.9
         ...
16036    10.5
16037     6.5
16038     5.7
16039    12.9
16040     6.5
16041    11.0
16042     8.5
16043     8.5
16044    16.5
16045     6.5
16046     6.0
16047     6.1
16048     9.7
16049    15.7
16050     8.5
16051    11.5
16052    10.0
16053     4.0
16054     5.3
16055    48.3
16056    38.3
16057     5.0
16058     5.5
16059     5.3
16060    22.0
16061    10.9
16062     6.5
16063    16.1
```

```
16064     8.5
16065     8.1
Name: fare_amount, Length: 15908, dtype: float64
```

In [52]:

```
train_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 15908 entries, 0 to 16065
Data columns (total 7 columns):
fare_amount          15908 non-null float64
pickup_datetime      15908 non-null datetime64[ns, UTC]
pickup_longitude     15908 non-null float64
pickup_latitude      15908 non-null float64
dropoff_longitude    15908 non-null float64
dropoff_latitude     15908 non-null float64
passenger_count      15908 non-null object
dtypes: datetime64[ns, UTC](1), float64(5), object(1)
memory usage: 994.2+ KB
```

In [53]:

```
#For convinience splitting pickup_datetime variable#

train_data['year'] = train_data['pickup_datetime'].dt.year
train_data['Month'] = train_data['pickup_datetime'].dt.month
train_data['Date'] = train_data['pickup_datetime'].dt.day
train_data['Day'] = train_data['pickup_datetime'].dt.dayofweek
train_data['Hour'] = train_data['pickup_datetime'].dt.hour
train_data['Minute'] = train_data['pickup_datetime'].dt.minute
```

In [54]:

```
train_data.dtypes
```

Out[54]:

```
fare_amount                      float64
pickup_datetime      datetime64[ns, UTC]
pickup_longitude                 float64
pickup_latitude                  float64
dropoff_longitude                float64
dropoff_latitude                 float64
passenger_count                   object
year                               int64
Month                              int64
Date                               int64
Day                                int64
Hour                               int64
Minute                             int64
dtype: object
```

In [55]:

```
#Replicating the same in test dataset too#

test_data['pickup_datetime'] =  pd.to_datetime(test_data['pickup_datetime'],errors ="co
erce")
```

In [56]:

```
test_data['year'] = test_data['pickup_datetime'].dt.year
test_data['Month'] = test_data['pickup_datetime'].dt.month
test_data['Date'] = test_data['pickup_datetime'].dt.day
test_data['Day'] = test_data['pickup_datetime'].dt.dayofweek
test_data['Hour'] = test_data['pickup_datetime'].dt.hour
test_data['Minute'] = test_data['pickup_datetime'].dt.minute
```

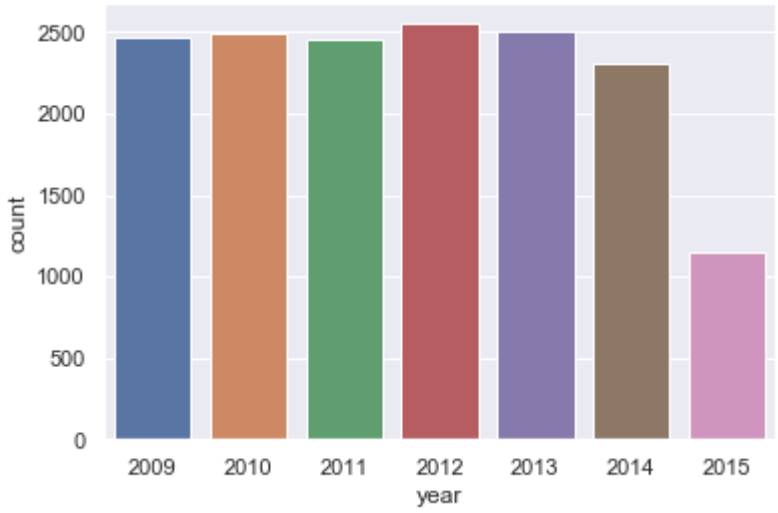
In [57]:

```
#fetching the visualizations for year, month, day, dayofweek, hourly basis#

plt.figure
sns.countplot(train_data['year'])
```

Out[57]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd12f2c5f60>
```

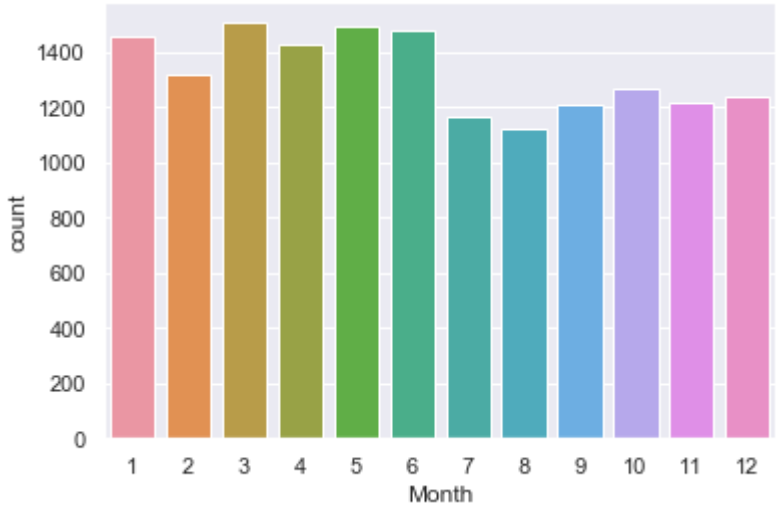


In [58]:

```
plt.figure
sns.countplot(train_data['Month'])
```

Out[58]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd12f7301d0>
```

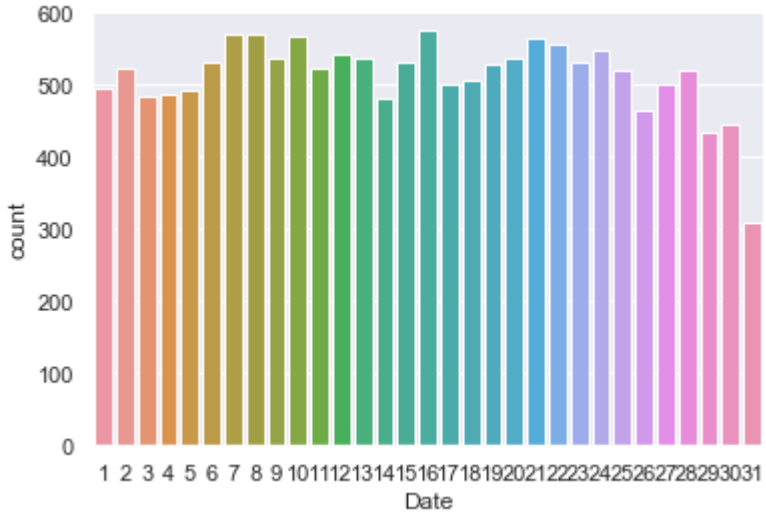


In [59]:

```
plt.figure
sns.countplot(train_data['Date'])
```

Out[59]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd12f7864e0>
```

