```
In [1]: import numpy as np
        import pandas as pd
        from sklearn.ensemble import RandomForestClassifier
        from sklearn.model_selection import train_test_split
        from sklearn.metrics import log_loss
```

Load Data

```
In [38]: train = pd.read_json('./../Data/train.json')
```

```
In [39]: train.shape
```

```
Out[39]: (49352, 15)
```

```
In [43]: def calculate_length(df):
             df["num_photos"] = df["photos"].apply(len)
             df["num_features"] = df["features"].apply(len)
             # .strip() removes all whitespace at the start and end, including spaces
             df["num_description_words"] = df["description"].apply(lambda x: len(x.st
             return(df)
         def calculate_date(df):
             df["created"] = pd.to_datetime(df["created"])
             df["created_year"] = df["created"].dt.year
             df["created_month"] = df["created"].dt.month
             df["created_day"] = df["created"].dt.day
             df["created_hour"] = df["created"].dt.hour
             return(df)
```

```
In [44]: train = calculate_length(train)
         train = calculate_date(train)
         train.shape
```

```
Out[44]: (49352, 22)
```

In [45]:
```
train.head(2)
```

Out[45]:

	bathrooms	bedrooms	building_id	created	description
10	1.5	3	53a5b119ba8f7b61d4e010512e0dfc85	2016-06-24 07:54:24	A Brand New 3 Bedroom 1.5 bath ApartmentEnjo ...
10000	1.0	2	c5c8a357cba207596b04d1afd1e4f130	2016-06-12 12:19:27	

2 rows × 22 columns

In [36]:
```
train.loc[10000,'description'].strip()
```

Out[36]:
```
u''
```

In [49]:
```
train.dtypes.unique()
```

Out[49]:
```
array([dtype('float64'), dtype('int64'), dtype('O'), dtype('<M8[ns]')], d
type=object)
```

In [52]:
```
numerical_features = train.select_dtypes(include=['int64', 'float64']).colur
numerical_features
```

Out[52]:
```
Index([            u'bathrooms',             u'bedrooms',
                    u'latitude',           u'listing_id',
                   u'longitude',                u'price',
                  u'num_photos',         u'num_features',
       u'num_description_words',         u'created_year',
               u'created_month',          u'created_day',
                u'created_hour'],
      dtype='object')
```

```
In [53]: numerical_features = [x for x in numerical_features if x not in ['listing_i
         numerical_features
```

```
Out[53]: [u'bathrooms',
          u'bedrooms',
          u'latitude',
          u'longitude',
          u'price',
          'num_photos',
          'num_features',
          'num_description_words',
          'created_year',
          'created_month',
          'created_day',
          'created_hour']
```

```
In [55]: X = train[numerical_features]
         y = train["interest_level"]
```

Train model using Random Forest

```
In [56]: X_train, X_val, y_train, y_val = train_test_split(X, y, test_size=0.33)
```

```
In [57]: rf = RandomForestClassifier(n_estimators=1000)
         rf.fit(X_train, y_train)
         y_val_pred = rf.predict_proba(X_val)
         log_loss(y_val, y_val_pred)
```

```
Out[57]: 0.61707908794236999
```

```
In [61]: rf.classes_ #column 0 is high, column 1 is low, and column 2 is medium
```

```
Out[61]: array([u'high', u'low', u'medium'], dtype=object)
```

```
In [64]: y_val_pred
```

```
Out[64]: array([[ 0.   ,  0.998,  0.002],
                [ 0.002,  0.957,  0.041],
                [ 0.074,  0.631,  0.295],
                ...,
                [ 0.059,  0.608,  0.333],
                [ 0.035,  0.678,  0.287],
                [ 0.367,  0.261,  0.372]])
```

