In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
# Load cleaned combined data
train = pd.read_csv(r"C:\Users\onl_a\Documents\Data Analytics, Big Data & Predictive Analytics/Data/bikeshare_c
train.drop(['Unnamed: 0'], axis=1, inplace=True)
```

In [3]:
```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8722 entries, 0 to 8721
Data columns (total 21 columns):
 #   Column                Non-Null Count  Dtype
---  ------                --------------  -----
 0   date                  8722 non-null   object
 1   trips                 8722 non-null   int64
 2   Temp (°C)             8722 non-null   float64
 3   Dew Point Temp (°C)   8722 non-null   float64
 4   Rel Hum (%)           8722 non-null   float64
 5   Visibility (km)       8722 non-null   float64
 6   Stn Press (kPa)       8722 non-null   float64
 7   Hmdx                  8722 non-null   float64
 8   Wind Chill            8722 non-null   float64
 9   Strong Wind           8722 non-null   int64
 10  Fog                   8722 non-null   int64
 11  Freezing Rain         8722 non-null   int64
 12  Haze                  8722 non-null   int64
 13  Heavy Rain            8722 non-null   int64
 14  Moderate Rain         8722 non-null   int64
 15  Moderate Snow         8722 non-null   int64
 16  Rain                  8722 non-null   int64
 17  Snow                  8722 non-null   int64
 18  Thunderstorms         8722 non-null   int64
 19  Weekend               8722 non-null   int64
 20  Holiday               8722 non-null   int64
dtypes: float64(7), int64(13), object(1)
memory usage: 1.4+ MB
```

In [4]:
```
train.head()
```

Out[4]:

	date	trips	Temp (°C)	Dew Point Temp (°C)	Rel Hum (%)	Visibility (km)	Stn Press (kPa)	Hmdx	Wind Chill	Strong Wind	...	Freezing Rain	Haze	Heavy Rain	Moderate Rain	Moderate Snow	Rain	Snow
0	2018-01-01 00:00:00	4	-16.2	-20.5	70.0	16.1	102.13	0.0	-22.0	0	…	0	0	0	0	0	0	0
1	2018-01-01 01:00:00	10	-16.8	-21.1	70.0	16.1	102.10	0.0	-20.0	0	…	0	0	0	0	0	0	0
2	2018-01-01 02:00:00	6	-17.3	-20.8	75.0	16.1	102.15	0.0	-26.0	0	…	0	0	0	0	0	0	0
3	2018-01-01 03:00:00	14	-17.9	-21.6	73.0	16.1	102.13	0.0	-24.0	0	…	0	0	0	0	0	0	0
4	2018-01-01 04:00:00	6	-17.2	-21.1	72.0	16.1	102.09	0.0	-21.0	0	…	0	0	0	0	0	0	0

5 rows × 21 columns

In [5]:
```
# Scale numeric features
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
```

In [6]:
```
train.columns
```

Out[6]:
```
Index(['date', 'trips', 'Temp (°C)', 'Dew Point Temp (°C)', 'Rel Hum (%)',
       'Visibility (km)', 'Stn Press (kPa)', 'Hmdx', 'Wind Chill',
       'Strong Wind', 'Fog', 'Freezing Rain', 'Haze', 'Heavy Rain',
       'Moderate Rain', 'Moderate Snow', 'Rain', 'Snow', 'Thunderstorms',
       'Weekend', 'Holiday'],
      dtype='object')
```

In [7]:
```
num_vars = ['Temp (°C)', 'Dew Point Temp (°C)', 'Rel Hum (%)',
            'Visibility (km)', 'Stn Press (kPa)', 'Hmdx', 'Wind Chill']

train[num_vars] = scaler.fit_transform(train[num_vars])
```

In [8]:
```
train.head()
```

Out[8]:

	date	trips	Temp (°C)	Dew Point Temp (°C)	Rel Hum (%)	Visibility (km)	Stn Press (kPa)	Hmdx	Wind Chill	Strong Wind	...	Freezing Rain	Haze	Heavy Rain	Moderate Rain	Moderate Snow
0	2018-01-01 00:00:00	4	0.107750	0.139847	0.638554	1.0	0.748614	0.0	0.31250	0	…	0	0	0	0	0
1	2018-01-01 01:00:00	10	0.096408	0.128352	0.638554	1.0	0.743068	0.0	0.37500	0	…	0	0	0	0	0
2	2018-01-01 02:00:00	6	0.086957	0.134100	0.698795	1.0	0.752311	0.0	0.18750	0	…	0	0	0	0	0
3	2018-01-01 03:00:00	14	0.075614	0.118774	0.674699	1.0	0.748614	0.0	0.25000	0	…	0	0	0	0	0
4	2018-01-01 04:00:00	6	0.088847	0.128352	0.662651	1.0	0.741220	0.0	0.34375	0	…	0	0	0	0	0

5 rows × 21 columns

In [9]:
```
X,y =train[['Temp (°C)', 'Dew Point Temp (°C)', 'Rel Hum (%)',
       'Visibility (km)', 'Stn Press (kPa)', 'Hmdx', 'Wind Chill',
       'Strong Wind', 'Fog', 'Freezing Rain', 'Haze', 'Heavy Rain',
       'Moderate Rain', 'Moderate Snow', 'Rain', 'Snow', 'Thunderstorms',
       'Weekend', 'Holiday']].values,train['trips'].values
```

In [10]:
```
from sklearn.model_selection import train_test_split
```

In [11]:
```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.30,random_state=0)
print ("Training Set: %d rows\nTest Set: %d rows" % (X_train.shape[0], X_test.shape[0]))
```

