kaggle new york city taxi fare prediction challenge

September 25, 2018

In [1]:
```
# Initial Python environment setup...
import numpy as np # linear algebra
import pandas as pd # CSV file I/O (e.g. pd.read_csv)
import os # reading the input files we have access to

print(os.listdir('../input'))
```

```
['GCP-Coupons-Instructions.rtf', 'sample_submission.csv', 'test.csv', 'train.csv']
```

In [2]:
```
train_df =  pd.read_csv('../input/train.csv',nrows=10_000_000)
train_df.dtypes
```

Out[2]:
```
key                   object
fare_amount          float64
pickup_datetime       object
pickup_longitude     float64
pickup_latitude      float64
dropoff_longitude    float64
dropoff_latitude     float64
passenger_count        int64
dtype: object
```

In [3]:
```
#get a sense how training data looks like
train_df[:5]
```

Out[3]:
```
                             key  fare_amount          pickup_datetime  \
0    2009-06-15 17:26:21.0000001          4.5  2009-06-15 17:26:21 UTC
1    2010-01-05 16:52:16.0000002         16.9  2010-01-05 16:52:16 UTC
2   2011-08-18 00:35:00.00000049          5.7  2011-08-18 00:35:00 UTC
3    2012-04-21 04:30:42.0000001          7.7  2012-04-21 04:30:42 UTC
4  2010-03-09 07:51:00.000000135          5.3  2010-03-09 07:51:00 UTC

   pickup_longitude  pickup_latitude  dropoff_longitude  dropoff_latitude  \
0        -73.844311        40.721319         -73.841610         40.712278
1        -74.016048        40.711303         -73.979268         40.782004
2        -73.982738        40.761270         -73.991242         40.750562
3        -73.987130        40.733143         -73.991567         40.758092
```

```
4        -73.968095        40.768008         -73.956655         40.783762

   passenger_count
0                1
1                1
2                2
3                1
4                1
```

```
In [4]: plot = train_df.plot.scatter('passenger_count','fare_amount')
```

```
In [5]: train_df.describe()
```

```
Out[5]:         fare_amount  pickup_longitude  pickup_latitude  dropoff_longitude  \
count  1.000000e+07      1.000000e+07     1.000000e+07       9.999931e+06
mean   1.133854e+01     -7.250775e+01     3.991934e+01      -7.250897e+01
std    9.799930e+00      1.299421e+01     9.322539e+00       1.287532e+01
min   -1.077500e+02     -3.439245e+03    -3.492264e+03      -3.426601e+03
25%    6.000000e+00     -7.399207e+01     4.073491e+01      -7.399139e+01
50%    8.500000e+00     -7.398181e+01     4.075263e+01      -7.398016e+01
75%    1.250000e+01     -7.396710e+01     4.076712e+01      -7.396367e+01
max    1.273310e+03      3.457626e+03     3.344459e+03       3.457622e+03

       dropoff_latitude  passenger_count
count      9.999931e+06     1.000000e+07
mean       3.991913e+01     1.684793e+00
std        9.237280e+00     1.323423e+00
min       -3.488080e+03     0.000000e+00
25%        4.073403e+01     1.000000e+00
50%        4.075316e+01     1.000000e+00
75%        4.076810e+01     2.000000e+00
max        3.351403e+03     2.080000e+02
```

```
In [6]: # Given a dataframe, add two new features 'abs_diff_longitude' and
        # 'abs_diff_latitude' reprensenting the "Manhattan vector" from
        # the pickup location to the dropoff location.
        def add_travel_vector_features(df):
            df['abs_diff_longitude'] = (df.dropoff_longitude - df.pickup_longitude).abs()
            df['abs_diff_latitude'] = (df.dropoff_latitude - df.pickup_latitude).abs()

        add_travel_vector_features(train_df)
```

```
In [7]: #Clean NA values
        print('Old size: %d' % len(train_df))
        train_df = train_df.dropna(how = 'any', axis = 'rows')
        print('New size: %d' % len(train_df))
```

```
Old size: 10000000
New size: 9999931
```

```
In [8]: print('Old size: %d' % len(train_df))
        train_df = train_df[(train_df.abs_diff_longitude < 5.0) & (train_df.abs_diff_latitude <
        print('New size: %d' % len(train_df))
```

```
Old size: 9999931
New size: 9979187
```

```
In [9]: print('Old size: %d' % len(train_df))
        train_df = train_df[(train_df.fare_amount > 0)]
        print('New size: %d' % len(train_df))
```

```
Old size: 9979187
New size: 9978549
```

```
In [10]: print('Old size: %d' % len(train_df))
         train_df = train_df[(train_df.pickup_longitude != 0) & (train_df.pickup_latitude!=0)]
         print('New size: %d' % len(train_df))
```

```
Old size: 9978549
New size: 9797235
```

```
In [11]: print('Old size: %d' % len(train_df))
         train_df = train_df[(train_df.dropoff_longitude != 0) & (train_df.dropoff_latitude!=0)
         print('New size: %d' % len(train_df))
```

```
Old size: 9797235
New size: 9797221
```

