In [1]:

```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import matplotlib.pyplot as plt
import seaborn as sns
import xgboost as xgb

plt.style.use('fivethirtyeight')
color_palette = sns.color_palette()
```

import os for dirname, _, filenames in os.walk('http://localhost:8888/tree/Downloads/archive'): for filename in filenames: print(os.path.join(dirname, filename))

In [2]:

```
import os
for dirname, _, filenames in os.walk('http://localhost:8888/tree/Downloads/archive'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

In [38]:

```
df = pd.read_csv("C:/Users/Chiamaka/Downloads/archive/PJME_hourly.csv")
df = df.set_index("Datetime")
df.index = pd.to_datetime(df.index)
```

In [39]:

```
df.head()
```

Out[39]:

	COMED_MW
Datetime	
2011-12-31 01:00:00	9970.0
2011-12-31 02:00:00	9428.0
2011-12-31 03:00:00	9059.0
2011-12-31 04:00:00	8817.0
2011-12-31 05:00:00	8743.0

In [40]:

```
sns.color_palette()
```

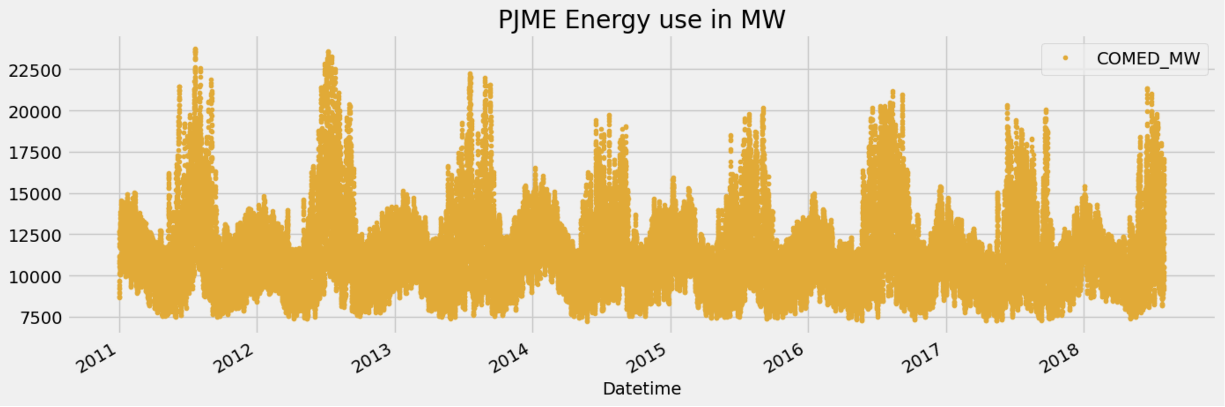
Out[40]:

In [41]:

```
df.plot(style=".",
        figsize=(15,5),
        color=color_palette[-4],
        title="PJME Energy use in MW")
```

Out[41]:

```
<Axes: title={'center': 'PJME Energy use in MW'}, xlabel='Datetime'>
```



In [42]:

```
df.index
```

Out[42]:

```
DatetimeIndex(['2011-12-31 01:00:00', '2011-12-31 02:00:00',
               '2011-12-31 03:00:00', '2011-12-31 04:00:00',
               '2011-12-31 05:00:00', '2011-12-31 06:00:00',
               '2011-12-31 07:00:00', '2011-12-31 08:00:00',
               '2011-12-31 09:00:00', '2011-12-31 10:00:00',
               ...
               ...
               '2018-01-01 15:00:00', '2018-01-01 16:00:00',
               '2018-01-01 17:00:00', '2018-01-01 18:00:00',
               '2018-01-01 19:00:00', '2018-01-01 20:00:00',
               '2018-01-01 21:00:00', '2018-01-01 22:00:00',
               '2018-01-01 23:00:00', '2018-01-02 00:00:00'],
              dtype='datetime64[ns]', name='Datetime', length=66497, freq=None)
```

In [43]:

```
df.index
```

Out[43]:

```
DatetimeIndex(['2011-12-31 01:00:00', '2011-12-31 02:00:00',
               '2011-12-31 03:00:00', '2011-12-31 04:00:00',
               '2011-12-31 05:00:00', '2011-12-31 06:00:00',
               '2011-12-31 07:00:00', '2011-12-31 08:00:00',
               '2011-12-31 09:00:00', '2011-12-31 10:00:00',
               ...
               '2018-01-01 15:00:00', '2018-01-01 16:00:00',
               '2018-01-01 17:00:00', '2018-01-01 18:00:00',
               '2018-01-01 19:00:00', '2018-01-01 20:00:00',
               '2018-01-01 21:00:00', '2018-01-01 22:00:00',
               '2018-01-01 23:00:00', '2018-01-02 00:00:00'],
              dtype='datetime64[ns]', name='Datetime', length=66497, freq=None)
```

In [44]:

```
train = df.loc[df.index < "01-01-2015"]
test = df.loc[df.index >= "01-01-2015"]
```

In [45]:

```
train.tail()
```

Out[45]:

	COMED_MW
Datetime	
2014-01-01 20:00:00	13015.0
2014-01-01 21:00:00	12831.0
2014-01-01 22:00:00	12598.0
2014-01-01 23:00:00	12231.0
2014-01-02 00:00:00	11605.0

In [46]:

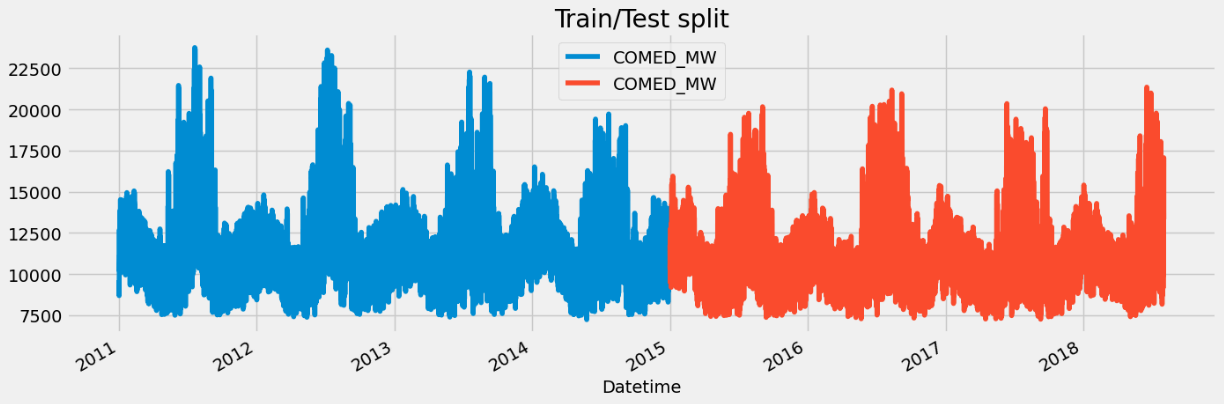
```
test.head()
```

Out[46]:

	COMED_MW
Datetime	
2015-01-01 00:00:00	11774.0
2015-12-31 01:00:00	10419.0
2015-12-31 02:00:00	9893.0
2015-12-31 03:00:00	9544.0
2015-12-31 04:00:00	9341.0

In [47]:

```
# plotting the data
fig, ax = plt.subplots(figsize=(15,5))
train.plot(ax=ax, label="training set", title="Train/Test split")
test.plot(ax=ax, label="test set")
#ax.axvline("01-01-2015", color="black", ls="-")
plt.show()
```

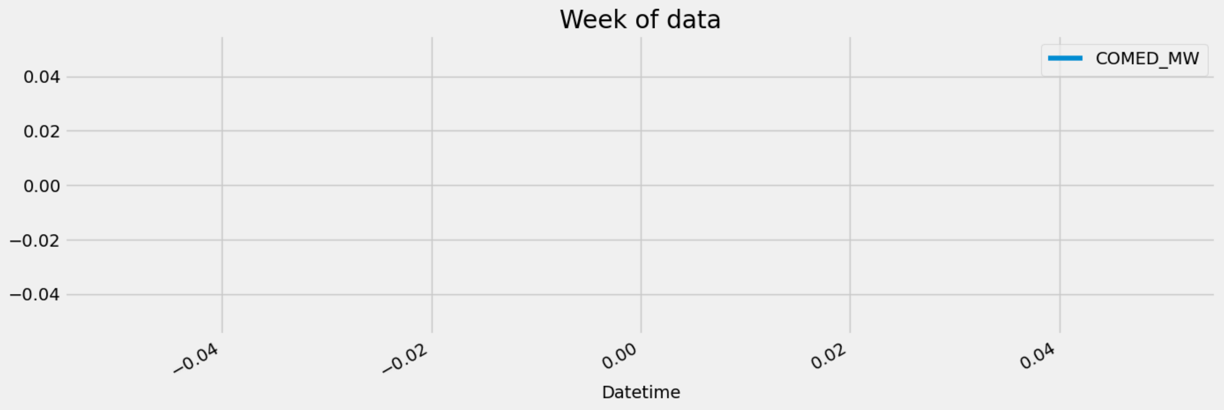


In [48]:

```
df.loc[(df.index > "01-01-2010") & (df.index < "01-08-2010")].plot(figsize=(15,5), title="Week of data")
```

Out[48]:

```
<Axes: title={'center': 'Week of data'}, xlabel='Datetime'>
```



In [49]:

```
def create_features(df):
    """
    Creates timeseries features from time series index
    """
    df = df.copy()
    df['hour'] = df.index.hour
    df['dayofweek'] = df.index.dayofweek
    df['quarter'] = df.index.quarter
    df['month'] = df.index.month
    df['year'] = df.index.year
    df['dayofyear'] = df.index.dayofyear
    return df
```

In [50]:

```
df = create_features(df)
```

In [19]:

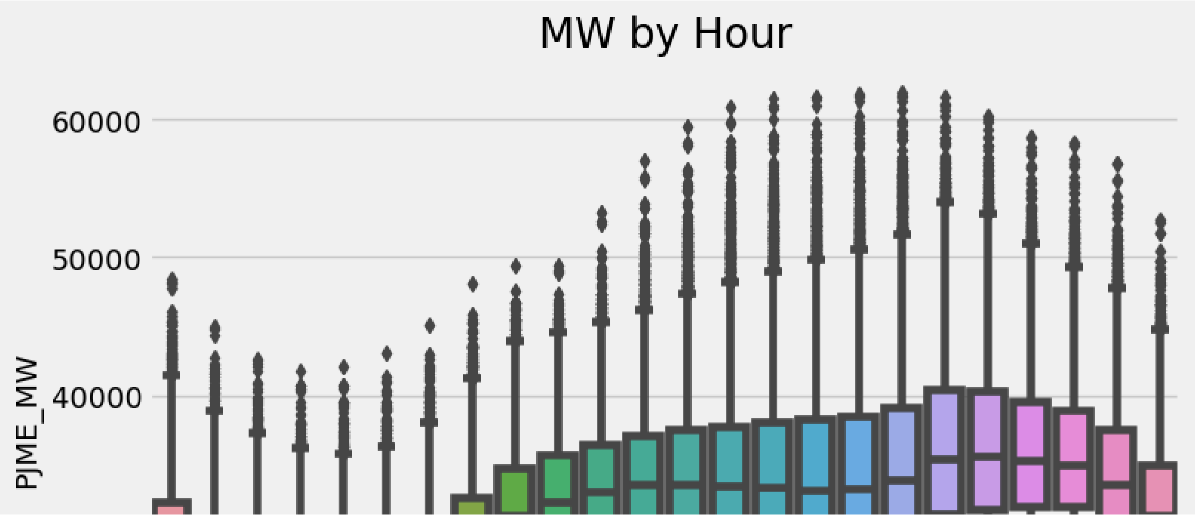
```
df.head()
```

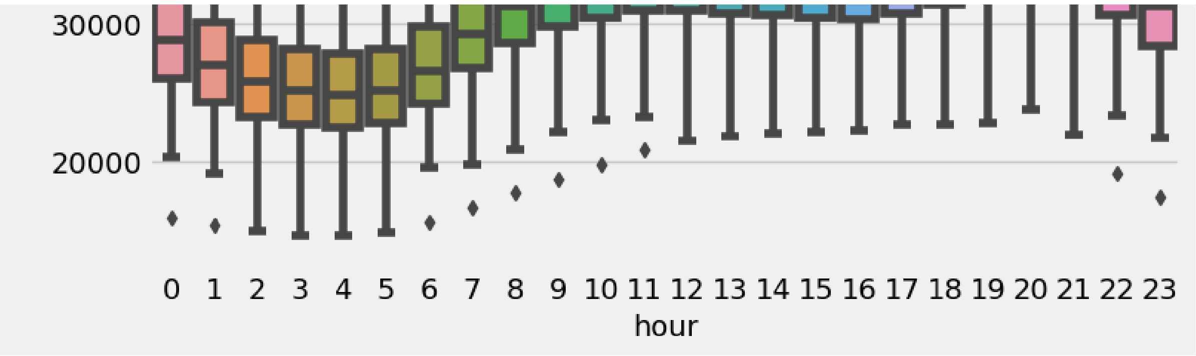
Out[19]:

	PJME_MW	hour	dayofweek	quarter	month	year	dayofyear
Datetime							
2002-12-31 01:00:00	26498.0	1	1	4	12	2002	365
2002-12-31 02:00:00	25147.0	2	1	4	12	2002	365
2002-12-31 03:00:00	24574.0	3	1	4	12	2002	365
2002-12-31 04:00:00	24393.0	4	1	4	12	2002	365
2002-12-31 05:00:00	24860.0	5	1	4	12	2002	365

In [20]:

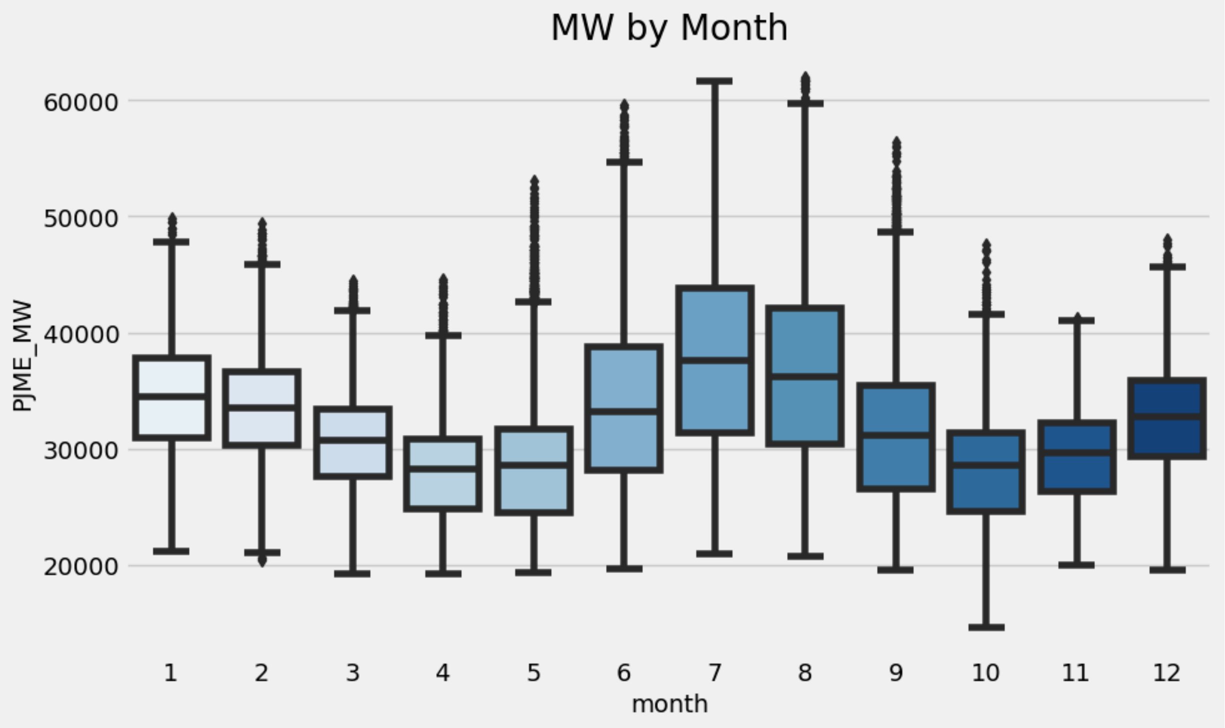
```
# Visualize Our Feature/Target Relationship
fig, ax = plt.subplots(figsize=(8, 6))
sns.boxplot(data=df, x='hour', y='PJME_MW')
ax.set_title("MW by Hour")
plt.show()
```





In [21]:

```
fig, ax = plt.subplots(figsize=(10, 6))
sns.boxplot(data=df, x='month', y='PJME_MW', palette='Blues')
ax.set_title("MW by Month")
plt.show()
```



In [22]:

```
# Create our model
# Import our metrics
from sklearn.metrics import mean_squared_error
```

In [23]:

```
train = create_features(train)
test = create_features(test)
```

In [24]:

```
FEATURES = ['hour', 'dayofweek', 'quarter', 'month', 'year', 'dayofyear']
TARGET = 'PJME_MW'
```

In [25]:

```
X_train = train[FEATURES]
y_train = train[TARGET]

X_test = test[FEATURES]
y_test = test[TARGET]
```

In [26]:

```
reg = xgb.XGBRegressor(n_estimators=1000,
                       early_stopping_rounds=50,
                       learning_rate=0.01)
reg.fit(X_train, y_train,
       eval_set=[(X_train, y_train), (X_test, y_test)],
       verbose=100)
```

```
[0]     validation_0-rmse:32601.87826   validation_1-rmse:31654.28935
[100]   validation_0-rmse:12342.17856   validation_1-rmse:11516.21767
[200]   validation_0-rmse:5373.20460    validation_1-rmse:5164.97392
[300]   validation_0-rmse:3375.48321    validation_1-rmse:3834.00707
[400]   validation_0-rmse:2884.85132    validation_1-rmse:3716.33146
```

```
[450]	validation_0-rmse:2771.93085	validation_1-rmse:3730.77469
```

Out[26]:

```
XGBRegressor(base_score=None, booster=None, callbacks=None,
             colsample_bylevel=None, colsample_bynode=None,
             colsample_bytree=None, early_stopping_rounds=50,
             enable_categorical=False, eval_metric=None, feature_types=None,
             gamma=None, gpu_id=None, grow_policy=None, importance_type=None,
             interaction_constraints=None, learning_rate=0.01, max_bin=None,
             max_cat_threshold=None, max_cat_to_onehot=None,
             max_delta_step=None, max_depth=None, max_leaves=None,
             min_child_weight=None, missing=nan, monotone_constraints=None,
             n_estimators=1000, n_jobs=None, num_parallel_tree=None,
             predictor=None, random_state=None, ...)
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.

On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [27]:

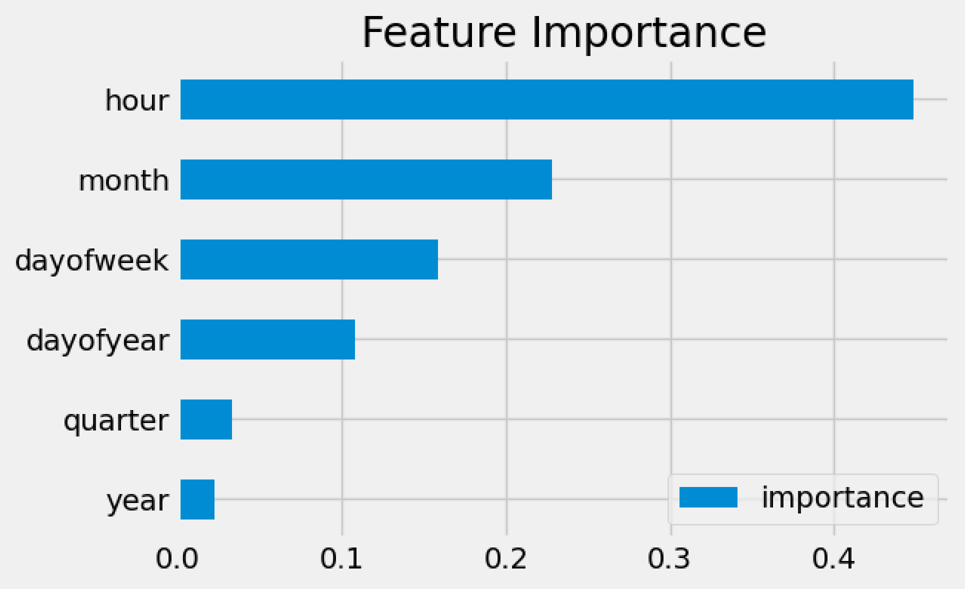
```
fea_imp = pd.DataFrame(data=reg.feature_importances_,
                index=reg.feature_names_in_,
                columns=['importance'])
fea_imp
```

Out[27]:

	importance
hour	0.448804
dayofweek	0.158668
quarter	0.033319
month	0.228156
year	0.022634
dayofyear	0.108419

In [28]:

```
fea_imp.sort_values('importance').plot(kind='barh',
                                       figsize=(6,4),
                                       title="Feature Importance")
plt.show()
```



In [29]:

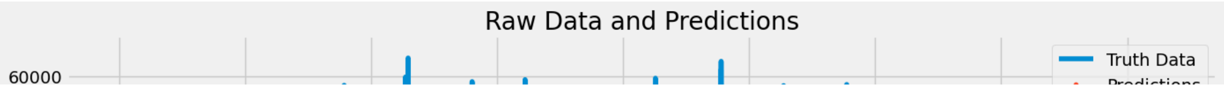
```
test['prediction'] = reg.predict(X_test)
```

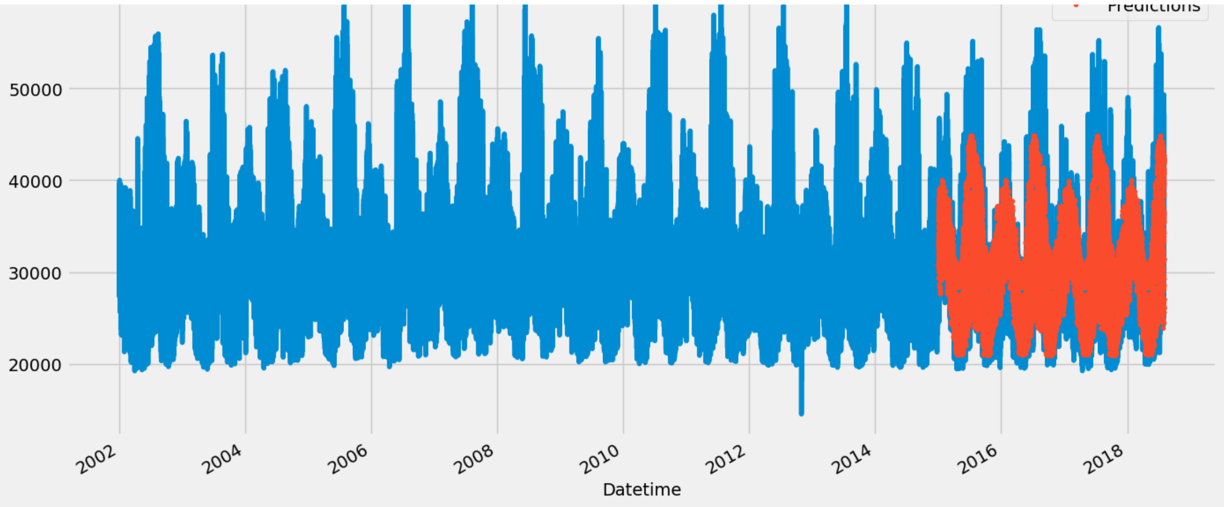
In [30]:

```
df = df.merge(test[['prediction']], how='left', left_index=True, right_index=True)
```