```
Training Set: 6105 rows
Test Set: 2617 rows
```

Linear Regression Model (Trial 1)

In [12]:
```
from sklearn.linear_model import LinearRegression
```

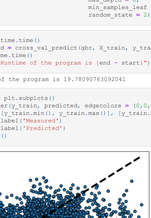
In [13]:
```
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import cross_val_predict
import time
```

In [14]:
```
regressor = LinearRegression()
```

In [25]:
```
start = time.time()
predicted = cross_val_predict(regressor, X_train, y_train, cv=15)
end = time.time()
print(f"Runtime of the program is {end - start}")
```

```
Runtime of the program is 0.05203199338659668
```

In [18]:
```
import matplotlib.pyplot as plt
fig,ax = plt.subplots()
ax.scatter(y_train, predicted, edgecolors = (0,0,0))
ax.plot([y_train.min(), y_train.max()], [y_train.min(), y_train.max()], 'k--', lw=4)
ax.set_xlabel('Measured')
ax.set_ylabel('Predicted')
plt.show()
```



In [20]:
```
import math
```

In [27]:
```
scoring = ['r2','neg_mean_squared_error','neg_mean_absolute_error']
for i in scoring:
    scores = cross_val_score(regressor, X_train, y_train, cv=15, scoring = i)
#    print(scores)
    if i == 'r2':
        print(i, ': ', scores.mean())
    elif i == 'neg_mean_squared_error':
        x = -1*scores.mean()
        y = math.sqrt(x)
        print('RMSE: ', "%0.3f" % y)
    elif i == 'neg_mean_absolute_error':
        x = -1*scores.mean()
        print(i, ': %0.2f (+/- %0.2f)' % (x, scores.std() * 2))
```

```
r2 :  0.34476860531144393
RMSE:  201.572
neg_mean_absolute_error : 140.18 (+/- 14.38)
```

Random Forest Regression Model (Trial 1)

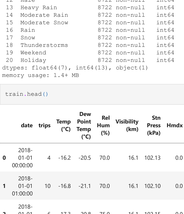
In [28]:
```
from sklearn.ensemble import RandomForestRegressor
```

In [29]:
```
rfr1 = RandomForestRegressor(n_estimators=60, criterion='mse', random_state=2)
```

In [30]:
```
start = time.time()
predicted = cross_val_predict(rfr1, X_train, y_train, cv=15)
end = time.time()
print(f"Runtime of the program is {end - start}")
```

```
Runtime of the program is 10.654997825622559
```

In [31]:
```
fig,ax = plt.subplots()
ax.scatter(y_train, predicted, edgecolors = (0,0,0))
ax.plot([y_train.min(), y_train.max()], [y_train.min(), y_train.max()], 'k--', lw=4)
ax.set_xlabel('Measured')
ax.set_ylabel('Predicted')
plt.show()
```



In [32]:
```
scoring = ['r2','neg_mean_squared_error','neg_mean_absolute_error']
for i in scoring:
    scores = cross_val_score(rfr1, X_train, y_train, cv=15, scoring = i)
#    print(scores)
    if i == 'r2':
        print(i, ': ', scores.mean())
    elif i == 'neg_mean_squared_error':
        x = -1*scores.mean()
        y = math.sqrt(x)
        print('RMSE: ', "%0.2f" % y)
    elif i == 'neg_mean_absolute_error':
        x = -1*scores.mean()
        print(i, ': %0.2f (+/- %0.2f)' % (x, scores.std() * 2))
```

```
r2 :  0.4026057258553218
RMSE:  192.321
neg_mean_absolute_error : 127.79 (+/- 16.21)
```

Gradient Boosting Regression Model (Trial 1)

In [33]:
```
from sklearn.ensemble import GradientBoostingRegressor
```

In [34]:
```
gbr = GradientBoostingRegressor(learning_rate = 0.12,
                                n_estimators = 150,
                                max_depth = 8,
                                min_samples_leaf = 1,
                                random_state = 2)
```

In [36]:
```
start = time.time()
predicted = cross_val_predict(gbr, X_train, y_train, cv=15)
end = time.time()
print(f"Runtime of the program is {end - start}")
```

```
Runtime of the program is 19.780907630920410
```

In [37]:
```
fig,ax = plt.subplots()
ax.scatter(y_train, predicted, edgecolors = (0,0,0))
ax.plot([y_train.min(), y_train.max()], [y_train.min(), y_train.max()], 'k--', lw=4)
ax.set_xlabel('Measured')
ax.set_ylabel('Predicted')
plt.show()
```


In [38]:
```
scoring = ['r2','neg_mean_squared_error','neg_mean_absolute_error']
for i in scoring:
    scores = cross_val_score(gbr, X_train, y_train, cv=15, scoring = i)
#    print(scores)
    if i == 'r2':
        print(i, ': ', scores.mean())
    elif i == 'neg_mean_squared_error':
        x = -1*scores.mean()
        y = math.sqrt(x)
        print('RMSE: ', "%0.3f" % y)
    elif i == 'neg_mean_absolute_error':
        x = -1*scores.mean()
        print(i, ': %0.2f (+/- %0.2f)' % (x, scores.std() * 2))
```

```
r2 :  0.3647459891257357
RMSE:  198.333
neg_mean_absolute_error : 132.01 (+/- 16.23)
```