In [0]:

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

import os
import shutil
import datetime
import gc
from tqdm import tqdm

import pandas as pd
import numpy as np

%matplotlib inline
import matplotlib.pyplot as plt
import seaborn as sns
sns.set(style='whitegrid')


import scipy
from scipy import hstack


from sklearn.metrics import mean_squared_error as mse
from math import sqrt
from sklearn.linear_model import Ridge
from sklearn.svm import SVR
from sklearn.ensemble import RandomForestRegressor
from lightgbm import LGBMRegressor

from sklearn.model_selection import RandomizedSearchCV
from scipy.stats import randint as sp_randint
from scipy.stats import uniform
from sklearn.feature_selection.univariate_selection import SelectKBest, f_regression
```

Loading data

In [2]:

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call
drive.mount("/content/drive", force_remount=True).
```

In [0]:

```
os.chdir('/content/drive/My Drive/Colab Notebooks/MercariCS')
```

In [4]:

```
X_train = scipy.sparse.load_npz("train_final.npz")
y_train = np.load('y_train.npy')

X_cv = scipy.sparse.load_npz("cv_final.npz")
y_cv = np.load('y_cv.npy')

# X_test = scipy.sparse.load_npz("test_final.npz")
X_train.shape, y_train.shape, X_cv.shape, y_cv.shape
```

Out[4]:

```
((1332967, 48049), (1332967,), (148108, 48049), (148108,))
```

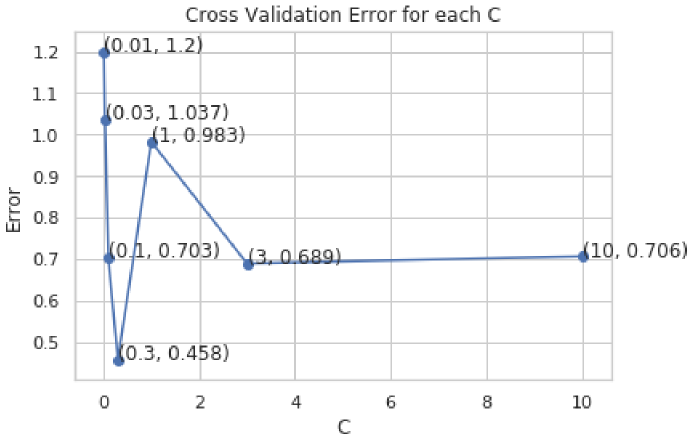
6.3. SVM Regression

Hyper parameter tuning using RandomizedSearchCV

In [7]:

```
c_param = [0.01, 0.03, 0.1, 0.3, 1, 3, 10]
cv_rmsle_array=[]

for i in c_param:
    model = SVR(C=i, max_iter=200)
    model.fit(X_train, y_train)
    preds_cv = model.predict(X_cv)
    cv_err = sqrt(mse(y_cv, preds_cv))
    cv_rmsle_array.append(cv_err)

    print('RMSLE for C=',i, 'is', cv_err)

best_C = np.argmin(cv_rmsle_array)

fig, ax = plt.subplots()
ax.plot(c_param, cv_rmsle_array)
ax.scatter(c_param, cv_rmsle_array)
for i, txt in enumerate(np.round(cv_rmsle_array,3)):
    ax.annotate((c_param[i],np.round(txt,3)), (c_param[i],cv_rmsle_array[i]))
plt.title("Cross Validation Error for each C")
plt.xlabel("C")
plt.ylabel("Error")
plt.show()
```

```
RMSLE for C= 0.01 is 1.199926186837584
RMSLE for C= 0.03 is 1.0373687259431916
RMSLE for C= 0.1 is 0.7031124570842185
RMSLE for C= 0.3 is 0.45763721721801703
RMSLE for C= 1 is 0.9825724712557466
RMSLE for C= 3 is 0.6889839235210923
RMSLE for C= 10 is 0.7062493308619081
```



Training and testing using best parameters

In [9]:

```
best_C = c_param[best_C]
print('Best C: ', best_C)
model = SVR(C=best_C, max_iter=200)
model.fit(X_train, y_train)
```

```
Best C:  0.3
```

Out[9]:

```
SVR(C=0.3, cache_size=200, coef0=0.0, degree=3, epsilon=0.1, gamma='scale',
    kernel='rbf', max_iter=200, shrinking=True, tol=0.001, verbose=False)
```

In [10]:

```
svr_preds_tr = model.predict(X_train)
svr_preds_cv = model.predict(X_cv)
print('Train RMSLE:', sqrt(mse(y_train, svr_preds_tr)))

svr_rmsle = sqrt(mse(y_cv, svr_preds_cv))
print("Cross validation RMSLE: ", svr_rmsle)
```

```
Train RMSLE: 0.44156303699190574
Cross validation RMSLE:  0.45763721721801703
```

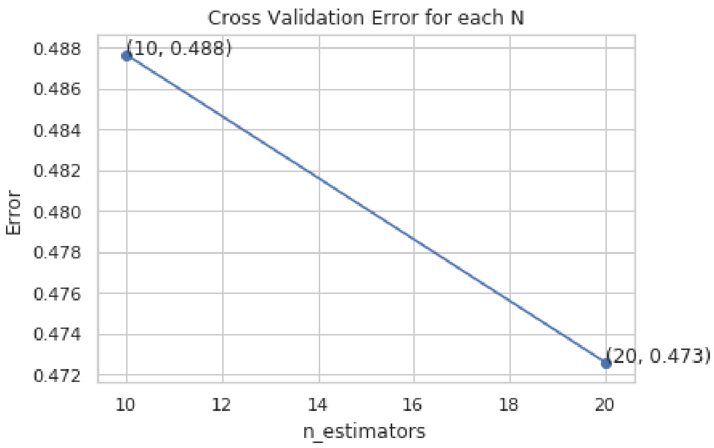
6.4. RandomForest Regression

Hyper parameter tuning using RandomizedSearchCV

In [25]:

```
dt = datetime.datetime #to track time

estimators = [10, 20]
cv_rmsle_array=[]
t0 = dt.now()
for i in estimators:
    model = RandomForestRegressor(n_estimators=i, min_samples_split=10, max_features='sqrt', max_sa
mples=0.9, random_state=42)
    model.fit(X_train, y_train)
    preds_cv = model.predict(X_cv)
    cv_err = sqrt(mse(y_cv, preds_cv))
    cv_rmsle_array.append(cv_err)

    print (f'RMSLE for N={i} is {cv_err}\t elapsed time:{dt.now() - t0}')

best_N = np.argmin(cv_rmsle_array)

fig, ax = plt.subplots()
ax.plot(estimators, cv_rmsle_array)
ax.scatter(estimators, cv_rmsle_array)
for i, txt in enumerate(np.round(cv_rmsle_array,3)):
    ax.annotate((estimators[i],np.round(txt,3)), (estimators[i],cv_rmsle_array[i]))
plt.title("Cross Validation Error for each N")
plt.xlabel("n_estimators")
plt.ylabel("Error")
plt.show()
```

```
RMSLE for N=10 is 0.487657647189664  elapsed time:0:46:21.136700
RMSLE for N=20 is 0.47260697582126654  elapsed time:2:02:11.229545
```



Training RandomForest Regressor with higher values of n_estimators was taking tremendous amount of time without giving any results. Due to this reason, we have trained it with less number of estimators. The above code itself took approx. 3 hrs and hence, we did not train further.

Training and testing using best parameters

In [ ]:

```
best_N = estimators[best_N]
print('Best n_estimators: ', best_N)
model = RandomForestRegressor(n_estimators=best_N, min_samples_split=10, max_features='sqrt', max_s
amples=0.9, random_state=42)
model.fit(X_train, y_train)
```

In [0]:

```
# X_test = scipy.sparse.load_npz("test_final.npz")
```

In [ ]:

```
rf_preds_tr = model.predict(X_train)
rf_preds_cv = model.predict(X_cv)
# rf_preds_te = model.predict(X_test)

print('Train RMSLE:', sqrt(mse(y_train, rf_preds_tr)))

rf_rmsle = sqrt(mse(y_cv, rf_preds_cv))
print("Cross validation RMSLE: ", rf_rmsle)
```