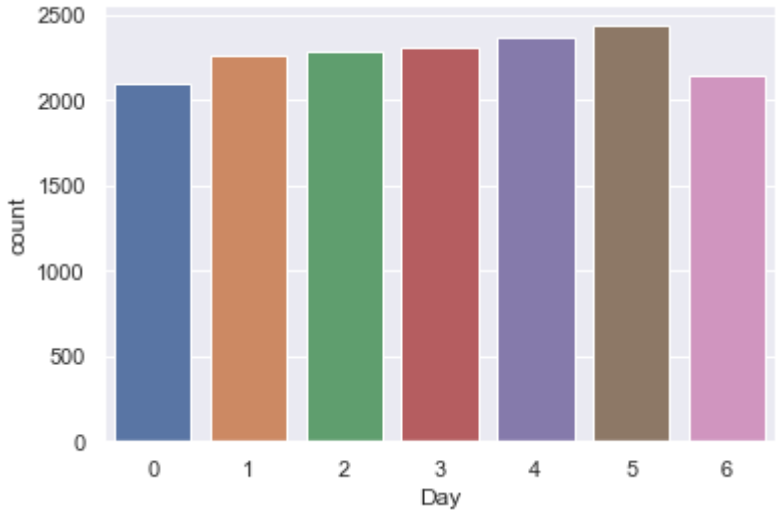


In [60]:

```
plt.figure
sns.countplot(train_data['Day'])
```

Out[60]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd12f7cccf8>
```

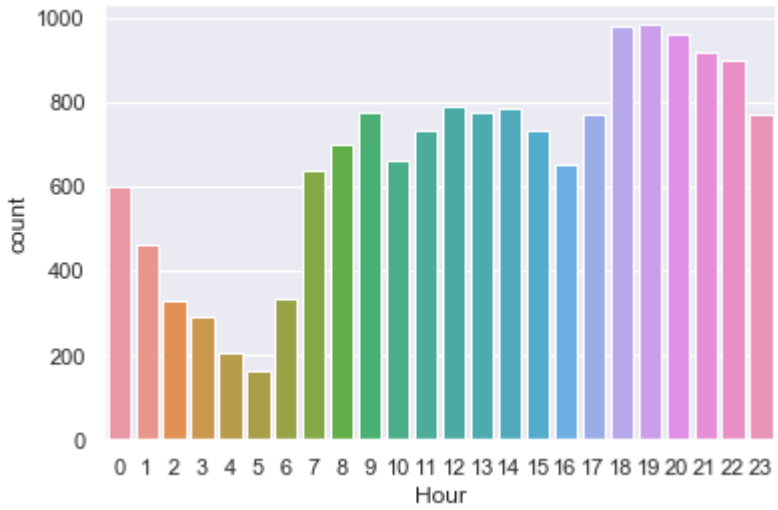


In [61]:

```
plt.figure
sns.countplot(train_data['Hour'])
```

Out[61]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd134a91be0>
```

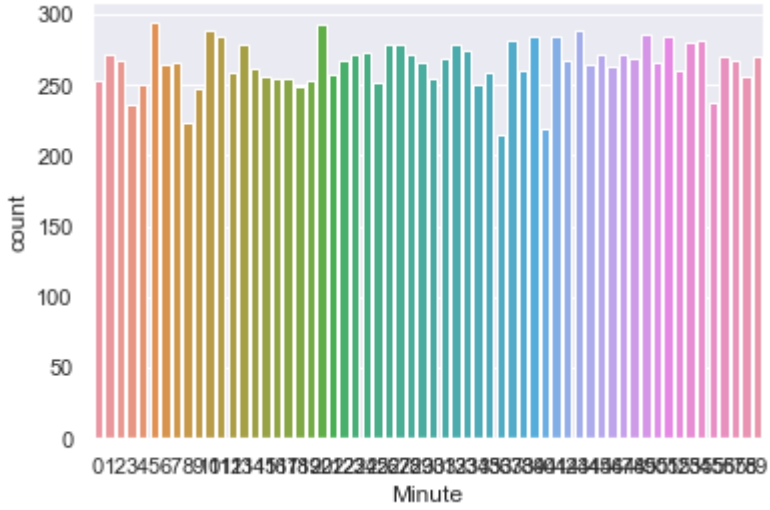


In [62]:

```
plt.figure
sns.countplot(train_data['Minute'])
```

Out[62]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd134b45240>
```



In [63]:

```
test_data.isnull().sum()
```

Out[63]:

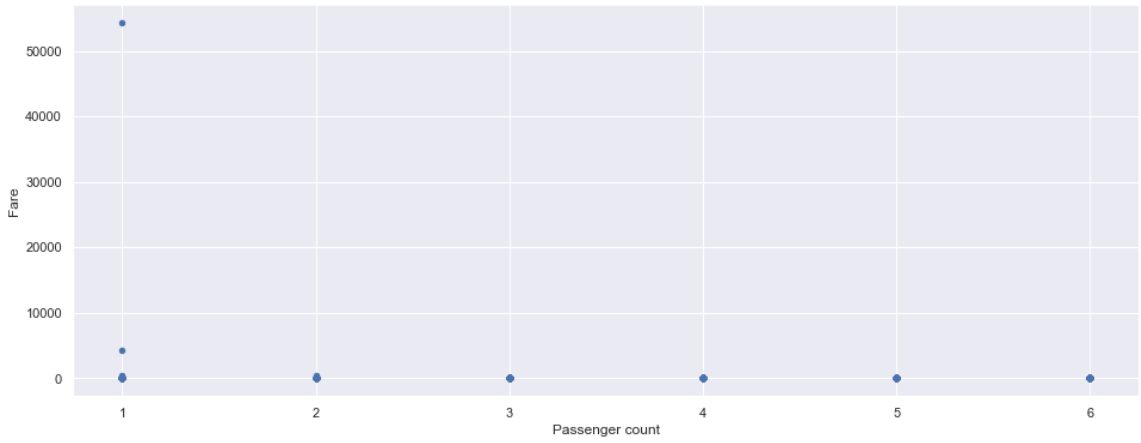
```
pickup_datetime      0
pickup_longitude     0
pickup_latitude      0
dropoff_longitude    0
dropoff_latitude     0
passenger_count      0
year                 0
Month                0
Date                 0
Day                  0
Hour                 0
Minute               0
dtype: int64
```

In [64]:

```
#Since our datasets are clean now we can obtain visualization to determine the relation
ship among key variables#
plt.figure(figsize=(16,6))
plt.scatter(x=train_data['passenger_count'], y=train_data['fare_amount'], s=20)
plt.xlabel('Passenger count')
plt.ylabel('Fare')
```

Out[64]:

```
Text(0, 0.5, 'Fare')
```

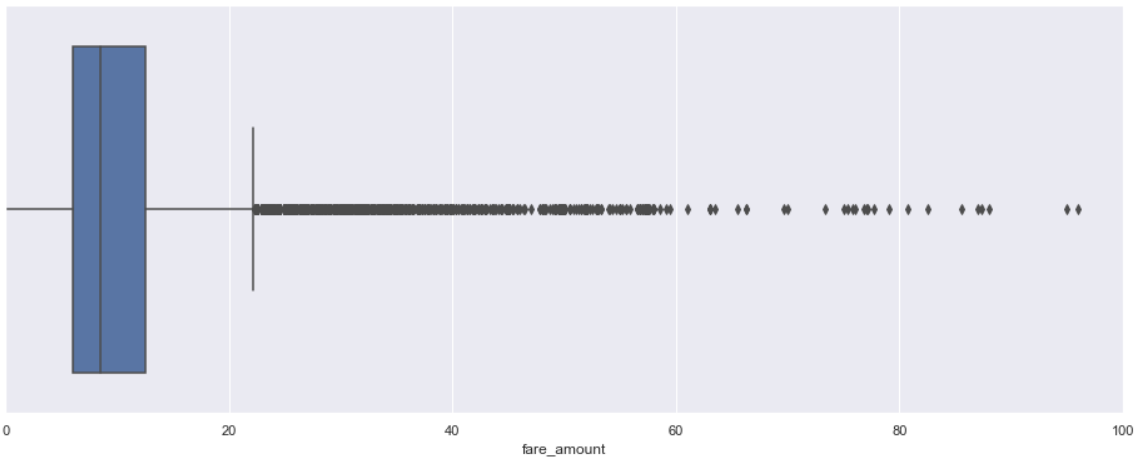


In [65]:

```
plt.figure(figsize=(16,6))
plt.xlim(0,100)
sns.boxplot(x=train_data['fare_amount'],data=train_data)
```

Out[65]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13d4ddd30>
```



In [66]:

```
#It seems the fareamount still contains outliers#
#Lets check again#

train_data["fare_amount"].sort_values(ascending=False)
```