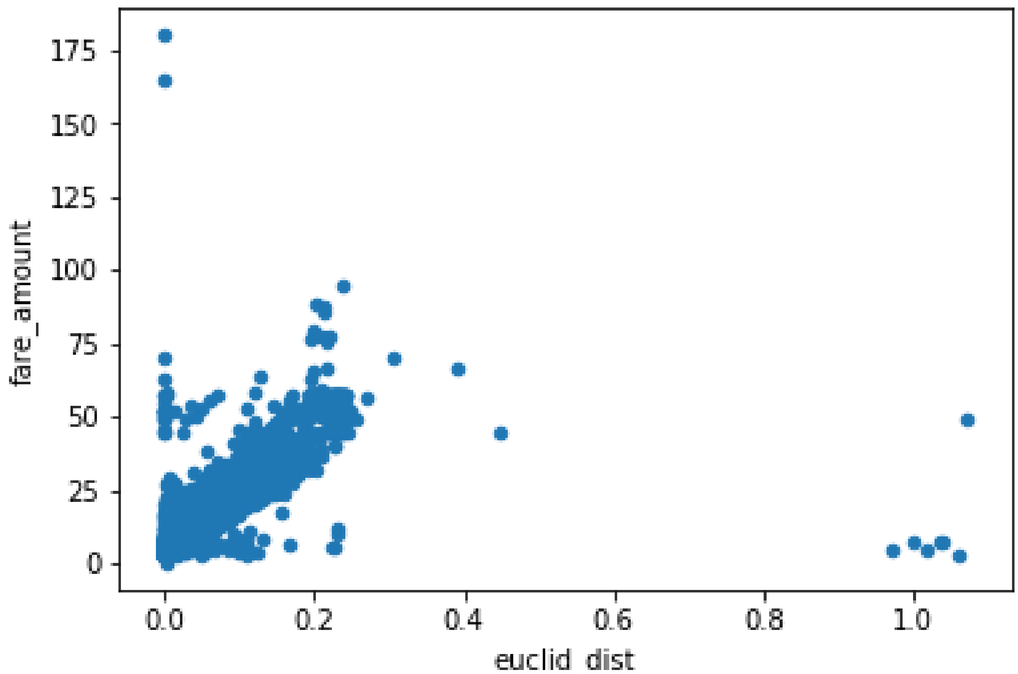
```
In [12]: # Given a dataframe, add two new features 'abs_diff_longitude' and
         # 'abs_diff_latitude' reprensenting the "Manhattan vector" from
         # the pickup location to the dropoff location.
         def add_euclid_distance_feature(df):
             abs_diff_longitude = (df.dropoff_longitude - df.pickup_longitude)
             abs_diff_latitude = (df.dropoff_latitude - df.pickup_latitude)
             abs_diff_longitude_square = abs_diff_longitude ** 2
             abs_diff_latitude_square = abs_diff_latitude ** 2
             df['euclid_dist'] = (abs_diff_longitude_square + abs_diff_latitude_square) ** (1/

         add_euclid_distance_feature(train_df)
```

```
In [13]: train_df.corr()
```