In [31]:

```
# Plotting the predictions
ax = df[['PJME_MW']].plot(figsize=(15,8))
df['prediction'].plot(ax=ax, style='.')
plt.legend(['Truth Data', 'Predictions'])
ax.set_title('Raw Data and Predictions')
plt.show()
```



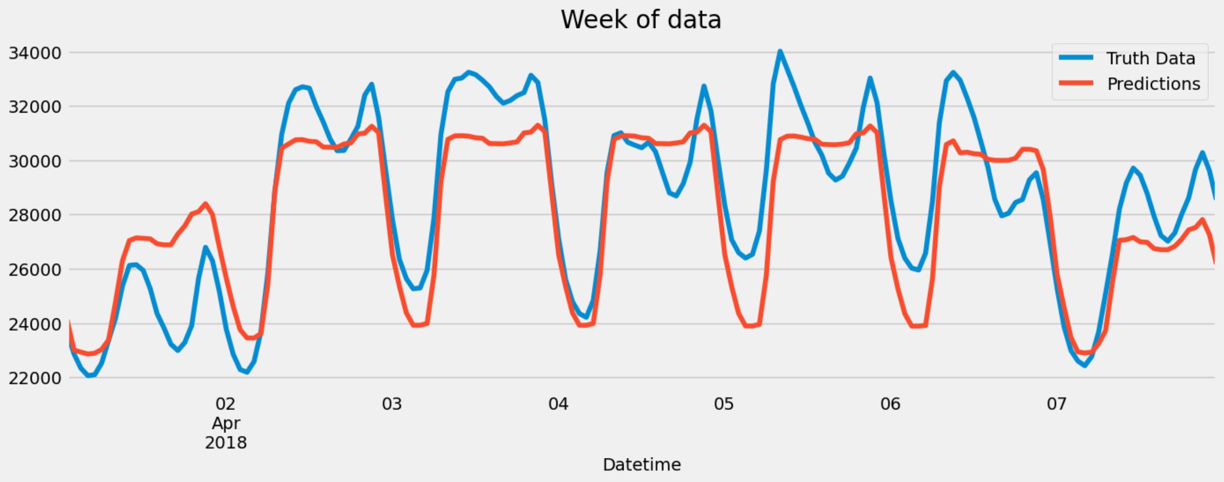


In [32]:

```
# Plot for one week data
ax = df.loc[(df.index > "04-01-2018") & (df.index < "04-08-2018")]['PJME_MW'].plot(figsize=(15,5), title="Week o
df.loc[(df.index > "04-01-2018") & (df.index < "04-08-2018")]['prediction'].plot()
plt.legend(['Truth Data', 'Predictions'])
```

Out[32]:

```
<matplotlib.legend.Legend at 0x22c6c1ceec0>
```



In [34]:

```
score = np.sqrt(mean_squared_error(test['PJME_MW'], test['prediction']))
print(f'RMSE score on test set: {score:0.2f}')
```

```
RMSE score on test set: 3715.93
```

In [37]:

```
# Let's look at the Worst and Best Predicted days
test['error'] = np.abs(test[TARGET] - test['prediction'])
test['date'] = test.index.date
test.groupby(['date'])['error'].mean().sort_values(ascending=False).head()
```

Out[37]:

```
date
2016-08-13    14577.210124
2016-08-14    14472.472738
2016-09-10    12494.880941
2016-08-12    11525.418376
2016-09-09    11369.640299
Name: error, dtype: float64
```

In [ ]: