In [1]:

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction import stop_words
from nltk.tokenize import word_tokenize, sent_tokenize
from sklearn.feature_extraction.text import CountVectorizer
from nltk.corpus import stopwords
import re
import matplotlib.pyplot as plt
```

In [2]:

```
df = pd.read_csv('train.tsv', sep = '\t')
df.head()
```

Out[2]:

	train_id	name	item_condition_id	category_name	brand_name
0	0	MLB Cincinnati Reds T Shirt Size XL	3	Men/Tops/T-shirts	NaN
1	1	Razer BlackWidow Chroma Keyboard	3	Electronics/Computers & Tablets/Components & P...	Razer
2	2	AVA-VIV Blouse	1	Women/Tops & Blouses/Blouse	Target
3	3	Leather Horse Statues	1	Home/Home Décor/Home Décor Accents	NaN
4	4	24K GOLD plated rose	1	Women/Jewelry/Necklaces	NaN

In [3]:

```
df.apply(lambda x: x.nunique())
```

Out[3]:

```
train_id             1482535
name                 1225273
item_condition_id          5
category_name           1287
brand_name              4809
price                    828
shipping                   2
item_description     1281426
dtype: int64
```

In [4]:

```
df.dtypes
```

Out[4]:

```
train_id               int64
name                  object
item_condition_id      int64
category_name         object
brand_name            object
price                float64
shipping               int64
item_description      object
dtype: object
```

In [5]:

```
df.isnull().sum()
```

Out[5]:

```
train_id                  0
name                      0
item_condition_id         0
category_name          6327
brand_name           632682
price                     0
shipping                  0
item_description          4
dtype: int64
```

In [6]:

```
mean = (df.price.mean())
```

In [7]:

```
df['category_name'] = df['category_name'].fillna(mean)
df['brand_name'] = df['brand_name'].fillna(mean)
```

In [8]:

```
df.shape
```

Out[8]:

```
(1482535, 8)
```

In [9]:

```
df.dropna(axis=0, how='any', subset=['item_description'], inplace = True)
```

In [10]:

```
df.shape
```

Out[10]:

```
(1482531, 8)
```

In [11]:

```
df.isnull().sum()
```

Out[11]:

```
train_id             0
name                 0
item_condition_id    0
category_name        0
brand_name           0
price                0
shipping             0
item_description     0
dtype: int64
```

In [12]:

```
def split_cat(text):
    try: return text.split("/")
    except: return ("No Label", "No Label", "No Label")
```

In [13]:

```
#train
# splitting the raw category into main and sub sub categories
df['main_cat'], df['subcat_1'], df['subcat_2'] = \
zip(*df['category_name'].apply(lambda x: split_cat(x)))
# sanity checking the train for new categories
df.head()
```

Out[13]:

	train_id	name	item_condition_id	category_name	brand_name	pr
0	0	MLB Cincinnati Reds T Shirt Size XL	3	Men/Tops/T-shirts	26.7375	10
1	1	Razer BlackWidow Chroma Keyboard	3	Electronics/Computers & Tablets/Components & P...	Razer	52
2	2	AVA-VIV Blouse	1	Women/Tops & Blouses/Blouse	Target	10
3	3	Leather Horse Statues	1	Home/Home Décor/Home Décor Accents	26.7375	35
4	4	24K GOLD plated rose	1	Women/Jewelry/Necklaces	26.7375	44

In [14]:

```
%%time
mean_brand_name = df.groupby(['brand_name'], as_index=False)['price'].mean()
#mean_shipping = df.groupby(['shipping'], as_index=False)['price'].mean()
mean_main_cat = df.groupby(['main_cat'], as_index=False)['price'].mean()
mean_subcat_1 = df.groupby(['subcat_1'], as_index=False)['price'].mean()
mean_subcat_2 = df.groupby(['subcat_2'], as_index=False)['price'].mean()
mean_item_condition_id = df.groupby(['item_condition_id'], as_index=False)['pric
e'].mean()
```

```
CPU times: user 1.82 s, sys: 198 ms, total: 2.02 s
Wall time: 4.02 s
```

In [15]:

```
%%time
df = df.merge(mean_brand_name, on=['brand_name'], how='left', suffixes=('', 'mean_brand_name'))
#df = df.merge(mean_shipping, on=['shipping'], how='left', suffixes=('', 'mean_shipping'))
df = df.merge(mean_main_cat, on=['main_cat'], how='left', suffixes=('', 'mean_main_cat'))
df = df.merge(mean_subcat_1, on=['subcat_1'], how='left', suffixes=('', 'mean_subcat_1'))
df = df.merge(mean_subcat_2, on=['subcat_2'], how='left', suffixes=('', 'mean_subcat_2'))
df = df.merge(mean_item_condition_id, on=['item_condition_id'], how='left', suffixes=('', 'mean_item_condition_id'))
```

```
CPU times: user 5.27 s, sys: 349 ms, total: 5.62 s
Wall time: 11.3 s
```

In [16]:

```
df.head()
```

Out[16]:

	train_id	name	item_condition_id	category_name	brand_name
0	0	MLB Cincinnati Reds T Shirt Size XL	3	Men/Tops/T-shirts	26.7375
1	1	Razer BlackWidow Chroma Keyboard	3	Electronics/Computers & Tablets/Components & P...	Razer
2	2	AVA-VIV Blouse	1	Women/Tops & Blouses/Blouse	Target
3	3	Leather Horse Statues	1	Home/Home Décor/Home Décor Accents	26.7375
4	4	24K GOLD plated rose	1	Women/Jewelry/Necklaces	26.7375

In [17]:

```
df.isnull().sum()
```

Out[17]:

```
train_id                       0
name                           0
item_condition_id              0
category_name                  0
brand_name                     0
price                          0
shipping                       0
item_description               0
main_cat                       0
subcat_1                       0
subcat_2                       0
pricemean_brand_name           0
pricemean_main_cat             0
pricemean_subcat_1             0
pricemean_subcat_2             0
pricemean_item_condition_id    0
dtype: int64
```

In [18]:

```
df.dtypes
```

Out[18]:

```
train_id                         int64
name                            object
item_condition_id                int64
category_name                   object
brand_name                      object
price                          float64
shipping                         int64
item_description                object
main_cat                        object
subcat_1                        object
subcat_2                        object
pricemean_brand_name           float64
pricemean_main_cat             float64
pricemean_subcat_1             float64
pricemean_subcat_2             float64
pricemean_item_condition_id    float64
dtype: object
```

In [19]:

```
df = df.loc[df['price'] != 0]
```

In [20]:

```
df.shape
```

Out[20]:

```
(1481657, 16)
```

In [21]:

```
temp = df.copy()
```

In [22]:

```
y = temp['price']
```

In [23]:

```
del temp['price']
```

Random Model

In [24]:

```
X_train, X_test, y_train, y_test = train_test_split(temp, y, test_size=0.33, random_state=42)
```

In [25]:

```
y_pred_rand = y_train.sample(488947,random_state = 42)
```

In [26]:

```
y_pred_rand.reset_index(drop = True, inplace = True)
```

In [27]:

```
y_test_rand = y_test.copy()
```

In [28]:

```
y_test_rand.shape
```

Out[28]:

```
(488947,)
```

In [29]:

```
y_test_rand.reset_index(drop = True, inplace = True)
```

In [30]:

```
def rmsle(y_test, y_pred):
    assert len(y_test) == len(y_pred)
    return np.sqrt(np.mean(np.power(np.log1p(y_test)-np.log1p(y_pred), 2)))
```

In [31]:

```
def symm_mean_absolute_percentage_error(y_true, y_pred):
    return np.mean((np.abs(y_true - y_pred))/(np.abs(y_true) + np.abs(y_pred)))*200
```

In [32]:

```
def mean_absolute_percentage_error(y_true, y_pred):
    return np.mean(np.abs((y_true - y_pred) / y_true)) * 100
```

In [33]:

```
rmsle(y_test_rand,y_pred_rand)
```

Out[33]:

```
1.0554860228592233
```

In [34]:

```
symm_mean_absolute_percentage_error(y_test_rand,y_pred_rand)
```

Out[34]:

```
74.31774169546513
```

In [35]:

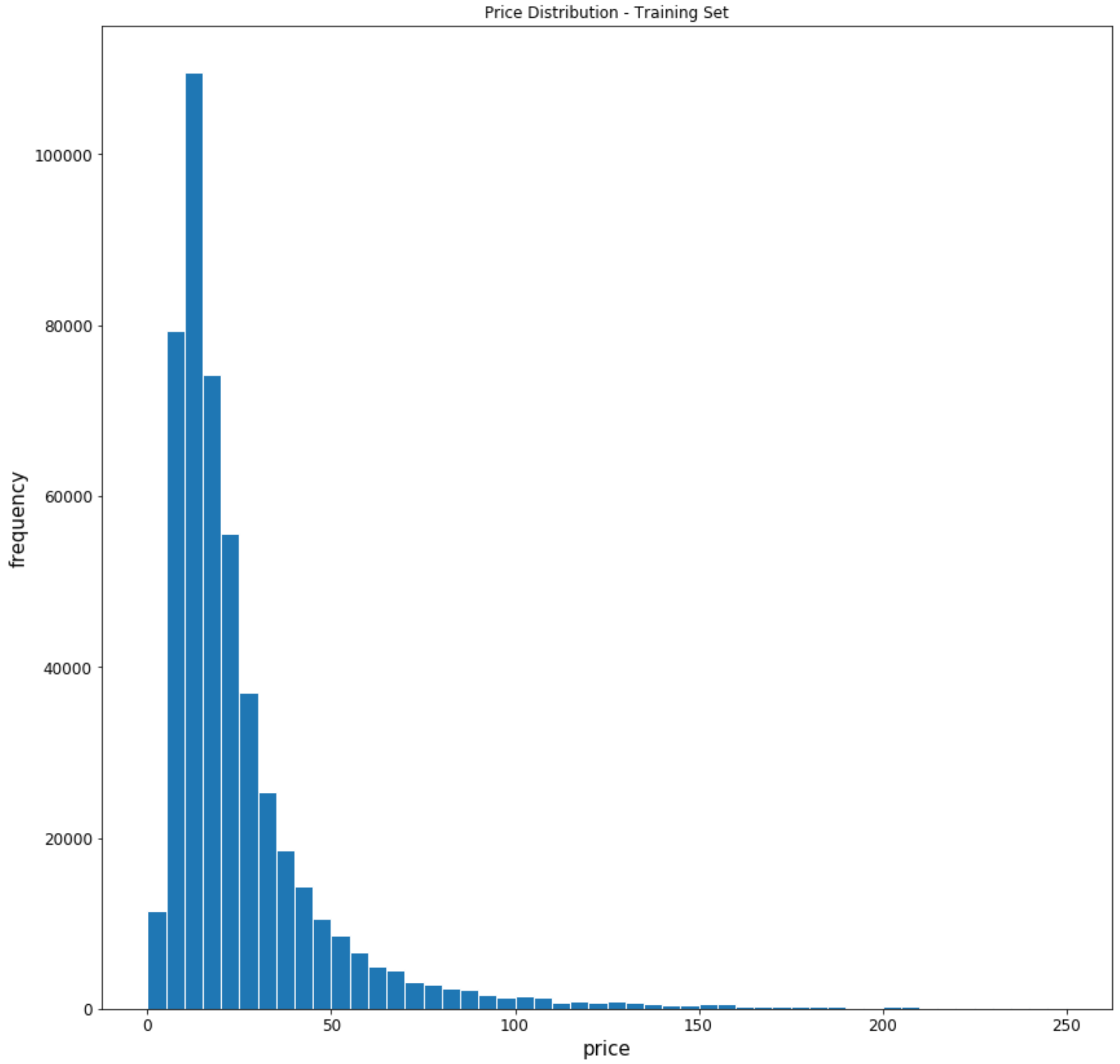
```
mean_absolute_percentage_error(y_test_rand,y_pred_rand)
```

Out[35]:

```
141.9383145100844
```

In [36]:

```
y_pred_rand.plot.hist(bins=50, figsize=(14,14), edgecolor='white',range=[0,250])
plt.xlabel('price', fontsize=15)
plt.ylabel('frequency', fontsize=15)
plt.tick_params(labelsize=12)
plt.title('Price Distribution - Training Set', fontsize=12)
plt.show()
```


Price Distribution - Training Set
frequency
100000
80000
60000
40000
20000
0
0
50
100
150
200
250
price

Tf-Idf

In [37]:

```
stop = set(stopwords.words('english'))
def tokenize(text):
    """
    sent_tokenize(): segment text into sentences
    word_tokenize(): break sentences into words
    """
    try:
        regex = re.compile('[^A-Za-z0-9]+')
        text = regex.sub(" ", text) # remove punctuation

        tokens_ = [word_tokenize(s) for s in sent_tokenize(text)]
        tokens = []
        for token_by_sent in tokens_:
            tokens += token_by_sent
        tokens = list(filter(lambda t: t.lower() not in stop, tokens))
        filtered_tokens = [w for w in tokens if re.search('[a-zA-Z]', w)]
        filtered_tokens = [w.lower() for w in filtered_tokens if len(w)>=3]

        return filtered_tokens

    except TypeError as e: print(text,e)
```

In [38]:

```
temp.shape
```

Out[38]:

```
(1481657, 15)
```

In [39]:

```
%%time
vect = TfidfVectorizer(tokenizer=tokenize, stop_words='english')
tfidf_item_dscp = vect.fit_transform(temp['item_description'])
```

```
CPU times: user 11min 21s, sys: 2.52 s, total: 11min 23s
Wall time: 22min 29s
```

In [40]:

```
tfidf_item_dscp
```

Out[40]:

```
<1481657x151371 sparse matrix of type '<class 'numpy.float64'>'
        with 20074078 stored elements in Compressed Sparse Row forma
t>
```

In [41]:

```
new_cols1 = vect.get_feature_names()
```

In [42]:

```
%%time
vect1 = TfidfVectorizer(tokenizer=tokenize, stop_words='english')
tfidf_name = vect1.fit_transform(temp['name'])
```

```
CPU times: user 5min 57s, sys: 750 ms, total: 5min 58s
Wall time: 10min 28s
```

In [43]:

```
tfidf_name
```

Out[43]:

```
<1481657x101351 sparse matrix of type '<class 'numpy.float64'>'
        with 5478208 stored elements in Compressed Sparse Row format
>
```

In [44]:

```
df_t = temp[['pricemean_brand_name','pricemean_main_cat','pricemean_subcat_1','p
ricemean_subcat_2','pricemean_item_condition_id']]
```

In [45]:

```
df_t['shipping1'] = temp['shipping']
```

```
/home/ajetias129/anaconda3/lib/python3.5/site-packages/ipykernel_lau
ncher.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
```

In [46]:

```
from scipy.sparse import hstack
```

In [47]:

```
sparse_tfidf = hstack([tfidf_item_dscp,tfidf_name])
```

In [48]:

```
sparse_tfidf
```

Out[48]:

```
<1481657x252722 sparse matrix of type '<class 'numpy.float64'>'
        with 25552286 stored elements in COOrdinate format>
```

In [49]:

```
combined = hstack([sparse_tfidf,df_t])
```

In [50]:

```
combined
```

Out[50]:

```
<1481657x252728 sparse matrix of type '<class 'numpy.float64'>'
	with 33623355 stored elements in COOrdinate format>
```

In [ ]:

```

```

In [51]:

```
from sklearn.feature_extraction import stop_words
from nltk.tokenize import word_tokenize, sent_tokenize
from nltk.corpus import stopwords
import re
```

In [52]:

```
stop = set(stopwords.words('english'))
def tokenizeW(text):
    """
    sent_tokenize(): segment text into sentences
    word_tokenize(): break sentences into words
    """
    try:
        regex = re.compile('[^A-Za-z0-9]+')
        text = regex.sub(" ", text) # remove punctuation

        tokens_ = [word_tokenize(s) for s in sent_tokenize(text)]
        tokens = []
        for token_by_sent in tokens_:
            tokens += token_by_sent
        tokens = list(filter(lambda t: t.lower() not in stop, tokens))
        filtered_tokens = [w for w in tokens if re.search('[a-zA-Z]', w)]
        filtered_tokens = [w.lower() for w in filtered_tokens]

        return filtered_tokens

    except TypeError as e: print(text,e)
```

In [53]:

```
tok_item_descp = df['item_description'].map(tokenizeW).tolist()
```

In [54]:

```
tok_item_name = df['name'].map(tokenizeW).tolist()
```

In [ ]:

```

```

In [ ]:

```

```

In [55]:

```
import gensim
from gensim.models import KeyedVectors
```

In [56]:

```
#train
w2v_modelD=gensim.models.Word2Vec(tok_item_descp,min_count=1,size=75, workers=8)
```

In [57]:

```
w2v_modelN=gensim.models.Word2Vec(tok_item_name,min_count=1,size=75, workers=8)
```

In [58]:

```
w2v_modelD.save('w2v_modelDescp')
```

In [59]:

```
w2v_modelN.save('w2v_modelName')
```

In [60]:

```
#train
model1 = gensim.models.Word2Vec.load('w2v_modelDescp')
```

In [61]:

```
model2 = gensim.models.Word2Vec.load('w2v_modelName')
```

In [62]:

```
d1 = df_t.copy()
```

In [63]:

```
d1.head()
```

Out[63]:

	pricemean_brand_name	pricemean_main_cat	pricemean_subcat_1	pricemean_
0	21.133446	34.708614	18.999442	18.352495
1	45.021277	35.173922	87.887754	42.913900
2	15.047109	28.885554	18.237514	15.659676
3	21.133446	24.536599	21.566301	22.185020
4	21.133446	28.885554	27.501571	25.587509

In [64]:

```
%%time
lisD =()
counter = 0
for sent in tok_item_descp:
    x = 0
    counter = counter + 1
    if counter == 120000:
        print(counter)
        counter = 0
    for w in sent:
        x = x +  model1.wv[w].sum()
    lisD = np.append(lisD,x)
```

```
120000
120000
120000
120000
120000
120000
120000
120000
120000
120000
120000
120000
CPU times: user 39min 25s, sys: 43.6 ms, total: 39min 25s
Wall time: 51min 8s
```

In [65]:

```
se = pd.Series(lisD)
```

In [66]:

```
d1['descp_w2v'] = se.values
```

In [67]:

```
%%time
lisN =()
counter = 0
for sent in tok_item_name:
    x = 0
    counter = counter + 1
    if counter == 120000:
        print(counter)
        counter = 0
    for w in sent:
        x = x +  model2.wv[w].sum()
    lisN = np.append(lisN,x)
```

```
120000
120000
120000
120000
120000
120000
120000
120000
120000
120000
120000
120000
CPU times: user 36min 48s, sys: 61.9 ms, total: 36min 48s
Wall time: 45min 52s
```

In [68]:

```
se1 = pd.Series(lisN)
```

In [69]:

```
d1['name_w2v'] = se1.values
```

In [ ]:

```

```

In [70]:

```
d1.head()
```

Out[70]:

	pricemean_brand_name	pricemean_main_cat	pricemean_subcat_1	pricemean_
0	21.133446	34.708614	18.999442	18.352495
1	45.021277	35.173922	87.887754	42.913900
2	15.047109	28.885554	18.237514	15.659676
3	21.133446	24.536599	21.566301	22.185020
4	21.133446	28.885554	27.501571	25.587509

In [ ]:

In [71]:

```
x_train_T, x_test_T, y_train_T, y_test_T = train_test_split(combined, y, test_size=0.30, random_state=42)
```

In [72]:

```
x_train_W, x_test_W, y_train_W, y_test_W = train_test_split(d1, y, test_size=0.30, random_state=42)
```

In [73]:

```
x_train_Nt, x_test_Nt, y_train_Nt, y_test_Nt = train_test_split(df_t, y, test_size=0.30, random_state=42)
```

In [ ]:

Linear Regression

LR Using Word2Vec

In [74]:

```
from sklearn import linear_model
```

In [75]:

```
Tfidf_LR = linear_model.LinearRegression(n_jobs=-1)
```

In [76]:

```
%%time
Tfidf_LR.fit(x_train_W,y_train_W)
```

```
CPU times: user 520 ms, sys: 429 ms, total: 949 ms
Wall time: 1.82 s
```

Out[76]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=-1, normalize=False)
```

In [77]:

```
y_predLT = Tfidf_LR.predict(x_test_W)
```

In [78]:

```
rmsle(y_test_T, y_predLT)
```

```
/home/ajetias129/anaconda3/lib/python3.5/site-packages/ipykernel_lau
ncher.py:3: RuntimeWarning: invalid value encountered in log1p
  This is separate from the ipykernel package so we can avoid doing
imports until
```

Out[78]:

```
0.6549567656842449
```

In [79]:

```
symm_mean_absolute_percentage_error(y_test_T, y_predLT)
```

Out[79]:

```
50.617166736977794
```

In [80]:

```
mean_absolute_percentage_error(y_test_T,y_predLT)
```

Out[80]:

```
76.53866072999116
```

In [ ]:

```

```

LR using non text features

In [81]:

```
Nt_LR = linear_model.LinearRegression(n_jobs=-1)
```

In [82]:

```
%%time
Nt_LR.fit(x_train_Nt,y_train_Nt)
```

```
CPU times: user 322 ms, sys: 225 ms, total: 546 ms
Wall time: 524 ms
```

Out[82]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=-1, normali
ze=False)
```

In [83]:

```
y_predLnT = Nt_LR.predict(x_test_Nt)
```

In [84]:

```
rmsle(y_test_Nt, y_predLnT)
```

```
/home/ajetias129/anaconda3/lib/python3.5/site-packages/ipykernel_lau
ncher.py:3: RuntimeWarning: invalid value encountered in log1p
  This is separate from the ipykernel package so we can avoid doing
imports until
```

Out[84]:

```
0.6542190585799218
```

In [85]:

```
symm_mean_absolute_percentage_error(y_test_Nt, y_predLnT)
```

Out[85]:

```
50.554284528804736
```

In [86]:

```
mean_absolute_percentage_error(y_test_Nt,y_predLnT)
```

Out[86]:

```
76.3281452150147
```

In [ ]:

```

```

LR using TfIdf

In [ ]:

```

```

In [87]:

```
combined_LR = linear_model.LinearRegression(n_jobs=-1)
```

In [88]:

```
%%time
combined_LR.fit(x_train_T,y_train_T)
```

```
CPU times: user 1h 1min 59s, sys: 38min 6s, total: 1h 40min 5s
Wall time: 1h 15min 56s
```

Out[88]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=-1, normali
ze=False)
```

In [89]:

```
y_predLT = combined_LR.predict(x_test_T)
```

In [90]:

```
rmsle(y_test_T, y_predLT)
```

```
/home/ajetias129/anaconda3/lib/python3.5/site-packages/ipykernel_lau
ncher.py:3: RuntimeWarning: invalid value encountered in log1p
  This is separate from the ipykernel package so we can avoid doing
imports until
```

Out[90]:

```
0.7167646486245024
```

In [91]:

```
symm_mean_absolute_percentage_error(y_test_T, y_predLT)
```

Out[91]:

```
55.7709145999113
```

In [92]:

```
mean_absolute_percentage_error(y_test_T,y_predLT)
```

Out[92]:

```
75.35593213418356
```

In [ ]:

```

```

In [ ]:

```

```

Random Forests

In [93]:

```
from sklearn.ensemble import RandomForestRegressor
```

RF using Word2Vec

In [94]:

```
W_Rf = RandomForestRegressor(max_depth=15, random_state=42,n_jobs=-1)
```

In [95]:

```
%%time
W_Rf.fit(x_train_W,y_train_W)
```

```
CPU times: user 1min 38s, sys: 0 ns, total: 1min 38s
Wall time: 35.6 s
```

Out[95]:

```
RandomForestRegressor(bootstrap=True, criterion='mse', max_depth=15,
           max_features='auto', max_leaf_nodes=None,
           min_impurity_split=1e-07, 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
=42,
           verbose=0, warm_start=False)
```

In [96]:

```
y_predRf_W = W_Rf.predict(x_test_W)
```

In [97]:

```
rmsle(y_test_W, y_predRf_W)
```

Out[97]:

```
0.58294109509526926
```

In [98]:

```
symm_mean_absolute_percentage_error(y_test_W, y_predRf_W)
```

Out[98]:

```
44.87405190897382
```

In [99]:

```
mean_absolute_percentage_error(y_test_W,y_predRf_W)
```

Out[99]:

```
64.94846616084615
```

In [ ]:

In [ ]:

In [100]:

```
W_Rf = RandomForestRegressor(max_depth=15, random_state=42,n_jobs=-1)
```

In [101]:

```
%%time
W_Rf.fit(x_train_W,y_train_W)
```

```
CPU times: user 1min 39s, sys: 0 ns, total: 1min 39s
Wall time: 35.6 s
```

Out[101]:

```
RandomForestRegressor(bootstrap=True, criterion='mse', max_depth=15,
           max_features='auto', max_leaf_nodes=None,
           min_impurity_split=1e-07, 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
=42,
           verbose=0, warm_start=False)
```

In [102]:

```
y_predRf_W = W_Rf.predict(x_test_W)
```

In [103]:

```
rmsle(y_test_W, y_predRf_W)
```

Out[103]:

```
0.58294109509526926
```

In [104]:

```
symm_mean_absolute_percentage_error(y_test_W, y_predRf_W)
```

Out[104]:

```
44.87405190897382
```

In [105]:

```
mean_absolute_percentage_error(y_test_W,y_predRf_W)
```

Out[105]:

```
64.94846616084615
```

In [ ]:

```

```

Random Forests using Tf-Idf

In [106]:

```
T_Rf = RandomForestRegressor(max_depth=15, random_state=42,n_jobs=-1)
```

In [107]:

```
%%time
T_Rf.fit(x_train_T,y_train_T)
```

```
CPU times: user 1h 4min 58s, sys: 0 ns, total: 1h 4min 58s
Wall time: 22min 31s
```

Out[107]:

```
RandomForestRegressor(bootstrap=True, criterion='mse', max_depth=15,
           max_features='auto', max_leaf_nodes=None,
           min_impurity_split=1e-07, 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
=42,
           verbose=0, warm_start=False)
```

In [108]:

```
y_predRf_T = T_Rf.predict(x_test_T)
```

In [109]:

```
rmsle(y_test_T, y_predRf_T)
```

Out[109]:

```
0.60565792206271252
```

In [110]:

```
symm_mean_absolute_percentage_error(y_test_T, y_predRf_T)
```

Out[110]:

```
47.144996894838094
```

In [111]:

```
mean_absolute_percentage_error(y_test_T,y_predRf_T)
```

Out[111]:

```
69.59506906053538
```

In [ ]:

```

```

Hyper parameter Tuning

In [112]:

```
from sklearn.model_selection import RandomizedSearchCV
```

In [113]:

```
# Number of trees in random forest
n_estimators = [int(x) for x in np.linspace(start = 100, stop = 2000, num = 10)]
# Number of features to consider at every split
max_features = ['auto', 'sqrt']
# Maximum number of levels in tree
max_depth = [int(x) for x in np.linspace(10, 110, num = 11)]
max_depth.append(None)
# Minimum number of samples required to split a node
min_samples_split = [2, 5, 10]
# Minimum number of samples required at each leaf node
min_samples_leaf = [1, 2, 4]
# Method of selecting samples for training each tree
bootstrap = [True, False]
# Create the random grid
random_grid = {'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf,
               'bootstrap': bootstrap}
```

In [114]:

```
print(random_grid)
```

```
{'bootstrap': [True, False], 'min_samples_split': [2, 5, 10], 'n_est
imators': [100, 311, 522, 733, 944, 1155, 1366, 1577, 1788, 2000],
'max_depth': [10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, None],
'max_features': ['auto', 'sqrt'], 'min_samples_leaf': [1, 2, 4]}
```