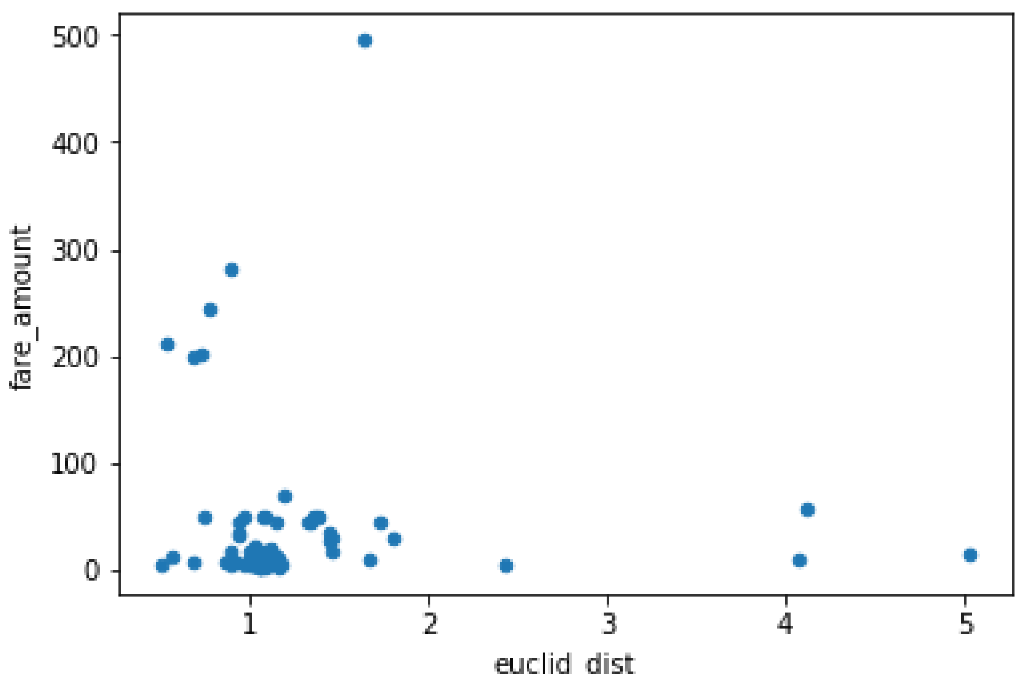
```
Out[13]:                    fare_amount  pickup_longitude  pickup_latitude  \
         fare_amount           1.000000          0.005782        -0.004231
         pickup_longitude      0.005782          1.000000        -0.353907
```

```
pickup_latitude      -0.004231        -0.353907        1.000000
dropoff_longitude     0.004879         0.999945       -0.353907
dropoff_latitude     -0.004082        -0.353901        0.999954
passenger_count       0.013833         0.005445       -0.005951
abs_diff_longitude    0.710765         0.002789       -0.000495
abs_diff_latitude     0.536288         0.003477       -0.003181
euclid_dist           0.726546         0.003378       -0.001911

                    dropoff_longitude  dropoff_latitude  passenger_count  \
fare_amount                  0.004879         -0.004082         0.013833
pickup_longitude             0.999945         -0.353901         0.005445
pickup_latitude             -0.353907          0.999954        -0.005951
dropoff_longitude            1.000000         -0.353897         0.005428
dropoff_latitude            -0.353897          1.000000        -0.005928
passenger_count              0.005428         -0.005928         1.000000
abs_diff_longitude           0.002041         -0.000392         0.007301
abs_diff_latitude            0.002850         -0.003186         0.006233
euclid_dist                  0.002674         -0.001905         0.007672

                    abs_diff_longitude  abs_diff_latitude  euclid_dist
fare_amount                   0.710765           0.536288     0.726546
pickup_longitude              0.002789           0.003477     0.003378
pickup_latitude              -0.000495          -0.003181    -0.001911
dropoff_longitude             0.002041           0.002850     0.002674
dropoff_latitude             -0.000392          -0.003186    -0.001905
passenger_count               0.007301           0.006233     0.007672
abs_diff_longitude            1.000000           0.507669     0.904494
abs_diff_latitude             0.507669           1.000000     0.808833
euclid_dist                   0.904494           0.808833     1.000000
```