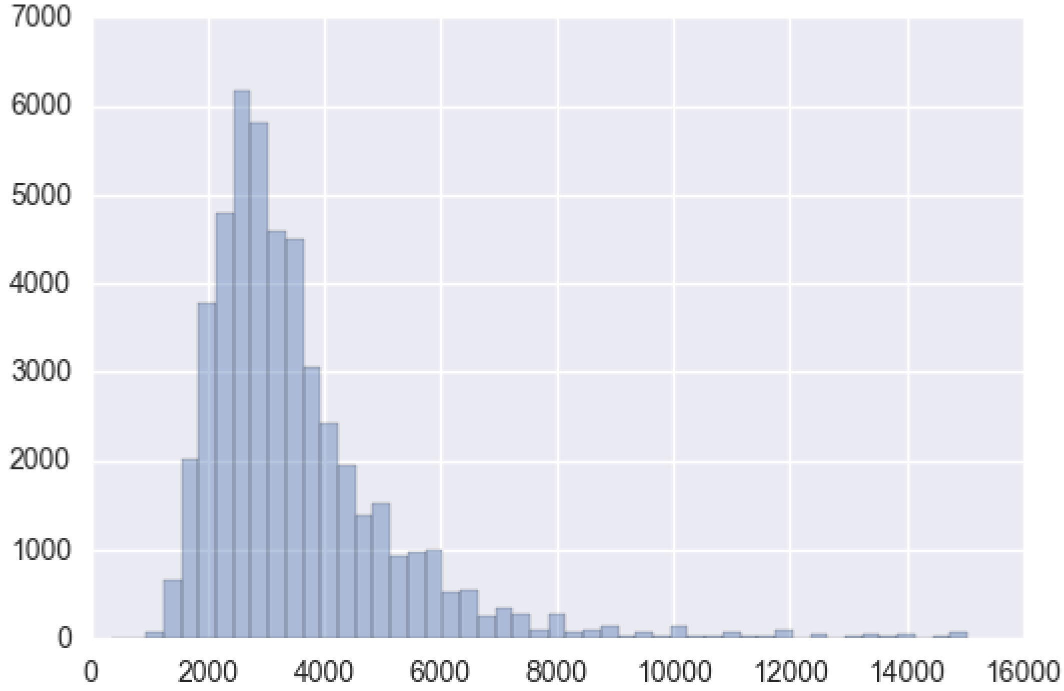
Remove outliers and try Random Forest

```
In [109]: price_ulimit = np.percentile(train.price.values, 99.5)
          price_ulimit
```

```
Out[109]: 15500.0
```

```
In [142]: sns.distplot(train[train.price < price_ulimit].price.values, kde=False)
```

```
Out[142]: <matplotlib.axes._subplots.AxesSubplot at 0x17e6e60d0>
```



```
In [111]: import scipy.stats as stats
          stats.skew(train[train.price < price_ulimit].price.values)
```