Out[66]:

```
1015     54343.00
1072      4343.00
607        453.00
980        434.00
1335       180.00
1483       165.00
6630       128.83
14142      108.00
12349      104.67
12915       96.00
7810        95.00
9431        88.00
10077       87.30
12614       87.00
4620        85.50
14519       82.50
12437       80.75
2639        79.00
4013        77.70
13962       77.15
2013        77.00
6668        76.80
8363        76.00
10524       75.80
11019       75.33
13615       75.00
15023       73.30
1494        70.00
4118        69.70
9651        66.30
           ...
9621         2.50
15370        2.50
8547         2.50
8596         2.50
4058         2.50
503          2.50
8603         2.50
6703         2.50
8680         2.50
6632         2.50
8711         2.50
8795         2.50
15490        2.50
4084         2.50
14304        2.50
12705        2.50
12598        2.50
9177         2.50
12567        2.50
6297         2.50
15257        2.50
6276         2.50
6226         2.50
7408         2.50
1427         1.14
2780         0.01
10002        0.00
2486        -2.50
```

```
2039        -2.90
13032       -3.00
Name: fare_amount, Length: 15908, dtype: float64
```

In [67]:

```
#We can see some absurd values as high as 50k and some negetive values too#
#we need to eliminate these outliers#

train_data = train_data.drop(train_data[train_data["fare_amount"]<1].index, axis=0)
```

In [68]:

```
train_data = train_data.drop(train_data[train_data["fare_amount"]>453].index, axis=0)
```

In [69]:

```
train_data["fare_amount"].sort_values(ascending=False)
```

Out[69]:

```
607      453.00
980      434.00
1335     180.00
1483     165.00
6630     128.83
14142    108.00
12349    104.67
12915     96.00
7810      95.00
9431      88.00
10077     87.30
12614     87.00
4620      85.50
14519     82.50
12437     80.75
2639      79.00
4013      77.70
13962     77.15
2013      77.00
6668      76.80
8363      76.00
10524     75.80
11019     75.33
13615     75.00
15023     73.30
1494      70.00
4118      69.70
649       66.30
9651      66.30
1709      65.50
          ...
6703       2.50
15257      2.50
12705      2.50
10458      2.50
8263       2.50
1774       2.50
13488      2.50
3558       2.50
1750       2.50
15490      2.50
1419       2.50
10111      2.50
503        2.50
8711       2.50
6765       2.50
5449       2.50
12178      2.50
14530      2.50
8680       2.50
4084       2.50
12343      2.50
9773       2.50
4058       2.50
8603       2.50
12567      2.50
8596       2.50
13221      2.50
13571      2.50
```

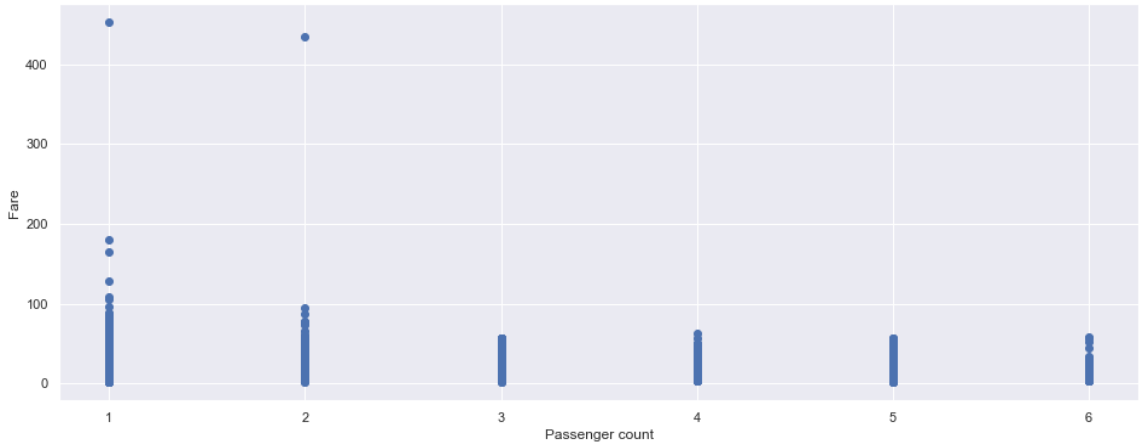
```
8547       2.50
1427       1.14
Name: fare_amount, Length: 15901, dtype: float64
```

In [70]:

```
#Now we are hopeful of generating proper visualization#
plt.figure(figsize=(16,6))
plt.scatter(x=train_data['passenger_count'], y=train_data['fare_amount'])
plt.xlabel('Passenger count')
plt.ylabel('Fare')
```

Out[70]:

```
Text(0, 0.5, 'Fare')
```

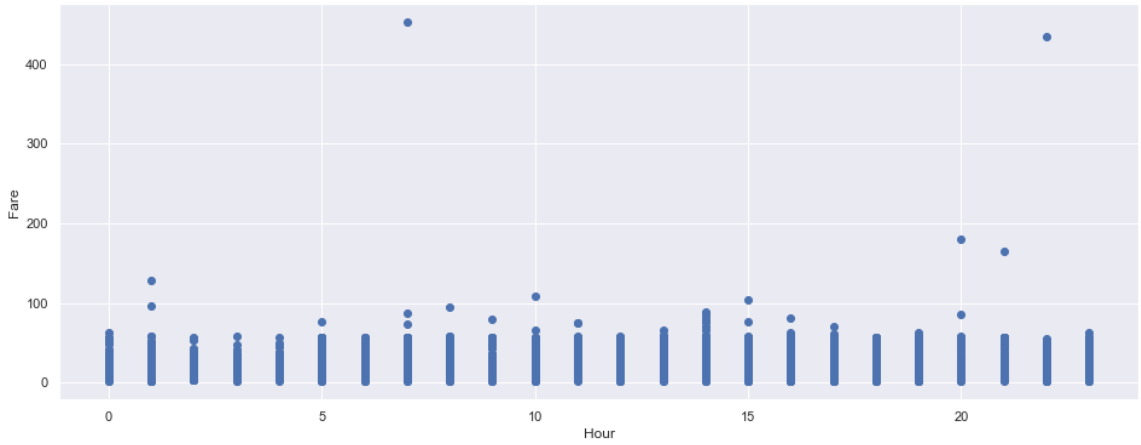


In [71]:

```
plt.figure(figsize=(16,6))
plt.scatter(x=train_data['Hour'], y=train_data['fare_amount'])
plt.xlabel('Hour')
plt.ylabel('Fare')
```

Out[71]:

```
Text(0, 0.5, 'Fare')
```

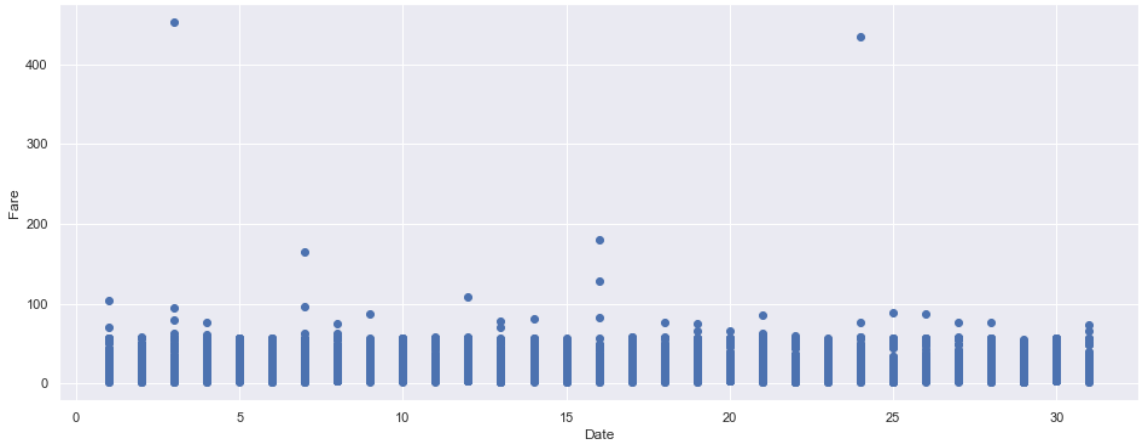


In [72]:

```
plt.figure(figsize=(16,6))
plt.scatter(x=train_data['Date'], y=train_data['fare_amount'])
plt.xlabel('Date')
plt.ylabel('Fare')
```