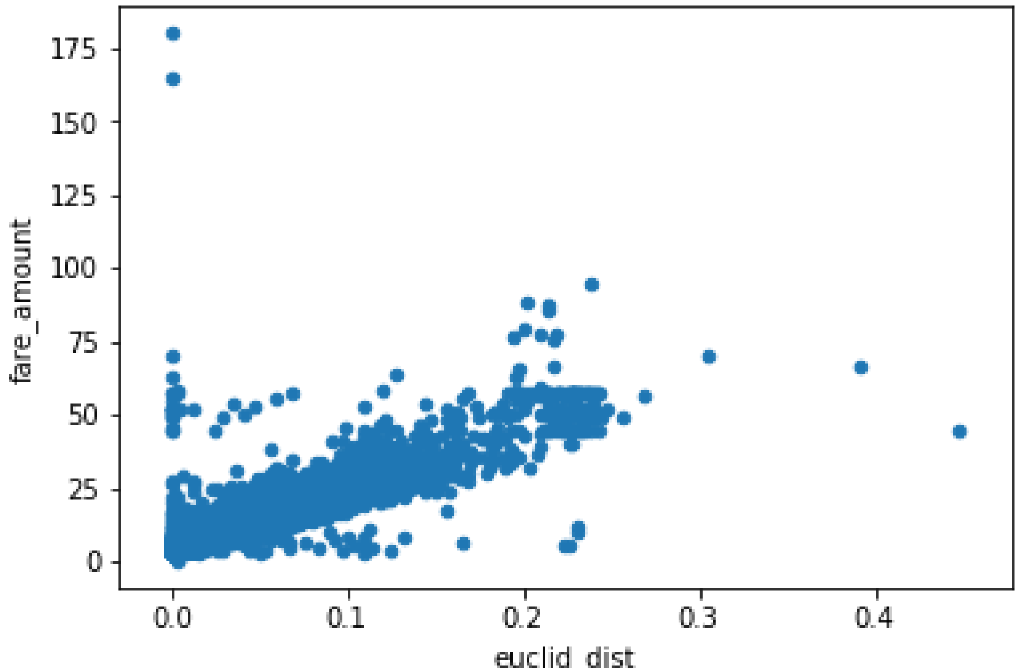
In [14]:
```
plot = train_df.iloc[:10000].plot.scatter('euclid_dist','fare_amount')
```




```
In [15]: #When euclid distance is more than 0.5, you can still fit a line but most of the data
         x = train_df[train_df.euclid_dist>0.5]
         plot = x.iloc[:100].plot.scatter('euclid_dist','fare_amount')
```



In [16]:
```
#When euclid distance is less than 0.5, one can fit a line such that most data points
x = train_df[train_df.euclid_dist<0.5]
plot = x.iloc[:10000].plot.scatter('euclid_dist','fare_amount')
```



In [17]:
```
#Convert pickup date time string to a pandas datetime object

from datetime import timedelta, datetime
from pandas import DataFrame, Series

lines = train_df['pickup_datetime']

dt_lst = []

for date_str in lines:
    dt = datetime.strptime(date_str, '%Y-%m-%d %H:%M:%S UTC')
    seconds_since_midnight = int((dt - dt.replace(hour=0, minute=0, second=0, microsec
    dt_lst.append(seconds_since_midnight)

# Create a Series named "Request_Time"
sr_dt = Series(dt_lst, name='Second_Of_Day')

# Create a DataFrame using the Request_Time Series
```

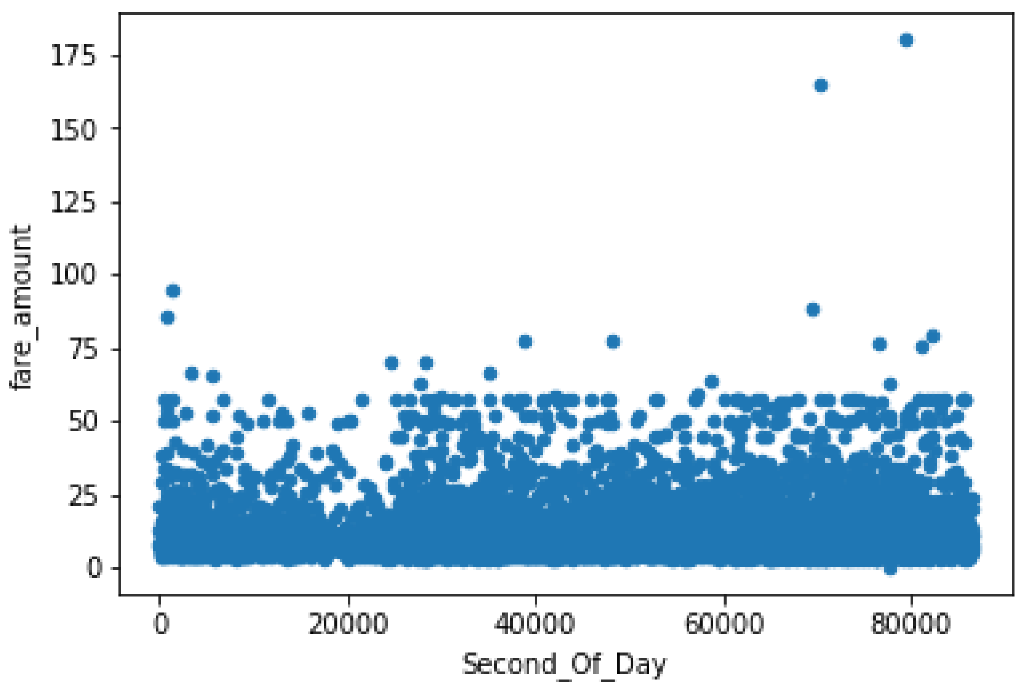
```
df = DataFrame(sr_dt)
df['fare_amount'] = train_df['fare_amount']
df['euclid_dist'] = train_df['euclid_dist']
```