6.5. LightGBM Regression

Hyper parameter tuning using RandomizedSearchCV

In [0]:

```
lgb_model = LGBMRegressor(subsample=0.9)

params = {'learning_rate': uniform(0, 1),
          'n_estimators': sp_randint(200, 1500),
          'num_leaves': sp_randint(20, 200),
          'max_depth': sp_randint(2, 15),
          'min_child_weight': uniform(0, 2),
          'colsample_bytree': uniform(0, 1),
         }
lgb_random = RandomizedSearchCV(lgb_model, param_distributions=params, n_iter=10, cv=3, random_stat
e=42,
                                scoring='neg_root_mean_squared_error', verbose=10,
return_train_score=True)
lgb_random = lgb_random.fit(X_train, y_train)
```

```
Fitting 3 folds for each of 10 candidates, totalling 30 fits
[CV] colsample_bytree=0.3745401188473625, learning_rate=0.9507143064099162, max_depth=12,
min_child_weight=1.5593820005455385, n_estimators=1244, num_leaves=122
```

```
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
```

```
[CV]  colsample_bytree=0.3745401188473625, learning_rate=0.9507143064099162, max_depth=12,
min_child_weight=1.5593820005455385, n_estimators=1244, num_leaves=122, score=(train=-0.268,
test=-0.439), total= 5.4min
[CV] colsample_bytree=0.3745401188473625, learning_rate=0.9507143064099162, max_depth=12,
min_child_weight=1.5593820005455385, n_estimators=1244, num_leaves=122
```

```
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:  5.9min remaining:    0.0s
```

```
[CV]  colsample_bytree=0.3745401188473625, learning_rate=0.9507143064099162, max_depth=12,
min_child_weight=1.5593820005455385, n_estimators=1244, num_leaves=122, score=(train=-0.272,
test=-0.444), total= 5.6min
[CV] colsample_bytree=0.3745401188473625, learning_rate=0.9507143064099162, max_depth=12,
min_child_weight=1.5593820005455385, n_estimators=1244, num_leaves=122
```

```
[Parallel(n_jobs=1)]: Done   2 out of   2 | elapsed: 12.0min remaining:    0.0s
```

```
[CV]  colsample_bytree=0.3745401188473625, learning_rate=0.9507143064099162, max_depth=12,
min_child_weight=1.5593820005455385, n_estimators=1244, num_leaves=122, score=(train=-0.266,
test=-0.434), total= 5.6min
[CV] colsample_bytree=0.44583275285359114, learning_rate=0.09997491581800289, max_depth=12,
min_child_weight=1.7323522915498704, n_estimators=1323, num_leaves=123
```

```
[Parallel(n_jobs=1)]: Done   3 out of   3 | elapsed: 18.2min remaining:    0.0s
```

```
[CV]  colsample_bytree=0.44583275285359114, learning_rate=0.09997491581800289, max_depth=12,
min_child_weight=1.7323522915498704, n_estimators=1323, num_leaves=123, score=(train=-0.313,
test=-0.355), total= 7.6min
[CV] colsample_bytree=0.44583275285359114, learning_rate=0.09997491581800289, max_depth=12,
min_child_weight=1.7323522915498704, n_estimators=1323, num_leaves=123
```

```
[Parallel(n_jobs=1)]: Done   4 out of   4 | elapsed: 26.3min remaining:    0.0s
```

```
[CV]  colsample_bytree=0.44583275285359114, learning_rate=0.09997491581800289, max_depth=12,
min_child_weight=1.7323522915498704, n_estimators=1323, num_leaves=123, score=(train=-0.314,
test=-0.354), total= 7.8min
[CV] colsample_bytree=0.44583275285359114, learning_rate=0.09997491581800289, max_depth=12,
min_child_weight=1.7323522915498704, n_estimators=1323, num_leaves=123
```

```