Out[72]:

```
Text(0, 0.5, 'Fare')
```



In [73]:

```
#Feature engineering with longitude and latitude values#
#The longitude and latitude values should be put to usable data which we can understand and interpret#
#Now we will use the haversine formula to calculate distance with longitude and latitude values#

from math import radians, cos, sin, asin, sqrt
```

In [74]:

```
def haversine(k):
    plong=k[0]
    plat=k[1]
    dlong=k[2]
    dlat=k[3]

    plong, plat, dlong, dlat = map(radians, [plong, plat, dlong, dlat])
    del_lambda = dlong - plong
    del_phi = plat - dlat
    h = sin(del_phi/2)**2 + cos(plat) * cos(dlat) * sin(del_lambda/2)**2
    distance = 2 * asin(sqrt(h))
    kms = 6371 * distance
    return kms
```

In [75]:

```
train_data['range'] = train_data[['pickup_longitude','pickup_latitude','dropoff_longitude','dropoff_latitude']].apply(haversine,axis=1)
```

In [76]:

```
test_data['range'] = test_data[['pickup_longitude','pickup_latitude','dropoff_longitud
e','dropoff_latitude']].apply(haversine,axis=1)
```

In [77]:

```
train_data
```

Out[77]:

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dr
0	4.5	2009-06-15 17:26:21+00:00	-73.844311	40.721319	-73.841610	
1	16.9	2010-01-05 16:52:16+00:00	-74.016048	40.711303	-73.979268	
2	5.7	2011-08-18 00:35:00+00:00	-73.982738	40.761270	-73.991242	
3	7.7	2012-04-21 04:30:42+00:00	-73.987130	40.733143	-73.991567	
4	5.3	2010-03-09 07:51:00+00:00	-73.968095	40.768008	-73.956655	
5	12.1	2011-01-06 09:50:45+00:00	-74.000964	40.731630	-73.972892	
6	7.5	2012-11-20 20:35:00+00:00	-73.980002	40.751662	-73.973802	
7	16.5	2012-01-04 17:22:00+00:00	-73.951300	40.774138	-73.990095	
9	8.9	2009-09-02 01:11:00+00:00	-73.980658	40.733873	-73.991540	
10	5.3	2012-04-08 07:30:50+00:00	-73.996335	40.737142	-73.980721	
11	5.5	2012-12-24 11:24:00+00:00	0.000000	0.000000	0.000000	
12	4.1	2009-11-06 01:04:03+00:00	-73.991601	40.744712	-73.983081	
13	7.0	2013-07-02 19:54:00+00:00	-74.005360	40.728867	-74.008913	
14	7.7	2011-04-05 17:11:05+00:00	-74.001821	40.737547	-73.998060	
15	5.0	2013-11-23 12:57:00+00:00	0.000000	0.000000	0.000000	
16	12.5	2014-02-19 07:22:00+00:00	-73.986430	40.760465	-73.988990	
17	5.3	2009-07-22 16:08:00+00:00	-73.981060	40.737690	-73.994177	
18	5.3	2010-07-07 14:52:00+00:00	-73.969505	40.784843	-73.958732	
19	4.0	2014-12-06 20:36:22+00:00	-73.979815	40.751902	-73.979446	
20	10.5	2010-09-07 13:18:00+00:00	-73.985382	40.747858	-73.978377	
21	11.5	2013-02-12 12:15:46+00:00	-73.957954	40.779252	-73.961250	
22	4.5	2009-08-06 18:17:23+00:00	-73.991707	40.770505	-73.985459	
23	4.9	2010-12-06 12:29:00+00:00	-74.000632	40.747473	-73.986672	
24	6.1	2009-12-10 15:37:00+00:00	-73.969622	40.756973	-73.981152	

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dr
25	7.3	2011-06-21 16:15:00+00:00	-73.991875	40.754437	-73.977230	
27	4.5	2011-06-28 19:47:00+00:00	-73.988893	40.760160	-73.986445	
28	9.3	2012-05-04 06:11:20+00:00	-73.989258	40.690835	-74.004133	
29	4.5	2013-08-11 00:52:00+00:00	-73.981020	40.737760	-73.980668	
30	5.5	2014-02-19 16:03:00+00:00	-73.976075	40.752422	-73.981082	
32	31.9	2009-01-09 16:10:00+00:00	-73.873027	40.773883	-73.984545	
...	...	...	...	...	...	
16036	10.5	2010-08-17 11:34:00+00:00	-73.990103	40.729750	-73.978462	
16037	6.5	2012-02-27 21:40:50+00:00	-73.992618	40.723878	-73.977073	
16038	5.7	2010-08-31 10:43:42+00:00	-73.990336	40.718973	-73.956060	
16039	12.9	2010-12-11 16:25:00+00:00	-73.936462	40.794292	-73.948747	
16040	6.5	2014-06-16 00:05:19+00:00	-73.980597	40.744267	-73.979330	
16041	11.0	2014-11-17 21:53:00+00:00	-73.983610	40.747090	-73.961310	
16042	8.5	2015-04-06 21:53:06+00:00	-73.991425	40.749832	-74.000107	
16043	8.5	2011-11-17 10:58:05+00:00	-73.973961	40.764055	-73.986807	
16044	16.5	2013-04-29 03:05:45+00:00	-73.982785	40.731421	-74.011358	
16045	6.5	2013-09-19 23:56:00+00:00	-73.995227	40.733475	-73.984030	
16046	6.0	2014-04-24 01:48:40+00:00	-73.976298	40.753948	-73.993062	
16047	6.1	2010-03-18 11:09:00+00:00	-73.970733	40.758193	-73.979457	
16048	9.7	2012-07-10 17:32:00+00:00	-73.988040	40.774902	-74.005265	
16049	15.7	2012-07-31 12:27:00+00:00	-74.008657	40.715975	-73.975653	
16050	8.5	2013-01-23 07:36:49+00:00	-73.996715	40.742504	-73.977987	
16051	11.5	2014-10-01 20:05:00+00:00	-73.975540	40.755590	-73.944780	
16052	10.0	2014-10-03 22:24:00+00:00	-73.987298	40.722007	-74.000267	
16053	4.0	2014-09-23 09:49:00+00:00	-73.954977	40.788582	-73.964227	

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dr
16054	5.3	2009-11-28 15:58:02+00:00	-73.993929	40.756944	-73.993044	
16055	48.3	2012-09-05 17:34:00+00:00	-73.994077	40.741242	-73.830257	
16056	38.3	2012-12-17 14:59:16+00:00	0.000000	0.000000	0.000000	
16057	5.0	2013-01-31 15:46:00+00:00	-73.963582	40.774242	-73.956525	
16058	5.5	2014-04-19 14:58:57+00:00	-73.974265	40.756048	-73.980885	
16059	5.3	2010-01-03 18:26:00+00:00	-73.973297	40.743768	-73.986060	
16060	22.0	2014-10-01 09:15:00+00:00	-73.954582	40.778047	-74.005982	
16061	10.9	2009-05-20 18:56:42+00:00	-73.994191	40.751138	-73.962769	
16062	6.5	2014-12-12 07:41:00+00:00	-74.008820	40.718757	-73.998865	
16063	16.1	2009-07-13 07:58:00+00:00	-73.981310	40.781695	-74.014392	
16064	8.5	2009-11-11 11:19:07+00:00	-73.972507	40.753417	-73.979577	
16065	8.1	2010-05-11 23:53:00+00:00	-73.957027	40.765945	-73.981983	

15901 rows × 14 columns

In [78]:

```
test_data
```

Out[78]:

	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude
0	2015-01-27 13:08:24+00:00	-73.973320	40.763805	-73.981430	40.743835
1	2015-01-27 13:08:24+00:00	-73.986862	40.719383	-73.998886	40.739201
2	2011-10-08 11:53:44+00:00	-73.982524	40.751260	-73.979654	40.746139
3	2012-12-01 21:12:12+00:00	-73.981160	40.767807	-73.990448	40.751635
4	2012-12-01 21:12:12+00:00	-73.966046	40.789775	-73.988565	40.744427
5	2012-12-01 21:12:12+00:00	-73.960983	40.765547	-73.979177	40.740053
6	2011-10-06 12:10:20+00:00	-73.949013	40.773204	-73.959622	40.770893
7	2011-10-06 12:10:20+00:00	-73.777282	40.646636	-73.985083	40.759368
8	2011-10-06 12:10:20+00:00	-74.014099	40.709638	-73.995106	40.741365
9	2014-02-18 15:22:20+00:00	-73.969582	40.765519	-73.980686	40.770725
10	2014-02-18 15:22:20+00:00	-73.989374	40.741973	-73.999300	40.722534
11	2014-02-18 15:22:20+00:00	-74.001614	40.740893	-73.956387	40.767437
12	2010-03-29 20:20:32+00:00	-73.991198	40.739937	-73.997166	40.735269
13	2010-03-29 20:20:32+00:00	-73.982034	40.762723	-74.001867	40.761545
14	2011-10-06 03:59:12+00:00	-73.992455	40.728701	-73.983397	40.750149
15	2011-10-06 03:59:12+00:00	-73.983583	40.746993	-73.951178	40.785903
16	2012-07-15 16:45:04+00:00	-74.006746	40.731721	-74.010204	40.732318
17	2012-07-15 16:45:04+00:00	-73.976446	40.785598	-73.952220	40.772121
18	2012-07-15 16:45:04+00:00	-73.973548	40.763349	-73.972096	40.756417
19	2012-07-15 16:45:04+00:00	-73.970918	40.756025	-73.975954	40.755563
20	2014-10-29 02:09:56+00:00	-73.926071	40.705866	-73.941741	40.714789
21	2014-06-14 13:39:00+00:00	-73.970555	40.764702	-73.949132	40.771800
22	2014-06-14 13:39:00+00:00	-73.989102	40.736360	-73.992767	40.747767
23	2014-06-14 13:39:00+00:00	-74.003525	40.748480	-73.991520	40.762960

	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude
24	2014-06-14 13:39:00+00:00	-73.990352	40.759992	-74.015665	40.711682
25	2014-06-14 13:39:00+00:00	-73.989482	40.757450	-74.000850	40.762705
26	2014-06-14 13:39:00+00:00	-73.870785	40.773722	-73.741922	40.689945
27	2014-06-14 13:39:00+00:00	-73.992682	40.733877	-73.938852	40.808220
28	2014-06-14 13:39:00+00:00	-73.954020	40.778705	-73.950277	40.768810
29	2014-06-14 13:39:00+00:00	-73.972742	40.743432	-74.007125	40.710192
...	...	...	...	...	...
9884	2013-09-25 22:00:00+00:00	-73.790022	40.643817	-73.735688	40.773400
9885	2013-09-25 22:00:00+00:00	-74.007878	40.722762	-73.965740	40.754505
9886	2013-09-25 22:00:00+00:00	-73.978852	40.752837	-73.941152	40.812722
9887	2013-09-25 22:00:00+00:00	-73.959087	40.783282	-73.978802	40.785655
9888	2013-09-25 22:00:00+00:00	-73.956488	40.767512	-73.956488	40.767512
9889	2013-09-25 22:00:00+00:00	-73.966650	40.714675	-73.971912	40.693667
9890	2013-09-25 22:00:00+00:00	-73.976602	40.754152	-73.993297	40.730887
9891	2013-09-25 22:00:00+00:00	-73.987185	40.760505	-73.938755	40.799507
9892	2013-09-25 22:00:00+00:00	-73.969175	40.757770	-73.952318	40.781030
9893	2013-09-25 22:00:00+00:00	-73.949657	40.796197	-73.911755	40.827672
9894	2013-09-25 22:00:00+00:00	-74.002267	40.730415	-73.990360	40.756807
9895	2013-09-25 22:00:00+00:00	-73.985840	40.731167	-73.953883	40.653937
9896	2013-09-25 22:00:00+00:00	-73.955490	40.776862	-73.982162	40.769302
9897	2015-02-20 11:08:29+00:00	-73.965782	40.805538	-73.982384	40.761600
9898	2015-01-12 15:36:37+00:00	-73.979042	40.777515	-73.983658	40.781082
9899	2015-06-07 00:38:14+00:00	-73.983238	40.764874	-73.922928	40.743458
9900	2015-04-12 21:56:22+00:00	-73.962952	40.772480	-73.976051	40.786289
9901	2015-04-10 11:56:54+00:00	-73.977943	40.762753	-73.976219	40.776451

	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude
9902	2015-06-25 01:01:46+00:00	-73.905525	40.752655	-73.864151	40.737091
9903	2015-05-29 10:02:42+00:00	-73.988403	40.738731	-73.992340	40.759193
9904	2015-06-30 20:03:50+00:00	-73.776848	40.645035	-73.955460	40.652458
9905	2015-02-27 19:36:02+00:00	-73.989647	40.767406	-73.941177	40.845696
9906	2015-06-15 01:00:06+00:00	-73.988052	40.720776	-73.991043	40.718346
9907	2015-02-03 09:00:58+00:00	-73.863457	40.769611	-73.980995	40.763241
9908	2015-05-19 13:58:11+00:00	-73.987968	40.718922	-73.982124	40.732956
9909	2015-05-10 12:37:51+00:00	-73.968124	40.796997	-73.955643	40.780388
9910	2015-01-12 17:05:51+00:00	-73.945511	40.803600	-73.960213	40.776371
9911	2015-04-19 20:44:15+00:00	-73.991600	40.726608	-73.789742	40.647011
9912	2015-01-31 01:05:19+00:00	-73.985573	40.735432	-73.939178	40.801731
9913	2015-01-18 14:06:23+00:00	-73.988022	40.754070	-74.000282	40.759220

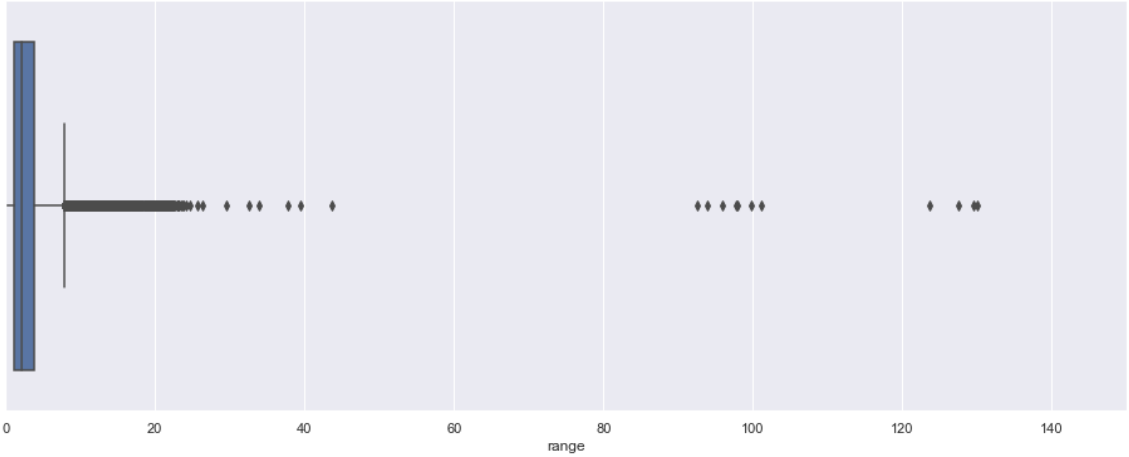
9914 rows × 13 columns

In [79]:

```
#Checking outliers in range#
plt.figure(figsize=(16,6))
plt.xlim(0,150)
sns.boxplot(x=train_data['range'],data=train_data)
```

Out[79]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13ea67908>
```



In [80]:

```
#too many outlers in range#
train_data["range"].sort_values(ascending=False)
```

Out[80]:

```
9147     8667.542104
8647     8667.497512
2397     8667.454421
472      8667.304968
11653    8666.701504
13340    8666.613646
10215    8666.584706
4597     8666.566030
10458    8665.976222
10672    8665.702390
10488    8665.555634
1260     8665.268588
4278     8665.223767
6188     8664.191488
12983    8664.131808
6302     8663.039123
12705    8661.362152
14197    8657.136619
15783    8656.714168
15749    6028.926779
2280     6026.494216
5864     5420.988959
7014     4447.086698
10710     129.950482
14536     129.560455
11619     127.509261
12228     123.561157
5663      101.094619
1684       99.771579
3075       97.985088
             ...
10964      0.000000
7280       0.000000
13037      0.000000
2722       0.000000
13045      0.000000
13050      0.000000
8331       0.000000
1630       0.000000
13062      0.000000
1637       0.000000
13677      0.000000
13015      0.000000
13013      0.000000
4454       0.000000
4461       0.000000
9863       0.000000
1542       0.000000
15012      0.000000
4473       0.000000
1561       0.000000
13000      0.000000
10548      0.000000
4455       0.000000
13008      0.000000
4458       0.000000
6632       0.000000
8605       0.000000
3433       0.000000
```

```
503         0.000000
3128        0.000000
Name: range, Length: 15901, dtype: float64
```

In [81]:

```
train_data = train_data.drop(train_data[train_data['range']== 0].index, axis=0)
```

In [82]:

```
train_data["range"].sort_values(ascending=True)
```

Out[82]:

```
15490       0.000111
13582       0.000202
15366       0.000238
510         0.000279
13488       0.000344
8263        0.000476
15093       0.000789
4861        0.000848
3558        0.000951
10611       0.001960
8596        0.002173
8603        0.002232
15370       0.002234
10258       0.002235
616         0.002507
8734        0.002616
4058        0.002687
9012        0.002693
1494        0.002733
9928        0.002838
14475       0.002842
5593        0.003054
14633       0.003069
3645        0.003173
8371        0.003434
184         0.003982
14530       0.004059
15530       0.004709
8773        0.004829
6002        0.004982
            ...
3075       97.985088
1684       99.771579
5663      101.094619
12228     123.561157
11619     127.509261
14536     129.560455
10710     129.950482
7014     4447.086698
5864     5420.988959
2280     6026.494216
15749    6028.926779
15783    8656.714168
14197    8657.136619
12705    8661.362152
6302     8663.039123
12983    8664.131808
6188     8664.191488
4278     8665.223767
1260     8665.268588
10488    8665.555634
10672    8665.702390
10458    8665.976222
4597     8666.566030
10215    8666.584706
13340    8666.613646
11653    8666.701504
472      8667.304968
2397     8667.454421
```

```
8647     8667.497512
9147     8667.542104
Name: range, Length: 15447, dtype: float64
```

In [83]:

```
train_data = train_data.drop(train_data[train_data['range']< 0.1].index, axis=0)
```

In [84]:

```
train_data.describe()
```

Out[84]:

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	
count	15351.000000	15351.000000	15351.000000	15351.000000	15351.000000	15
mean	11.348474	-73.869937	40.692723	-73.859843	40.669802	
std	10.543482	3.148628	3.956018	3.248466	2.680028	
min	1.140000	-74.438233	-74.006893	-74.227047	-73.994392	
25%	6.000000	-73.992385	40.736553	-73.991363	40.736289	
50%	8.500000	-73.982053	40.753320	-73.980558	40.754217	
75%	12.500000	-73.968149	40.767799	-73.965497	40.768311	
max	453.000000	40.766125	401.083332	40.802437	41.366138	

In [85]:

```
train_data["range"].sort_values(ascending=False)
```

Out[85]:

```
9147     8667.542104
8647     8667.497512
2397     8667.454421
472      8667.304968
11653    8666.701504
13340    8666.613646
10215    8666.584706
4597     8666.566030
10458    8665.976222
10672    8665.702390
10488    8665.555634
1260     8665.268588
4278     8665.223767
6188     8664.191488
12983    8664.131808
6302     8663.039123
12705    8661.362152
14197    8657.136619
15783    8656.714168
15749    6028.926779
2280     6026.494216
5864     5420.988959
7014     4447.086698
10710     129.950482
14536     129.560455
11619     127.509261
12228     123.561157
5663      101.094619
1684       99.771579
3075       97.985088
             ...
12492       0.182329
13692       0.181373
11556       0.179601
11952       0.176871
3847        0.165783
2118        0.163978
8196        0.157444
222         0.153822
15482       0.148980
6497        0.144335
4617        0.143273
9203        0.141834
10109       0.139252
3876        0.137802
11234       0.135342
3427        0.134988
4982        0.134882
13515       0.134701
5991        0.133471
2129        0.128002
11637       0.119481
4242        0.117210
3805        0.117131
15788       0.116629
5840        0.115744
5677        0.108810
14690       0.108643
15846       0.105867
```

```
7908        0.105735
5372        0.100688
Name: range, Length: 15351, dtype: float64
```

In [86]:

```
train_data = train_data.drop(train_data[train_data['range'] > 150 ].index, axis=0)
```

In [87]:

```
train_data["range"].sort_values(ascending=False)
```

Out[87]:

```
10710    129.950482
14536    129.560455
11619    127.509261
12228    123.561157
5663     101.094619
1684      99.771579
3075      97.985088
9899      97.670590
4487      95.852036
9808      93.925599
7401      92.605848
12349     43.648755
649       39.476975
6308      37.812945
5686      33.850093
4118      32.602535
7021      29.478280
6677      26.369072
4567      25.735917
8105      24.690884
15023     24.125745
15178     23.814940
14099     23.696200
12433     23.513721
4268      23.196680
3216      23.184092
4299      23.168706
12941     23.114168
13804     23.077267
538       23.066627
             ...
12492      0.182329
13692      0.181373
11556      0.179601
11952      0.176871
3847       0.165783
2118       0.163978
8196       0.157444
222        0.153822
15482      0.148980
6497       0.144335
4617       0.143273
9203       0.141834
10109      0.139252
3876       0.137802
11234      0.135342
3427       0.134988
4982       0.134882
13515      0.134701
5991       0.133471
2129       0.128002
11637      0.119481
4242       0.117210
3805       0.117131
15788      0.116629
5840       0.115744
5677       0.108810
14690      0.108643
15846      0.105867
```

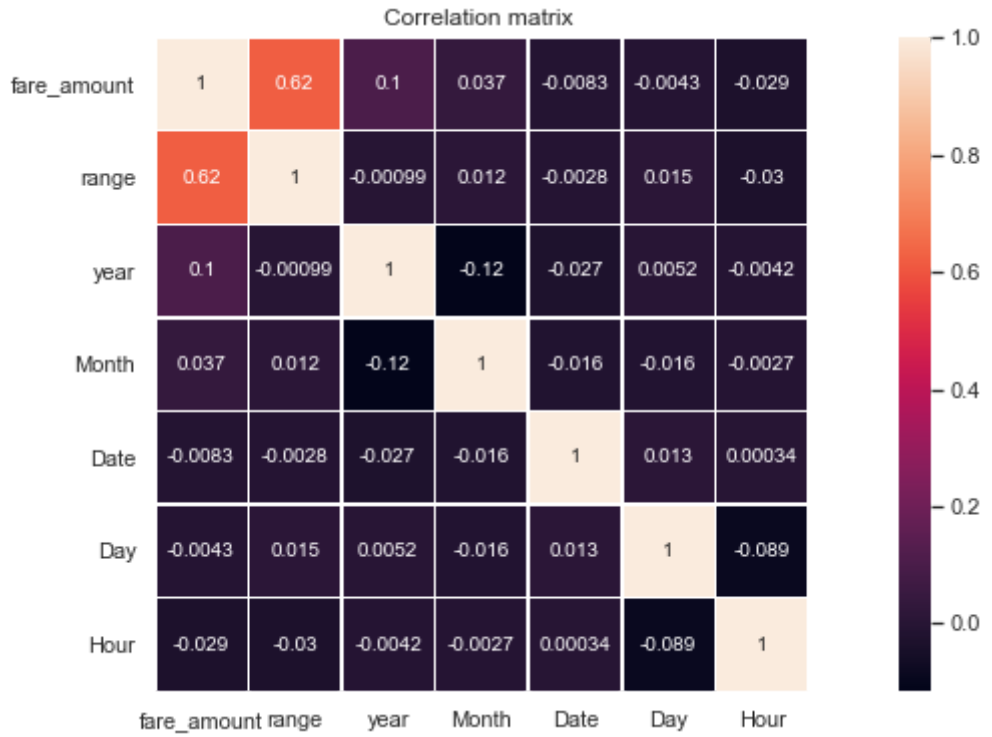
```
7908       0.105735
5372       0.100688
Name: range, Length: 15328, dtype: float64
```

In [88]:

```
num_var=['fare_amount','range', 'year', 'Month', 'Date', 'Day', 'Hour']
plt.figure(figsize=(16,6))
sns.heatmap(train_data[num_var].corr(), square=True,linewidths=0.5,annot=True)
plt.title('Correlation matrix ')
```

Out[88]:

```
Text(0.5, 1.0, 'Correlation matrix ')
```



In [89]:

```
#feature selection#
#Now we will drop the parent variables that were used to produce new & understandable v
ariables#

train_deselect = ['pickup_datetime', 'pickup_longitude', 'pickup_latitude','dropoff_lon
gitude', 'dropoff_latitude', 'Minute']
train_data = train_data.drop(train_deselect, axis = 1)
```

In [90]:

```
train_data.shape
```

Out[90]:

```
(15328, 8)
```

In [91]:

```
test_deselect = ['pickup_datetime', 'pickup_longitude', 'pickup_latitude', 'dropoff_lon
gitude', 'dropoff_latitude', 'Minute']
test_data = test_data.drop(test_deselect, axis = 1)
```

In [92]:

```
test_data.shape
```

Out[92]:

```
(9914, 7)
```

In [93]:

```
#Feature scaling#

train_data[num_var].var()
```

Out[93]:

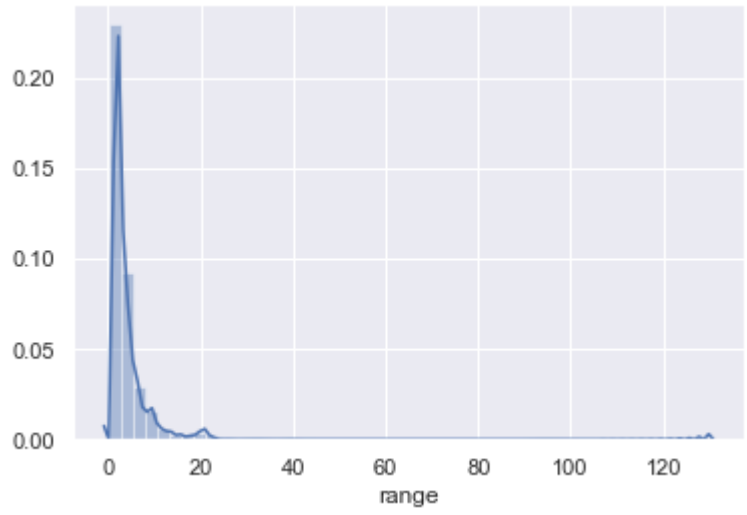
```
fare_amount    110.973021
range           21.253881
year             3.496080
Month           11.886020
Date            75.441081
Day              3.880569
Hour            42.320475
dtype: float64
```

In [94]:

```
sns.distplot(train_data['range'],bins=50)
```

Out[94]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13f9ebc18>
```



In [95]:

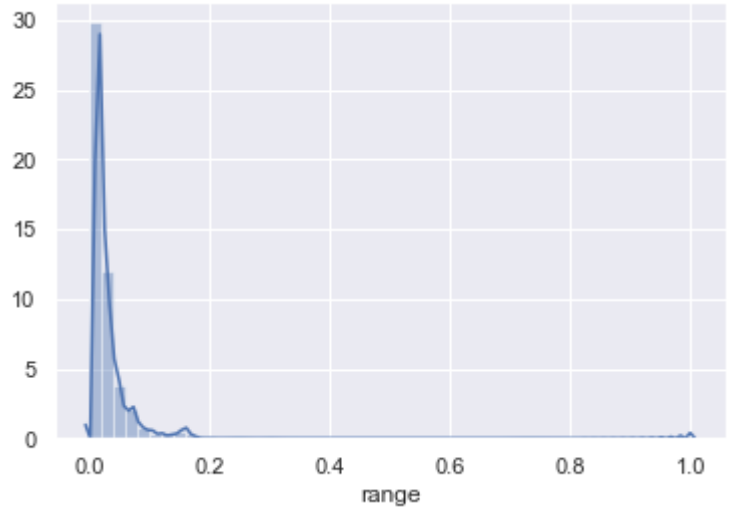
```
train_data['range'] = (train_data['range'] - min(train_data['range']))/(max(train_data[
'range']) - min(train_data['range']))
test_data['range'] = (test_data['range'] - min(test_data['range']))/(max(test_data['ran
ge']) - min(test_data['range']))
```

In [96]:

```
sns.distplot(train_data['range'],bins=50)
```

Out[96]:

```
<matplotlib.axes._subplots.AxesSubplot at 0xd13ae7c5c0>
```



In [97]:

```
#Running ML regression#
#train test splitting#

X_train, X_test, y_train, y_test = train_test_split(train_data.drop('fare_amount', axis
=1),
train_data['fare_amount'], test_size=0.15, random_state = 123)

print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(13028, 7)
(2300, 7)
(13028,)
(2300,)
```

In [98]:

```
LRtrain_model = LinearRegression().fit(X_train , y_train)
```

In [99]:

```
#LR prediction on train data#
LRtrain_pred = LRtrain_model.predict(X_train)
print (LRtrain_pred, sep='\n')
```

```
[14.45206819  8.41160465 10.71462893 ...  8.64270108  9.99600052
 13.35299906]
```

In [100]:

```
#LR prediction on test data#
LRtest_pred = LRtrain_model.predict(X_test)
print (LRtest_pred, sep='\n')
```

```
[ 9.90406085 10.53849378  9.99962426 ...  8.41051444 20.84039493
  7.06471911]
```

In [101]:

```
#calculating RMSE for train data#
from sklearn.metrics import mean_squared_error
RMSE_LRtrain = np.sqrt(mean_squared_error(y_train, LRtrain_pred))
```

In [102]:

```
print (RMSE_LRtrain)
```

```
8.487082202321318
```

In [103]:

```
#calculating RMSE for test data#
RMSE_LRtest = np.sqrt(mean_squared_error(y_test, LRtest_pred))
```

In [104]:

```
print(RMSE_LRtest)
```

```
6.060182502550654
```

In [105]:

```
import statsmodels.api as sm
```

In [106]:

```
def MAPE (y,y_pred):
    mape = np.mean(np.abs((y-y_pred)/y))
    return mape
```

In [107]:

```
MAPE(y_train, LRtrain_pred)
```

Out[107]:

```
0.3398222657529489
```

In [108]:

```
MAPE(y_test, LRtest_pred)
```

Out[108]:

```
0.3361035403575705
```

In [109]:

```
import sklearn.metrics as skl
```

In [110]:

```
skl.r2_score(y_train, LRtrain_pred)
```

Out[110]:

```
0.3794806216223916
```

In [111]:

```
skl.r2_score(y_test, LRtest_pred)
```

Out[111]:

```
0.5520699536660523
```

In [112]:

```
#Decision Tree#
DT_Model = DecisionTreeRegressor(max_depth = 2).fit(X_train,y_train)
```

In [113]:

```
#Prediction on train data#
DTpred_train = DT_Model.predict(X_train)
```