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

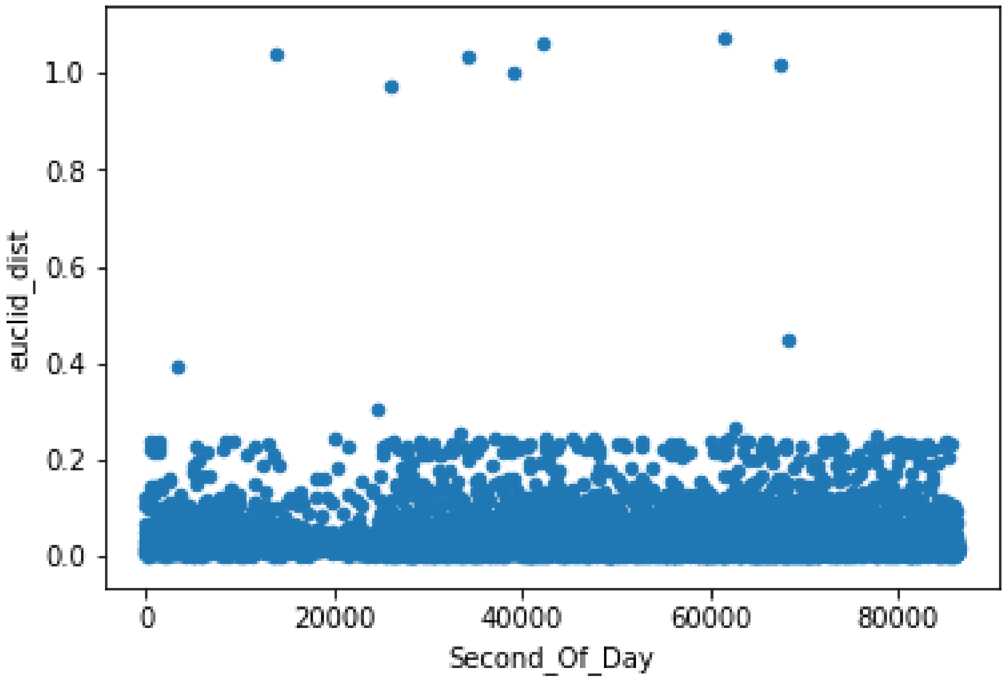
Out[18]:

	Second_Of_Day	fare_amount	euclid_dist
Second_Of_Day	1.000000	-0.000365	-0.000165
fare_amount	-0.000365	1.000000	0.725529
euclid_dist	-0.000165	0.725529	1.000000

In [19]:
```
plot = df.iloc[:10000].plot.scatter('Second_Of_Day','fare_amount')
```