[Parallel(n_jobs=1)]: Done   5 out of   5 | elapsed: 34.6min remaining:    0.0s
```

```
[CV]  colsample_bytree=0.44583275285359114, learning_rate=0.09997491581800289, max_depth=12,
min_child_weight=1.7323522915498704, n_estimators=1323, num_leaves=123, score=(train=-0.315,
test=-0.353), total= 7.7min
[CV] colsample_bytree=0.7080725777960455, learning_rate=0.020584494295802447, max_depth=3,
min_child_weight=1.4439975445336495, n_estimators=1005, num_leaves=149
```

```
[Parallel(n_jobs=1)]: Done   6 out of   6 | elapsed: 42.9min remaining:    0.0s
```

```
[CV]  colsample_bytree=0.7080725777960455, learning_rate=0.020584494295802447, max_depth=3,
min_child_weight=1.4439975445336495, n_estimators=1005, num_leaves=149, score=(train=-0.368,
test=-0.369), total= 2.3min
[CV] colsample_bytree=0.7080725777960455, learning_rate=0.020584494295802447, max_depth=3,
min_child_weight=1.4439975445336495, n_estimators=1005, num_leaves=149
```

```
[Parallel(n_jobs=1)]: Done   7 out of   7 | elapsed: 45.4min remaining:    0.0s
```

```
[CV]  colsample_bytree=0.7080725777960455, learning_rate=0.020584494295802447, max_depth=3,
min_child_weight=1.4439975445336495, n_estimators=1005, num_leaves=149, score=(train=-0.368,
test=-0.369), total= 2.3min
[CV] colsample_bytree=0.7080725777960455, learning_rate=0.020584494295802447, max_depth=3,
min_child_weight=1.4439975445336495, n_estimators=1005, num_leaves=149
```

```
[Parallel(n_jobs=1)]: Done   8 out of   8 | elapsed: 47.9min remaining:    0.0s
```

```
[CV]  colsample_bytree=0.7080725777960455, learning_rate=0.020584494295802447, max_depth=3,
min_child_weight=1.4439975445336495, n_estimators=1005, num_leaves=149, score=(train=-0.368,
test=-0.368), total= 2.3min
[CV] colsample_bytree=0.18182496720710062, learning_rate=0.18340450985343382, max_depth=13,
min_child_weight=1.2233063209765618, n_estimators=452, num_leaves=108
```

```
[Parallel(n_jobs=1)]: Done   9 out of   9 | elapsed: 50.5min remaining:    0.0s
```

```
[CV]  colsample_bytree=0.18182496720710062, learning_rate=0.18340450985343382, max_depth=13,
min_child_weight=1.2233063209765618, n_estimators=452, num_leaves=108, score=(train=-0.329, test=-
0.360), total= 2.8min
[CV] colsample_bytree=0.18182496720710062, learning_rate=0.18340450985343382, max_depth=13,
min_child_weight=1.2233063209765618, n_estimators=452, num_leaves=108
[CV]  colsample_bytree=0.18182496720710062, learning_rate=0.18340450985343382, max_depth=13,
min_child_weight=1.2233063209765618, n_estimators=452, num_leaves=108, score=(train=-0.330, test=-
0.360), total= 3.0min
[CV] colsample_bytree=0.18182496720710062, learning_rate=0.18340450985343382, max_depth=13,
min_child_weight=1.2233063209765618, n_estimators=452, num_leaves=108
[CV]  colsample_bytree=0.18182496720710062, learning_rate=0.18340450985343382, max_depth=13,
[CV]  colsample_bytree=0.18182496720710062, learning_rate=0.18340450985343382, max_depth=13,
min_child_weight=1.2233063209765618, n_estimators=452, num_leaves=108, score=(train=-0.329, test=-
0.358), total= 2.9min
[CV] colsample_bytree=0.2912291401980419, learning_rate=0.6118528947223795, max_depth=11,
min_child_weight=0.09333132642723085, n_estimators=899, num_leaves=34
[CV]  colsample_bytree=0.2912291401980419, learning_rate=0.6118528947223795, max_depth=11,
min_child_weight=0.09333132642723085, n_estimators=899, num_leaves=34, score=(train=-0.317, test=-
0.372), total= 3.2min
[CV] colsample_bytree=0.2912291401980419, learning_rate=0.6118528947223795, max_depth=11,
min_child_weight=0.09333132642723085, n_estimators=899, num_leaves=34
[CV]  colsample_bytree=0.2912291401980419, learning_rate=0.6118528947223795, max_depth=11,
min_child_weight=0.09333132642723085, n_estimators=899, num_leaves=34, score=(train=-0.320, test=-
0.374), total= 3.3min
[CV] colsample_bytree=0.2912291401980419, learning_rate=0.6118528947223795, max_depth=11,
min_child_weight=0.09333132642723085, n_estimators=899, num_leaves=34
[CV]  colsample_bytree=0.2912291401980419, learning_rate=0.6118528947223795, max_depth=11,
min_child_weight=0.09333132642723085, n_estimators=899, num_leaves=34, score=(train=-0.317, test=-
0.369), total= 3.3min
[CV] colsample_bytree=0.45606998421703593, learning_rate=0.7851759613930136, max_depth=4,
min_child_weight=0.7649239825343255, n_estimators=1467, num_leaves=83
[CV]  colsample_bytree=0.45606998421703593, learning_rate=0.7851759613930136, max_depth=4,
min_child_weight=0.7649239825343255, n_estimators=1467, num_leaves=83, score=(train=-0.337, test=-
0.372), total= 2.8min
[CV] colsample_bytree=0.45606998421703593, learning_rate=0.7851759613930136, max_depth=4,
min_child_weight=0.7649239825343255, n_estimators=1467, num_leaves=83
[CV]  colsample_bytree=0.45606998421703593, learning_rate=0.7851759613930136, max_depth=4,
min_child_weight=0.7649239825343255, n_estimators=1467, num_leaves=83, score=(train=-0.338, test=-
0.372), total= 2.8min
[CV] colsample_bytree=0.45606998421703593, learning_rate=0.7851759613930136, max_depth=4,
min_child_weight=0.7649239825343255, n_estimators=1467, num_leaves=83
[CV]  colsample_bytree=0.45606998421703593, learning_rate=0.7851759613930136, max_depth=4,
min_child_weight=0.7649239825343255, n_estimators=1467, num_leaves=83, score=(train=-0.337, test=-
0.370), total= 2.9min
[CV] colsample_bytree=0.4667628932479799, learning_rate=0.8599404067363206, max_depth=8,
min_child_weight=0.34104824737458306, n_estimators=366, num_leaves=37
[CV]  colsample_bytree=0.4667628932479799, learning_rate=0.8599404067363206, max_depth=8,
min_child_weight=0.34104824737458306, n_estimators=366, num_leaves=37, score=(train=-0.342, test=-
0.380), total= 1.3min
[CV] colsample_bytree=0.4667628932479799, learning_rate=0.8599404067363206, max_depth=8,
min_child_weight=0.34104824737458306, n_estimators=366, num_leaves=37
[CV]  colsample_bytree=0.4667628932479799, learning_rate=0.8599404067363206, max_depth=8,
min_child_weight=0.34104824737458306, n_estimators=366, num_leaves=37, score=(train=-0.348, test=-
0.385), total= 1.4min
[CV] colsample_bytree=0.4667628932479799, learning_rate=0.8599404067363206, max_depth=8,
min_child_weight=0.34104824737458306, n_estimators=366, num_leaves=37
[CV]  colsample_bytree=0.4667628932479799, learning_rate=0.8599404067363206, max_depth=8,
min_child_weight=0.34104824737458306, n_estimators=366, num_leaves=37, score=(train=-0.343, test=-
0.379), total= 1.4min
[CV] colsample_bytree=0.9488855372533332, learning_rate=0.9656320330745594, max_depth=3,
min_child_weight=0.7708330050798322, n_estimators=764, num_leaves=149
