Final Project for ECE 514 – Time Series Forecasting for Energy Consumption in Greece

Due data: June 10, 2023

Time series forecasting is an important area of machine learning because there are so many prediction problems that involve a time component. The time component makes time series problems more difficult to handle and important to study.

The problem of time series forecasting in energy consumption is a complex one due to the unpredictable nature of energy demand and the various factors that can impact it. One challenge is the seasonality of energy consumption. Energy usage patterns can vary significantly depending on the time of day, day of the week, and time of year. For example, during hot summer months, air conditioning usage may significantly increase energy demand, while during colder winter months, heating systems may increase demand. Another challenge is the unpredictability of external factors that can impact energy consumption, such as weather patterns, economic conditions, and technological advancements. For example, a sudden heat wave can increase energy consumption for cooling, while a recession can decrease overall energy usage. Furthermore, renewable energy sources such as solar and wind power can introduce additional complexity in forecasting energy consumption. The output of renewable sources depends on weather conditions, which can be difficult to predict accurately. Finally, there may be policy changes or regulations that impact energy consumption, such as changes in tax incentives or energy efficiency standards. These changes can be difficult to predict and may have significant effects on energy demand.

Overall, accurately forecasting energy consumption requires the consideration of a wide range of factors, making it a challenging and complex problem.

Part I: Identify datasets related to energy consumption in Greece.

There are several datasets available that provide information on energy consumption in Greece. Here are a few options:

1. The Hellenic Statistical Authority (ELSTAT) publishes data on energy statistics for Greece, including information on energy production, imports, consumption, and prices. The data is available on their website and can be accessed through their Energy section.

2. Eurostat, the statistical office of the European Union, provides a range of energy-related statistics for EU member states, including Greece. Their website offers access to a variety of datasets, including information on energy production and consumption, renewable energy, and energy prices.

3. The International Energy Agency (IEA) also provides data on energy consumption in Greece. Their website offers access to a range of datasets, including information on energy use by sector, energy efficiency, and renewable energy.

4. The Open Power System Data (OPSD) platform provides a range of energy-related data for countries across Europe, including Greece. The platform offers access to datasets on energy generation, consumption, and prices, among other topics.

5. The Greek Energy Exchange (EXAE) provides real-time data on energy consumption and production in Greece, including information on electricity, natural gas, and oil.

Part II: Apply different statistical and machine learning algorithms to a dataset that you are going to use and compare their performance. Following are the algorithms that you are going to explore.

There are several time series machine learning algorithms that can be used for forecasting energy consumption in Greece. Here are some common ones:

1. ARIMA (Autoregressive Integrated Moving Average): ARIMA is a classical time series algorithm that is widely used for forecasting. It models the time series as a combination of autoregressive, integrated, and moving average terms. ARIMA is particularly effective for modeling stationary time series.
2. LSTM (Long Short-Term Memory): LSTM is a type of recurrent neural network (RNN) that is particularly effective for modeling sequences with long-term dependencies. It has been shown to be effective for a wide range of time series forecasting tasks.
3. Prophet: Prophet is a forecasting algorithm developed by Facebook that is particularly effective for time series with strong seasonal patterns. It uses a decomposable time series model with three main components: trend, seasonality, and holidays.
4. XGBoost (Extreme Gradient Boosting): XGBoost is a popular machine learning algorithm that is particularly effective for modeling structured data. It is based on decision trees and uses gradient boosting to improve the performance of the models.
5. Time series AutoML refers to automated machine learning techniques that are specifically designed to handle time series data. These techniques can be applied to a wide range of applications, including energy consumption forecasting. Some popular time series AutoML platforms include:

    1. H2O.ai: This platform offers a range of AutoML tools for time series data, including automated feature engineering and model selection.

2. DataRobot: This platform includes a Time Series model which provides an end-to-end time series forecasting process, from automatically selecting appropriate forecasting techniques and hyperparameter tuning to generating production-ready forecasts.

3. Google Cloud AutoML: Google offers an AutoML service that can be used for time series forecasting, which includes pre-processing tools, hyperparameter tuning and selection of a suitable model for the data.

You should choose one of them.

Keep up the good work!