In [20]:
```
plot = df.iloc[:10000].plot.scatter('Second_Of_Day','euclid_dist')
```




```
In [21]: # Model 1 : A simple linear regression model that uses the feature euclidean distance
         import matplotlib.pyplot as plt
         from scipy import stats

         xi = train_df['euclid_dist']
         y = train_df['fare_amount']

         #Train the model on train data
         slope, intercept, r_value, p_value, std_err = stats.linregress(xi,y)

         print ('r value', r_value)
         print  ('p_value', p_value)
         print ('standard deviation', std_err)
         print ('slope is:', slope)
         print ("r-squared:", r_value**2)

         #Check the model fit
         #plt.plot(xi, y, 'o', label='original data')
         #plt.plot(xi, intercept + slope*xi, 'r', label='fitted line')
         #plt.legend()
         #plt.show()
```

```
r value 0.7265459653520138
p_value 0.0
standard deviation 0.04594354813355792
```

```
slope is: 152.05748221076286
r-squared: 0.5278690397692896
```

```
In [22]: #Test the model on test data
         test_df = pd.read_csv('../input/test.csv')
         add_euclid_distance_feature(test_df)

         xi = test_df['euclid_dist']

         test_y_predictions=[]
         for x in xi:
             y = round(slope*x + intercept, 2)
             test_y_predictions.append(y)

         # Write the predictions to a CSV file which we can submit to the competition.
         submission = pd.DataFrame(
             {'key': test_df.key, 'fare_amount': test_y_predictions},
             columns = ['key', 'fare_amount'])
         submission.to_csv('submission.csv', index = False)

         print(os.listdir('.'))
```

```
['.git', '.ipynb_checkpoints', 'kaggle new york city taxi fare prediction challenge.ipynb', 'mo
```

```
In [23]: # Model 2 : Use random forest regressor model that uses the feature euclidean distanc
         from sklearn.ensemble import RandomForestRegressor as rfr
         from sklearn.model_selection import cross_val_score
         # build the model with the desired parameters...
         numFeatures = 1 # the number of features to inlcude
         train_df_mini = train_df[:1000000]
         trees = 10 # trees in the forest
         included_features = ['euclid_dist']
         # define the training data X...
         X = train_df_mini[included_features]
         Y = train_df_mini[['fare_amount']]
         yt = [i for i in Y['fare_amount']]
         np.random.seed(11111)
         model = rfr(n_estimators=trees,max_depth=None)
         scores_rfr = cross_val_score(model,X,yt,cv=10,scoring='explained_variance')
         print('explained variance scores for k=10 fold validation:',scores_rfr)
         print("Est. explained variance: %0.2f (+/- %0.2f)" % (scores_rfr.mean(), scores_rfr.s
         # fit the model
         model.fit(X,yt)
```

```
explained variance scores for k=10 fold validation: [0.66106363 0.68731691 0.64530205 0.668022
 0.70530754 0.69416429 0.69226933 0.6774113 ]
```

```
Est. explained variance: 0.68 (+/- 0.03)
```

```
Out[23]: RandomForestRegressor(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=10, n_jobs=1,
                    oob_score=False, random_state=None, verbose=0, warm_start=False)
```

```
In [24]: # apply the model to the test data and get the output...
         X_test = test_df[included_features]
         y_output = model.predict(X_test.fillna(0)) # get the results and fill nan's with 0
         print(y_output)

         test_y_predictions=[]
         for elem in y_output:
             test_y_predictions.append(round(elem,2))
```

```
[ 8.44973482  9.0342475   4.74166667 ... 42.648      21.472
  6.15284377]
```

```
In [25]: # Write the predictions to a CSV file which we can submit to the competition.
         submission = pd.DataFrame(
             {'key': test_df.key, 'fare_amount': test_y_predictions},
             columns = ['key', 'fare_amount'])
         submission.to_csv('submission.csv', index = False)

         print(os.listdir('.'))
```

```
['.git', '.ipynb_checkpoints', 'kaggle new york city taxi fare prediction challenge.ipynb', 'mo
```

```
In [26]: # Model 3 : Use LightGBM decision tree model that uses multiple features to predict t
         import lightgbm as lgb
         # load or create your dataset
         print('Load data...')

         included_features = ['euclid_dist','passenger_count','pickup_latitude','pickup_longitu
         train_X = train_df[included_features]
         train_y = train_df['fare_amount']

         params = {
                 'nthread': -1,
             }
         #Default Parameters

         train_set = lgb.Dataset(train_X, train_y, silent=True)
         model3 = lgb.train(params, train_set = train_set, num_boost_round=300)
```

```
Load data...
```

```
In [27]: model3.save_model('modellgbm.txt')
         print('Start predicting...')
         X_test = test_df[included_features]
         # predict
         y_pred = model3.predict(X_test, num_iteration=model3.best_iteration)
```

```
Start predicting...
```

```
In [28]: test_y_predictions=[]
         for elem in y_pred:
             test_y_predictions.append(round(elem,2))

         # Write the predictions to a CSV file which we can submit to the competition.
         submission = pd.DataFrame(
             {'key': test_df.key, 'fare_amount': test_y_predictions},
             columns = ['key', 'fare_amount'])
         submission.to_csv('submission.csv', index = False)

         print(os.listdir('.'))
```

```
['.git', '.ipynb_checkpoints', 'kaggle new york city taxi fare prediction challenge.ipynb', 'mo
```