In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

import seaborn as sns
pd.set_option("display.max_columns",60)

from IPython.core.pylabtools import figsize
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import MinMaxScaler
from sklearn.linear_model import LinearRegression
from sklearn.ensemble import RandomForestRegressor, GradientBoostingRegressor
from sklearn.svm import SVR
from sklearn.neighbors import KNeighborsRegressor
from sklearn.model_selection import RandomizedSearchCV, GridSearchCV
```

In [2]:

```
train_features = pd.read_csv('F:/Dhrumil/r/Tableau/training_features.csv')
test_features = pd.read_csv('F:/Dhrumil/r/Tableau/testing_features.csv')
train_labels = pd.read_csv('F:/Dhrumil/r/Tableau/training_labels.csv')
test_labels = pd.read_csv('F:/Dhrumil/r/Tableau/testing_labels.csv')

print('Training Feature Size: ', train_features.shape)
print('Testing Feature Size:  ', test_features.shape)
print('Training Labels Size:  ', train_labels.shape)
print('Testing Labels Size:   ', test_labels.shape)
```

```
Training Feature Size:  (6322, 65)
Testing Feature Size:   (2710, 65)
Training Labels Size:   (6322, 1)
Testing Labels Size:    (2710, 1)
```

In [3]:

```
train_features.head(12)
```

Out[3]:

	Order	Property Id	DOF Gross Floor Area	Year Built	number	Occupancy	Site EUI (kBtu/ft²)	Weather Normalized Site Electricity Intensity (kWh/ft²)	Weather Normalized Site Natural Gas Intensity (therms/ft²)	Weather Normalized Site Natural Gas Use (therms)	Water Intensity (All Water Sources) (gal/ft²)	Latitude	Longitude	Commur Bo
0	8749	2661595	69595.0	1964	1	100	95.4	5.6	NaN	NaN	NaN	40.882731	-73.903729	
1	10643	4938575	67500.0	1940	1	100	58.9	3.2	0.5	34446.7	32.17	40.645814	-73.962376	1
2	3605	2630626	85952.0	1927	1	100	76.6	13.9	0.0	390.3	40.71	40.757220	-73.979877	
3	335	4994373	370814.0	1970	1	95	24.6	6.5	0.0	8217.0	59.90	40.815052	-73.935936	1
4	6599	2795611	117080.0	1938	1	100	72.1	3.8	0.5	77304.6	NaN	40.833607	-73.918558	
5	8815	3116754	78825.0	1950	1	100	73.3	3.1	0.1	4782.4	64.43	40.896786	-73.896854	
6	2015	4949050	183168.0	1896	1	95	83.3	13.7	0.2	32817.6	NaN	40.743415	-73.989094	
7	3661	4403231	58001.0	1970	1	100	46.5	6.8	NaN	NaN	NaN	40.763197	-73.974496	
8	14500	4436800	85900.0	1965	1	70	108.7	15.6	0.6	48752.3	12027.41	NaN	NaN	N
9	13369	2790338	76681.0	1929	1	100	76.6	3.2	0.7	51950.3	NaN	NaN	NaN	N
10	4349	4401486	88829.0	1927	1	100	59.4	1.9	0.1	9521.4	35.59	40.769466	-73.962891	
11	8913	4494218	123700.0	1914	1	90	49.6	7.6	0.3	31407.7	22.54	40.702307	-73.989627	

12 rows × 65 columns

In [4]:

```
train_features= train_features.drop(columns=['Borough','Largest Property Use Type'])
```

In [5]:

```python
train_features.head()
```

Out[5]:

	Order	Property Id	DOF Gross Floor Area	Year Built	number	Occupancy	Site EUI (kBtu/ft²)	Weather Normalized Site Electricity Intensity (kWh/ft²)	Weather Normalized Site Natural Gas Intensity (therms/ft²)	Weather Normalized Site Natural Gas Use (therms)	Water Intensity (All Water Sources) (gal/ft²)	Latitude	Longitude	Communi Boa
0	8749	2661595	69595.0	1964	1	100	95.4	5.6	NaN	NaN	NaN	40.882731	-73.903729	8
1	10643	4938575	67500.0	1940	1	100	58.9	3.2	0.5	34446.7	32.17	40.645814	-73.962376	14
2	3605	2630626	85952.0	1927	1	100	76.6	13.9	0.0	390.3	40.71	40.757220	-73.979877	5
3	335	4994373	370814.0	1970	1	95	24.6	6.5	0.0	8217.0	59.90	40.815052	-73.935936	11
4	6599	2795611	117080.0	1938	1	100	72.1	3.8	0.5	77304.6	NaN	40.833607	-73.918558	4

5 rows × 63 columns

In [6]:

```python
test_features= test_features.drop(columns=['Borough','Largest Property Use Type'])
```

In [7]:

```python
test_features.head()
```

Out[7]:

	Order	Property Id	DOF Gross Floor Area	Year Built	number	Occupancy	Site EUI (kBtu/ft²)	Weather Normalized Site Electricity Intensity (kWh/ft²)	Weather Normalized Site Natural Gas Intensity (therms/ft²)	Weather Normalized Site Natural Gas Use (therms)	Water Intensity (All Water Sources) (gal/ft²)	Latitude	Longitude	Communi Boa
0	3848	1423551	345743.0	1980	1	100	61.1	14.4	NaN	NaN	16.12	40.756651	-73.972264	5

	Order	Property Id	DOF Gross Floor Area	Year Built	number	Occupancy	Site EUI (kBtu/ft²)	Weather Normalized Site Electricity Intensity (kWh/ft²)	Weather Normalized Site Natural Gas Intensity (therms/ft²)	Weather Normalized Site Natural Gas Use (therms)	Water Intensity (All Water Sources) (gal/ft²)	Latitude	Longitude	Communi Boa
1	13331	5838686	148181.0	1932	1	100	54.4	3.7	0.4	60727.8	32.41	NaN	NaN	Na
2	14865	3111579	195678.0	1983	1	100	79.1	NaN	NaN	NaN	55.80	40.581202	-74.162664	2
3	8461	4859883	125891.0	1962	1	100	90.7	4.7	0.3	37674.2	50.57	40.858853	-73.868957	11
4	9903	5848160	54698.0	2008	1	95	58.4	6.6	0.4	22174.9	22.10	40.716762	-73.964742	1

5 rows × 63 columns

In [8]:

```
imputer = SimpleImputer(strategy= 'median')
imputer.fit(train_features)
x= imputer.transform(train_features)
x_test = imputer.transform(test_features)
```

In [9]:

```
print('Missing values in training features: ', np.sum(np.isnan(x)))
print('Missing values in testing features:  ', np.sum(np.isnan(x_test)))
```

```
Missing values in training features:  0
Missing values in testing features:   0
```

In [10]:

```
print(np.where(~np.isfinite(x)))
print(np.where(~np.isfinite(x_test)))
```

```
(array([], dtype=int64), array([], dtype=int64))
(array([], dtype=int64), array([], dtype=int64))
```

In [12]:

```
scaler = MinMaxScaler(feature_range=(0,1))
scaler.fit(x)
```

```
x = scaler.transform(x)
x_test = scaler.transform(x_test)
```

In [14]:
```
y= np.array(train_labels).reshape((-1, ))
y_test= np.array(test_labels).reshape((-1, ))
```

In [19]:
```
def mae(y_test,y_pred):
    return np.mean(abs(y_test-y_pred))

def model_eval(model):
    model.fit(x,y)
    model_pred = model.predict(x_test)
    model_mae = mae(y_test,model_pred)
    return model_mae
```

In [20]:
```
lr= LinearRegression()
lr_mae = model_eval(lr)
lr_mae
```

Out[20]: 12.988557015563204

In [21]:
```
svm = SVR(C=1000, gamma=0.1)
svm_mae = model_eval(svm)
```

In [22]:
```
svm_mae
```

Out[22]: 10.49089165674137

In [24]:
```
random_forest = RandomForestRegressor(random_state=60)
random_forest_mae = model_eval(random_forest)
random_forest_mae
```

Out[24]: 9.623974169741699

In [25]:

```
gradient_boost = GradientBoostingRegressor(random_state=60)
gradient_boost_mae = model_eval(gradient_boost)
```

In [26]:

```
gradient_boost_mae
```

Out[26]: 9.773772232725227

In [27]:

```
knn = KNeighborsRegressor(n_neighbors= 10)
knn_mae = model_eval(knn)
knn_mae
```

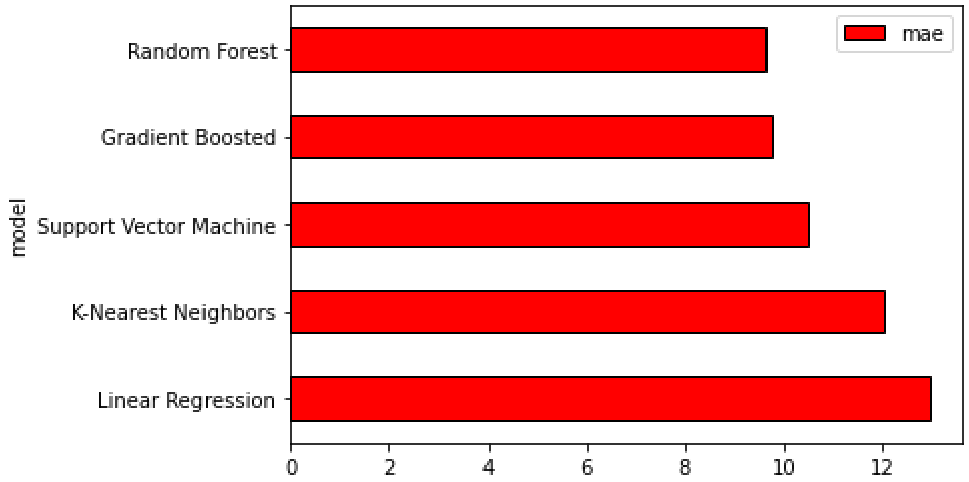
Out[27]: 12.04789667896679

In [29]:

```
model_comparison = pd.DataFrame({'model': ['Linear Regression', 'Support Vector Machine',
                                           'Random Forest', 'Gradient Boosted',
                                            'K-Nearest Neighbors'],
                                 'mae': [lr_mae, svm_mae, random_forest_mae,
                                         gradient_boost_mae, knn_mae]})

# Horizontal bar chart of test mae
model_comparison.sort_values('mae', ascending = False).plot(x = 'model', y = 'mae', kind = 'barh',
                                                           color = 'red', edgecolor = 'black')
```

Out[29]: <AxesSubplot:ylabel='model'>


mae
Random Forest
Gradient Boosted
Support Vector Machine
K-Nearest Neighbors
Linear Regression
model
0
2
4
6
8
10
12

```
In [ ]:
```