[CV]  colsample_bytree=0.9488855372533332, learning_rate=0.9656320330745594, max_depth=3,
min_child_weight=0.7708330050798322, n_estimators=764, num_leaves=149, score=(train=-0.348, test=-
0.365), total= 1.5min
[CV] colsample_bytree=0.9488855372533332, learning_rate=0.9656320330745594, max_depth=3,
min_child_weight=0.7708330050798322, n_estimators=764, num_leaves=149
[CV]  colsample_bytree=0.9488855372533332, learning_rate=0.9656320330745594, max_depth=3,
min_child_weight=0.7708330050798322, n_estimators=764, num_leaves=149, score=(train=-0.349, test=-
0.365), total= 1.4min
[CV] colsample_bytree=0.9488855372533332, learning_rate=0.9656320330745594, max_depth=3,
min_child_weight=0.7708330050798322, n_estimators=764, num_leaves=149
[CV]  colsample_bytree=0.9488855372533332, learning_rate=0.9656320330745594, max_depth=3,
min_child_weight=0.7708330050798322, n_estimators=764, num_leaves=149, score=(train=-0.349, test=-
0.364), total= 1.5min
[CV] colsample_bytree=0.6842330265121569, learning_rate=0.4401524937396013, max_depth=8,
min_child_weight=1.2199933155652418, n_estimators=975, num_leaves=194
[CV]  colsample_bytree=0.6842330265121569, learning_rate=0.4401524937396013, max_depth=8,
min_child_weight=1.2199933155652418, n_estimators=975, num_leaves=194, score=(train=-0.309, test=-
0.363), total= 3.6min
[CV] colsample_bytree=0.6842330265121569, learning_rate=0.4401524937396013, max_depth=8,
min_child_weight=1.2199933155652418, n_estimators=975, num_leaves=194
[CV]  colsample_bytree=0.6842330265121569, learning_rate=0.4401524937396013, max_depth=8,
min_child_weight=1.2199933155652418, n_estimators=975, num_leaves=194, score=(train=-0.309, test=-
0.361), total= 3.5min
[CV] colsample_bytree=0.6842330265121569, learning_rate=0.4401524937396013, max_depth=8,
min_child_weight=1.2199933155652418, n_estimators=975, num_leaves=194
[CV]  colsample_bytree=0.6842330265121569, learning_rate=0.4401524937396013, max_depth=8,
min_child_weight=1.2199933155652418, n_estimators=975, num_leaves=194, score=(train=-0.309, test=-
0.361), total= 3.7min
```

```
0.361), total= 3.7min
[CV] colsample_bytree=0.17336465350777208, learning_rate=0.3910606075732408, max_depth=3,
min_child_weight=1.325044568707964, n_estimators=1225, num_leaves=153
[CV]  colsample_bytree=0.17336465350777208, learning_rate=0.3910606075732408, max_depth=3,
min_child_weight=1.325044568707964, n_estimators=1225, num_leaves=153, score=(train=-0.353, test=-
0.363), total= 1.7min
[CV] colsample_bytree=0.17336465350777208, learning_rate=0.3910606075732408, max_depth=3,
min_child_weight=1.325044568707964, n_estimators=1225, num_leaves=153
[CV]  colsample_bytree=0.17336465350777208, learning_rate=0.3910606075732408, max_depth=3,
min_child_weight=1.325044568707964, n_estimators=1225, num_leaves=153, score=(train=-0.355, test=-
0.364), total= 1.9min
[CV] colsample_bytree=0.17336465350777208, learning_rate=0.3910606075732408, max_depth=3,
min_child_weight=1.325044568707964, n_estimators=1225, num_leaves=153
[CV]  colsample_bytree=0.17336465350777208, learning_rate=0.3910606075732408, max_depth=3,
min_child_weight=1.325044568707964, n_estimators=1225, num_leaves=153, score=(train=-0.354, test=-
0.362), total= 1.9min
```

```
[Parallel(n_jobs=1)]: Done  30 out of  30 | elapsed: 107.3min finished
```

In [0]:

```
df1 = pd.DataFrame(lgb_random.cv_results_)
df1[['param_learning_rate', 'param_n_estimators', 'param_num_leaves', 'param_max_depth',
'param_min_child_weight', 'param_colsample_bytree', 'mean_train_score', 'mean_test_score']]
```

Out[0]:

	param_learning_rate	param_n_estimators	param_num_leaves	param_max_depth	param_min_child_weight	param_colsample_bytree
0	0.950714	1244	122	12	1.55938	0.37454
1	0.0999749	1323	123	12	1.73235	0.445833
2	0.0205845	1005	149	3	1.444	0.708073
3	0.183405	452	108	13	1.22331	0.181825
4	0.611853	899	34	11	0.0933313	0.291229
5	0.785176	1467	83	4	0.764924	0.45607
6	0.85994	366	37	8	0.341048	0.466763
7	0.965632	764	149	3	0.770833	0.948886
8	0.440152	975	194	8	1.21999	0.684233
9	0.391061	1225	153	3	1.32504	0.173365

In [0]:

```
best_params = lgb_random.best_params_
print(best_params)
```

```
{'colsample_bytree': 0.44583275285359114, 'learning_rate': 0.09997491581800289, 'max_depth': 12, '
min_child_weight': 1.7323522915498704, 'n_estimators': 1323, 'num_leaves': 123}
```

Training and testing using best parameters

In [0]:

```
model = LGBMRegressor(**best_params, subsample=0.9, random_state=42, n_jobs=-1)
model.fit(X_train, y_train)
```

Out[0]:

```
LGBMRegressor(boosting_type='gbdt', class_weight=None,
              colsample_bytree=0.44583275285359114, importance_type='split',
              learning_rate=0.09997491581800289, max_depth=12,
              min_child_samples=20, min_child_weight=1.7323522915498704,
              min_split_gain=0.0, n_estimators=1323, n_jobs=-1, num_leaves=123,
              objective=None, random_state=42, reg_alpha=0.0, reg_lambda=0.0,
              silent=True, subsample=0.9, subsample_for_bin=200000,
              subsample_freq=0)
```

In [0]:

```
X_cv = scipy.sparse.load_npz("cv_final.npz")
y_cv = np.load('y_cv.npy')

X_test = scipy.sparse.load_npz("test_final.npz")
```

In [0]:

```
lgb_preds_tr = model.predict(X_train)
lgb_preds_cv = model.predict(X_cv)
lgb_preds_te = model.predict(X_test)

print('Train RMSLE:', sqrt(mse(y_train, lgb_preds_tr)))

lgb_rmsle = sqrt(mse(y_cv, lgb_preds_cv))
print("Cross validation RMSLE: ", lgb_rmsle)
```

```
Train RMSLE: 0.3197898252767807
Cross validation RMSLE:  0.42423139030835477
```

Creating submission file

In [0]:

```
submission_df = pd.read_csv('ridge_submission.csv')

submission_df['price'] = np.exp(lgb_preds_te) - 1

submission_df.to_csv('lgb_submission.csv', index=False)
```

Summary

In [3]:

```
from prettytable import PrettyTable
x=PrettyTable()
x.field_names=["Model", "Feature Space", "Train_RMSLE", "Validation_RMSLE", "Kaggle_RMSLE(Public)"]
x.add_row(["Ridge", "FeatureEngg + cat_OHE + text_TFIDF", "0.38345", "0.44153", "0.45444"])
x.add_row(["SVR", "48Kbest text&cat + Ridge Preds + MNB Preds", "0.44156", "0.45764", "-"])
x.add_row(["LightGBM", "48Kbest text&cat + Ridge Preds + MNB Preds", "0.31979", "0.42423",
"0.45823"])

print(x)
```

```
+----------+--------------------------------------------+-------------+------------------+---------
----------+
|  Model   |                Feature Space               | Train_RMSLE | Validation_RMSLE | Kaggle_R
SLE(Public) |
+----------+--------------------------------------------+-------------+------------------+---------
----------+
|  Ridge   |     FeatureEngg + cat_OHE + text_TFIDF     |   0.38345   |     0.44153      |       0.
5444         |
|   SVR    | 48Kbest text&cat + Ridge Preds + MNB Preds |   0.44156   |     0.45764      |
-            |
| LightGBM | 48Kbest text&cat + Ridge Preds + MNB Preds |   0.31979   |     0.42423      |       0.
45823         |
+----------+--------------------------------------------+-------------+------------------+---------
----------+
```

In order to get more accurate predictions, we should try Deep Learning models