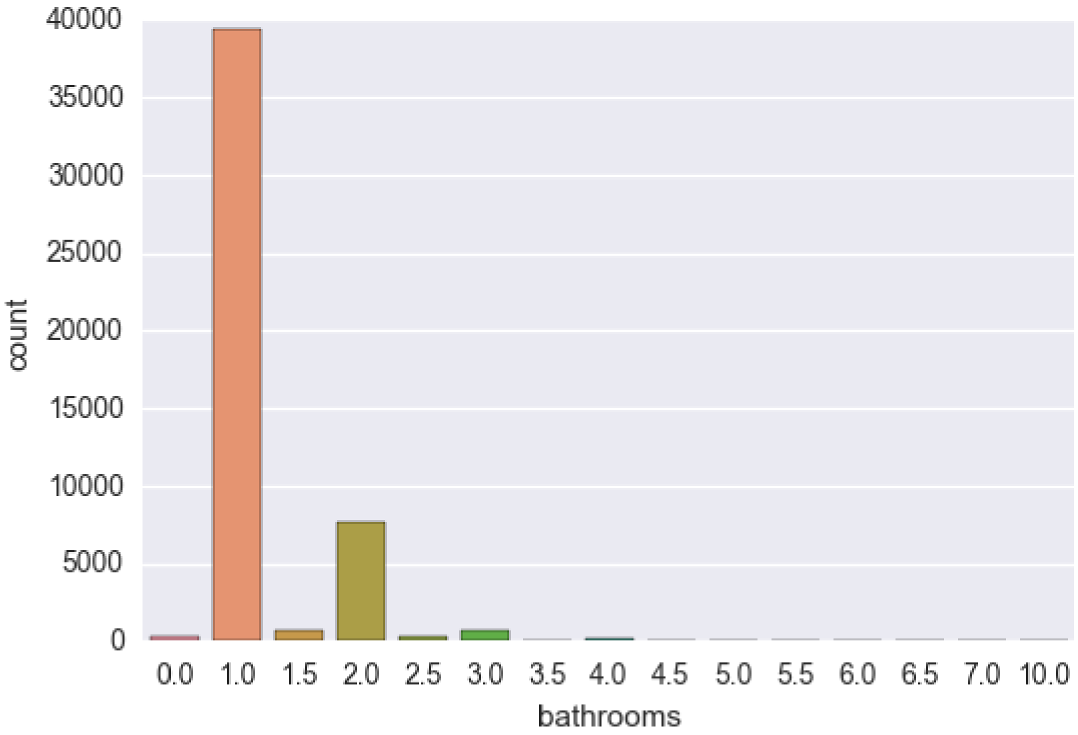
```
Out[111]: 2.4869146630675467
```

Price is skewed but lets leave it as it is since decision trees are robust to them.

```
In [72]: import seaborn as sns
         import matplotlib.pyplot as plt
         %matplotlib inline
```

```
In [73]: sns.countplot(data=train, x="bathrooms")
```

```
Out[73]: <matplotlib.axes._subplots.AxesSubplot at 0x124b6b790>
```



```
In [83]: train.loc[[104459], ['bathrooms', 'bedrooms', 'description']].values
```

```
Out[83]: array([[10.0, 2,
                 u'***The building?s well-attended lobby welcomes the residents wi
         th its 24-hour doorman and concierge service as well as a fitness center,
         private storage rooms, bicycle storage, sauna and a laundry area on every
         floor. Many units have been completely renovated with beautiful new finis
         hes, stone countertops and GE stainless steel appliances. Enjoy the Broad
         way theater district, Times Square, Central Park and exceptional dining a
         nd shopping<br /><br />***HUGE AS BIG AS A FOOT BALL FIELD AND FEATURES H
         IGH CEILING ,BRAND NEW KITCHEN ,MARBLE BATHROOM, TONS OF CLOSET SPACE ,UN
         OBSTRUCTED CITY VIEWS AND A TON OF LIGHT DUE TO ITS EXPOSURE AND HIGH FLO
         OR<br /><br />***TO SET UP TIME AND LOCATION CONTACT RUBENS 039-610-8860<
         br /><br /><p><a  website_redacted ']], dtype=object)
```

10 bathrooms for 2 bedrooms sounds unrealistic. Description suggests just one bathroom. Could it be a typo and it might just be 1 bathroom? Lets just fix it.

```
In [84]: train.loc[[104459], ['bathrooms']] = 1
```

In [89]:

```
train[train.bathrooms>5][['bedrooms', 'bathrooms']] # the rest looks realist
```

Out[89]:

	bedrooms	bathrooms
13701	5	6.0
26937	7	6.5
30788	5	6.0
35053	5	5.5
52189	4	5.5
66485	5	5.5
79611	5	6.0
84566	5	7.0
91709	6	6.0
96387	4	5.5
99199	4	5.5

In [90]:

```
train[train.bedrooms>5][['bedrooms', 'bathrooms']]
```

Out[90]:

	bedrooms	bathrooms
103313	6	4.0
104366	6	4.0
104687	7	3.0
10624	6	3.0
106350	6	5.0
108557	6	3.0
112409	6	4.0
11313	8	4.0
118793	6	3.0
15980	6	4.0
17769	6	2.0
20841	6	4.0
21441	6	4.0
21892	6	2.0
23030	6	3.0
23177	6	3.0
23513	6	4.0
23845	6	1.5
26937	7	6.5
28722	8	3.0
29865	6	3.0
29897	6	3.0
30840	6	3.0
33095	6	3.0
33995	6	3.0
39808	6	3.0
40728	6	3.0
4126	6	4.0
50503	6	2.0
54537	6	2.0
55247	6	4.0

	bedrooms	bathrooms
55912	6	4.0
59137	6	2.0
6185	6	2.0
66018	6	1.0
66523	6	4.0
69918	6	4.0
70564	6	3.0
70584	6	2.0
73318	6	3.0
74500	6	2.5
79297	6	2.0
79731	6	3.0
81654	6	2.0
8406	6	3.0
86531	6	2.0
91709	6	6.0
93622	6	3.0
97604	6	2.0
9821	6	3.0

In [92]:

```
train.loc[[23845], 'description'].values
```

Out[92]:

```
array([ u'Spacious 6 Bed - HIgh ceilings - Gushing lights.<br /><br />Apa
rtment features 1.5 marble baths - granite kitchen with a dishwasher - in
unit washer & dryer - hardwood floors.<br /><br />located in Midtown West
steps from the Theatre District nightlife and restaurants  - just around
 the corner from M11 & M104 bus service, A, C, E, subway lines and all tr
ansportation.<br /><br />Call or Email and Text for exclusive Showing!<br
/><br /><br /><br /><br /><br /><br /><br /><br /><br /><br /><br /><p><a
  website_redacted '], dtype=object)
```

In [112]:

```
train[train.price>price_ulimit].interest_level.value_counts()
```

Out[112]:

```
low     245
high      1
Name: interest_level, dtype: int64
```

Looks like anything outside the u_limit, we can predict as low!

Fit a model using only the data that is within 99.5 percentiles of

prices

```
In [113]: rf2 = RandomForestClassifier(n_estimators=1000)
          rf2.fit(X_train[X_train.price<price_ulimit], y_train[X_train.price<price_uli
```

```
Out[113]: RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gin
          i',
                      max_depth=None, 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=1000, n_jobs=1, oob_score=False,
                      random_state=None, verbose=0, warm_start=False)
```

```
In [117]: X_val.shape
```

```
Out[117]: (16287, 12)
```

```
In [116]: X_val[X_val.price>price_ulimit].shape
```

```
Out[116]: (99, 12)
```

```
In [120]: y_val_pred = rf2.predict_proba(X_val[X_val.price<price_ulimit])
          log_loss(y_val[X_val.price<price_ulimit], y_val_pred)
```

```
Out[120]: 0.62103997743430239
```

```
In [129]: y_val[X_val.price>price_ulimit].value_counts()
```

```
Out[129]: low    99
          Name: interest_level, dtype: int64
```

```
In [130]: y_val_pred = rf2.predict_proba(X_val)
          log_loss(y_val, y_val_pred)
```

```
Out[130]: 0.61781702733944877
```

```
In [140]: y_val_pred[X_val.price>price_ulimit]
```

```
          /anaconda/lib/python2.7/site-packages/ipykernel/__main__.py:1: FutureWarn
          ing: in the future, boolean array-likes will be handled as a boolean arra
          y index
            if __name__ == '__main__':
```

```
Out[140]: array([[ 0.,  1.,  0.],
                 [ 0.,  1.,  0.],
                 [ 0.,  1.,  0.],
                 ...,
                 [ 0.,  1.,  0.],
                 [ 0.,  1.,  0.],
                 [ 0.,  1.,  0.]])
```

```
In [141]: rf2.classes_
```

```
Out[141]: array([u'high', u'low', u'medium'], dtype=object)
```

Removing outliers doesn't really seem to help when doing Random Forests! It makes sense because tree based models are more robust to outliers.

To improve results, we will need to do gridsearch and find the optimal parameters for random forest. This is just a starter script. We should also leverage more features than just the numerical features.