In [114]:

```
#prediction on test data#
DTpred_test = DT_Model.predict(X_test)
```

In [115]:

```
#RMSE for train data#
RMSE_DTtrain = np.sqrt(mean_squared_error(y_train,DTpred_train))
```

In [116]:

```
#RMSE for test data#
RMSE_DTtest = np.sqrt(mean_squared_error(y_test,DTpred_test))
```

In [117]:

```
print(RMSE_DTtrain)
print(RMSE_DTtest)
```

```
7.1660517238852535
4.459095535444328
```

In [118]:

```
MAPE(y_train,DTpred_train)
```

Out[118]:

```
0.31408077440852067
```

In [119]:

```
MAPE(y_test,DTpred_test)
```

Out[119]:

```
0.3104447461594597
```

In [120]:

```
skl.r2_score(y_train,DTpred_train)
```

Out[120]:

```
0.5576170211854519
```

In [121]:

```
skl.r2_score(y_test,DTpred_test)
```

Out[121]:

```
0.7574884970804695
```

In [122]:

```
#Random Forest#
RF_Model = RandomForestRegressor(n_estimators = 200).fit(X_train,y_train)
```

In [123]:

```
#prediction on train data#
RFpred_train = RF_Model.predict(X_train)
```

In [124]:

```
#prediction on test data#
RFpred_test = RF_Model.predict(X_test)
```

In [125]:

```
RMSE_RFtrain = np.sqrt(mean_squared_error(y_train,RFpred_train))
```

In [126]:

```
RMSE_RFtest = np.sqrt(mean_squared_error(y_test,RFpred_test))
```

In [127]:

```
print (RMSE_RFtrain)
print (RMSE_RFtest)
```

```
2.531126161048096
3.80214771925627
```

In [128]:

```
MAPE(y_train,RFpred_train)
```

Out[128]:

```
0.08288401920760227
```

In [129]:

```
MAPE(y_test,RFpred_test)
```

Out[129]:

```
0.2093590408447905
```

In [130]:

```
skl.r2_score(y_train,RFpred_train)
```

Out[130]:

```
0.9448092727550343
```

In [131]:

```
skl.r2_score(y_test,RFpred_test)
```

Out[131]:

```
0.8236819555077476
```

In [132]:

```
#Hyper parameter tuning with Randomsearch CV#

rf = RandomForestRegressor(random_state = 45)
from pprint import pprint

#parameters used by our current forest#

print('Parameters currently in use')
pprint(rf.get_params())
```

```
Parameters currently in use
{'bootstrap': True,
 'criterion': 'mse',
 'max_depth': None,
 'max_features': 'auto',
 'max_leaf_nodes': None,
 'min_impurity_decrease': 0.0,
 'min_impurity_split': None,
 'min_samples_leaf': 1,
 'min_samples_split': 2,
 'min_weight_fraction_leaf': 0.0,
 'n_estimators': 'warn',
 'n_jobs': None,
 'oob_score': False,
 'random_state': 45,
 'verbose': 0,
 'warm_start': False}
```

In [133]:

```
from sklearn.model_selection import train_test_split,RandomizedSearchCV
```

In [138]:

```
#Random Search CV on Random Forest Model#

RFR = RandomForestRegressor(random_state = 0)
n_estimator = list(range(1,20,2))
depth = list(range(1,100,2))

# Create the random grid
rand_grid = {'n_estimators': n_estimator,
               'max_depth': depth}

randomcv_rf = RandomizedSearchCV(RFR, param_distributions = rand_grid, n_iter = 5, cv =
5, random_state=0)
randomcv_rf = randomcv_rf.fit(X_train,y_train)
predictions_RFR = randomcv_rf.predict(X_test)

view_best_params_RFR = randomcv_rf.best_params_

best_model = randomcv_rf.best_estimator_

predictions_RFR = best_model.predict(X_test)


#Calculating RMSE
RFR_rmse = np.sqrt(mean_squared_error(y_test,predictions_RFR))
```

In [139]:

```
print(view_best_params_RFR)
print(RFR_rmse)
```

```
{'n_estimators': 15, 'max_depth': 23}
4.359046337341404
```

In [140]:

```
#On r2 score#

RFR_r2 = skl.r2_score(y_test, predictions_RFR)
print(RFR_r2)
```

```
0.7682489235147077
```

In [137]:

```
# Grid Search CV on random Forest model#

from sklearn.model_selection import GridSearchCV

regr = RandomForestRegressor(random_state = 0)
n_estimator = list(range(11,20,1))
depth = list(range(5,15,2))

# Create the grid
grid_search = {'n_estimators': n_estimator,
               'max_depth': depth}

## Grid Search Cross-Validation with 5 fold CV
gridscv_rf = GridSearchCV(regr, param_grid = grid_search, cv = 5)
gridscv_rf = gridscv_rf.fit(X_train,y_train)
view_best_params_GRF = gridscv_rf.best_params_

#Apply model on test data
predictions_GRF = gridscv_rf.predict(X_test)

#R2 score#

GRF_r2 = skl.r2_score(y_test, predictions_GRF)

#RMSE#
GRF_rmse = np.sqrt(mean_squared_error(y_test,predictions_GRF))


print(view_best_params_GRF)
print(GRF_r2)
print(GRF_rmse)
```

```
{'max_depth': 5, 'n_estimators': 12}
0.8218275774135435
3.822089461628625
```

In [143]:

```
## Prediction of fare amount with Grid search CV
regr = RandomForestRegressor(random_state = 0)
n_estimator = list(range(11,20,1))
depth = list(range(5,15,2))


grid_search = {'n_estimators': n_estimator,
               'max_depth': depth}


gridscv_rf = GridSearchCV(regr, param_grid = grid_search, cv = 5)
gridscv_rf = gridscv_rf.fit(X_train,y_train)
view_best_params_GRF = gridscv_rf.best_params_

#Applying model on test data
predictions_GRRF = gridscv_rf.predict(X_test)
```

In [144]:

```
#Prediction of fare amount with Random search CV#

RFR = RandomForestRegressor(random_state = 0)
n_estimator = list(range(1,20,2))
depth = list(range(1,100,2))

# Create the random grid
rand_grid = {'n_estimators': n_estimator,
               'max_depth': depth}

randomcv_rf = RandomizedSearchCV(RFR, param_distributions = rand_grid, n_iter = 5, cv =
5, random_state=0)
randomcv_rf = randomcv_rf.fit(X_train,y_train)
predictions_RFR = randomcv_rf.predict(X_test)
```

In [145]:

```
predictions_GRRF
```

Out[145]:

```
array([ 9.17000061,  9.4255617 ,  7.52467979, ...,  9.09272808,
       25.95163572,  5.71933761])
```

In [146]:

```
predictions_RFR
```

Out[146]:

```
array([ 8.98333333,  8.58      ,  6.83333333, ...,  9.49733333,
       29.40266667,  7.44166667])
```

In [147]:

```
test_data['Predicted_fareamount as per RSCV'] = pd.DataFrame(predictions_RFR)
```

In [148]:

```
test_data['Predicted_fareamount as per GSCV'] = pd.DataFrame(predictions_GRRF)
```

In [149]:

```
test_data.head(10)
```

Out[149]:

	passenger_count	year	Month	Date	Day	Hour	range	Predicted_fareamount as per RSCV	Predict
0	1	2015	1	27	1	13	0.023234	8.983333	
1	1	2015	1	27	1	13	0.024254	8.580000	
2	1	2011	10	8	5	11	0.006187	6.833333	
3	1	2012	12	1	5	21	0.019611	11.604667	
4	1	2012	12	1	5	21	0.053875	8.820000	
5	1	2012	12	1	5	21	0.032227	14.684667	
6	1	2011	10	6	3	12	0.009296	7.946416	
7	1	2011	10	6	3	12	0.215410	30.596667	
8	1	2011	10	6	3	12	0.038741	5.601111	
9	1	2014	2	18	1	15	0.010998	8.858000	

In [ ]:

```

```