In [ ]:

```
%%time
# Use the random grid to search for best hyperparameters
# First create the base model to tune
rft = RandomForestRegressor()
# Random search of parameters, using 3 fold cross validation,
# search across 100 different combinations, and use all available cores
rf_random = RandomizedSearchCV(estimator = rft, param_distributions = random_gri
d, n_iter = 100, cv = 3, verbose=20, random_state=42, n_jobs = -1)
# Fit the random search model
rf_random.fit(x_train_T, y_train_T)
```

```
Fitting 3 folds for each of 100 candidates, totalling 300 fits
[CV] bootstrap=True, min_samples_split=5, n_estimators=311, max_dept
h=30, max_features=sqrt, min_samples_leaf=1
[CV] bootstrap=True, min_samples_split=5, n_estimators=311, max_dept
h=30, max_features=sqrt, min_samples_leaf=1
[CV] bootstrap=True, min_samples_split=5, n_estimators=311, max_dept
h=30, max_features=sqrt, min_samples_leaf=1
[CV] bootstrap=True, min_samples_split=5, n_estimators=2000, max_dep
th=10, max_features=sqrt, min_samples_leaf=1
[CV] bootstrap=True, min_samples_split=5, n_estimators=2000, max_dep
th=10, max_features=sqrt, min_samples_leaf=1
[CV] bootstrap=True, min_samples_split=5, n_estimators=2000, max_dep
th=10, max_features=sqrt, min_samples_leaf=1
[CV] bootstrap=False, min_samples_split=5, n_estimators=1155, max_de
pth=10, max_features=sqrt, min_samples_leaf=2
[CV] bootstrap=False, min_samples_split=5, n_estimators=1155, max_de
pth=10, max_features=sqrt, min_samples_leaf=2
[CV]  bootstrap=True, min_samples_split=5, n_estimators=311, max_dep
th=30, max_features=sqrt, min_samples_leaf=1, score=0.118804, total=
91.2min
[CV] bootstrap=False, min_samples_split=5, n_estimators=1155, max_de
pth=10, max_features=sqrt, min_samples_leaf=2


[Parallel(n_jobs=-1)]: Done   1 tasks      | elapsed: 94.0min

[CV]  bootstrap=True, min_samples_split=5, n_estimators=311, max_dep
th=30, max_features=sqrt, min_samples_leaf=1, score=0.123672, total=
91.6min
[CV] bootstrap=False, min_samples_split=2, n_estimators=2000, max_de
pth=30, max_features=auto, min_samples_leaf=4

[Parallel(n_jobs=-1)]: Done   2 tasks      | elapsed: 94.4min

[CV]  bootstrap=True, min_samples_split=5, n_estimators=311, max_dep
th=30, max_features=sqrt, min_samples_leaf=1, score=0.117639, total=
92.0min
[CV] bootstrap=False, min_samples_split=2, n_estimators=2000, max_de
pth=30, max_features=auto, min_samples_leaf=4

[Parallel(n_jobs=-1)]: Done   3 tasks      | elapsed: 94.8min

[CV]  bootstrap=False, min_samples_split=5, n_estimators=1155, max_d
epth=10, max_features=sqrt, min_samples_leaf=2, score=0.046146, tota
l=140.4min
[CV] bootstrap=False, min_samples_split=2, n_estimators=2000, max_de
pth=30, max_features=auto, min_samples_leaf=4

[Parallel(n_jobs=-1)]: Done   4 tasks      | elapsed: 148.1min

[CV]  bootstrap=False, min_samples_split=5, n_estimators=1155, max_d
epth=10, max_features=sqrt, min_samples_leaf=2, score=0.044858, tota
l=141.9min
[CV] bootstrap=True, min_samples_split=2, n_estimators=1577, max_dep
th=10, max_features=sqrt, min_samples_leaf=4

[Parallel(n_jobs=-1)]: Done   5 tasks      | elapsed: 149.8min

[CV]  bootstrap=True, min_samples_split=5, n_estimators=2000, max_de
pth=10, max_features=sqrt, min_samples_leaf=1, score=0.046173, total
=166.4min
[CV] bootstrap=True, min_samples_split=2, n_estimators=1577, max_dep
th=10, max_features=sqrt, min_samples_leaf=4
```

```
[Parallel(n_jobs=-1)]: Done   6 tasks      | elapsed: 180.4min

[CV]  bootstrap=True, min_samples_split=5, n_estimators=2000, max_de
pth=10, max_features=sqrt, min_samples_leaf=1, score=0.045801, total
=166.9min
[CV] bootstrap=True, min_samples_split=2, n_estimators=1577, max_dep
th=10, max_features=sqrt, min_samples_leaf=4

[Parallel(n_jobs=-1)]: Done   7 tasks      | elapsed: 181.1min

[CV]  bootstrap=True, min_samples_split=5, n_estimators=2000, max_de
pth=10, max_features=sqrt, min_samples_leaf=1, score=0.045261, total
=167.8min
[CV] bootstrap=False, min_samples_split=5, n_estimators=733, max_dep
th=30, max_features=sqrt, min_samples_leaf=4

[Parallel(n_jobs=-1)]: Done   8 tasks      | elapsed: 181.8min

[CV]  bootstrap=False, min_samples_split=5, n_estimators=1155, max_d
epth=10, max_features=sqrt, min_samples_leaf=2, score=0.045282, tota
l=140.7min

[Parallel(n_jobs=-1)]: Done   9 tasks      | elapsed: 242.6min

[CV] bootstrap=False, min_samples_split=5, n_estimators=733, max_dep
th=30, max_features=sqrt, min_samples_leaf=4
[CV]  bootstrap=True, min_samples_split=2, n_estimators=1577, max_de
pth=10, max_features=sqrt, min_samples_leaf=4, score=0.043660, total
=130.9min
[CV] bootstrap=False, min_samples_split=5, n_estimators=733, max_dep
th=30, max_features=sqrt, min_samples_leaf=4

[Parallel(n_jobs=-1)]: Done  10 tasks      | elapsed: 291.1min

[CV]  bootstrap=True, min_samples_split=2, n_estimators=1577, max_de
pth=10, max_features=sqrt, min_samples_leaf=4, score=0.046447, total
=131.8min
[CV] bootstrap=False, min_samples_split=5, n_estimators=944, max_dep
th=100, max_features=sqrt, min_samples_leaf=2

[Parallel(n_jobs=-1)]: Done  11 tasks      | elapsed: 322.8min

[CV]  bootstrap=True, min_samples_split=2, n_estimators=1577, max_de
pth=10, max_features=sqrt, min_samples_leaf=4, score=0.046006, total
=131.3min
[CV] bootstrap=False, min_samples_split=5, n_estimators=944, max_dep
th=100, max_features=sqrt, min_samples_leaf=2

[Parallel(n_jobs=-1)]: Done  12 tasks      | elapsed: 323.2min
```

In [ ]:

```
rf_random.best_params_
```

In [ ]:

```
def evaluate(model, test_features, test_labels):
    predictions = model.predict(test_features)
    errors = abs(predictions - test_labels)
    mape = 100 * np.mean(errors / test_labels)
    accuracy = 100 - mape
    print('Model Performance')
    print('RMSLE = {0.4f} '.format(rmsle(test_features, test_labels)))
    print('MAPE = {0.4f} '.format(mean_absolute_percentage_error(test_features,
test_labels)))
    print('SMAPE = {0.4f} '.format(symm_mean_absolute_percentage_error(test_feat
ures, test_labels)))
    print('Average Error: {:0.4f} degrees.'.format(np.mean(errors)))
    print('Accuracy = {:0.2f}%.'.format(accuracy))

    return accuracy
```

In [ ]:

```
base_model = RandomForestRegressor(n_estimators = 10, random_state = 42)
base_model.fit(x_train_T, y_train_T)
base_accuracy = evaluate(base_model, x_test_T, y_test_T)
```

In [ ]:

```
best_random = rf_random.best_estimator_
random_accuracy = evaluate(best_random, x_test_T, y_test_T)
```

In [ ]:

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```

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```

XgBoost

XbBoost using Word2Vec

In [ ]:

```
import xgboost as xgb
from xgboost.sklearn import XGBClassifier
from sklearn import cross_validation, metrics
from sklearn.grid_search import GridSearchCV
```

In [ ]:

```
data_train = xgb.DMatrix(x_train_W, label=y_train_W)
data_valid = xgb.DMatrix(x_test_W, label=y_test_W)


watchlist = [(data_train, 'train'), (data_valid, 'test')]

xgb_params = {'min_child_weight': 20,
              'eta': 0.013,
              'colsample_bytree': 0.45,
              'max_depth': 16,
            'subsample': 0.88,
              'lambda': 2.07,

              'booster' :
              'gbtree',
              'silent': 1,
            'eval_metric': 'rmse',
              'objective': 'reg:linear'}
```

In [ ]:

```
%%time
xgb_W = xgb.train(xgb_params, data_train, 2000, watchlist, early_stopping_rounds
=20, verbose_eval=50)
```

In [ ]:

```
%%time
data_test = xgb.DMatrix(x_test_W)
y_predXg_W = xgb_W.predict(data_test)
```

In [ ]:

```
rmsle(y_test_W, y_predXg_W)
```

In [ ]:

```
symm_mean_absolute_percentage_error(y_test_W, y_predXg_W)
```

In [ ]:

```
mean_absolute_percentage_error(y_test_W,y_predXg_W)
```

In [ ]:

```
```

XgBoost using Tf-Idf

In [ ]:

```
```

In [ ]:

```
```

In [ ]:

```
data_train1 = xgb.DMatrix(x_train_T, label=y_train_T)
data_valid1 = xgb.DMatrix(x_test_T, label=y_test_T)


watchlist = [(data_train1, 'train'), (data_valid1, 'test')]

xgb_params = {'min_child_weight': 20,
              'eta': 0.013,
              'colsample_bytree': 0.45,
              'max_depth': 16,
            'subsample': 0.88,
              'lambda': 2.07,

              'booster' :
              'gbtree',
              'silent': 1,
            'eval_metric': 'rmse',
              'objective': 'reg:linear'}
```

In [ ]:

```
%%time
xgb_T = xgb.train(xgb_params, data_train1, 2000, watchlist, early_stopping_rounds=20, verbose_eval=50)
```

In [ ]:

```
%%time
data_test1 = xgb.DMatrix(x_test_T)
y_predXg_T = xgb_T.predict(data_test1)
```

In [ ]:

```
rmsle(y_test_T, y_predXg_T)
```

In [ ]:

```
symm_mean_absolute_percentage_error(y_test_T, y_predXg_T)
```

In [ ]:

```
mean_absolute_percentage_error(y_test_T,y_predXg_T)
```

In [ ]:

XgBoost Hyper Parameter tuning

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