Integrative Demand Forecasting for Energy Consumption: A Machine Learning Approach with Seasonal Decomposition and Climate Change Impact Analysis

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## 0.1 Introduction and Motivation

The supply and demand of energy is volatile and for suppliers to enter and remain in the market, the supply of power needs to be profitable, and being profitable relies on predicting and providing the most efficient amount of power to the grid.

It’s a known fact weather plays a major role in the demand of power, i.e., when the temperature drops, heating is utilized, and when the temperature rises, air-conditioning is utilized. Therefore, this analysis will look at the effects of the weather on the power demand, to better predict the supply required. If proper supply is not calculated, the supplier may need to provide additional power which could cost excessively. With the weather playing such a huge role in demand of power, analysis on the effects of global warming and erratic storm periods will be considered.

There are other factors which also play a part in the supply of power, and this project will attempt to identify the patterns which daily, seasonal variations, and holidays play on the demand.

With all these factors included when analysing the power demand, the advantages of having a machine learning model would be advantageous to predict the demand and therefore supply can be provided efficiently.

Specifically, in the scope of this project, we will identify the energy consumption patterns to uncover the hidden temporal patterns in energy demand, including daily and seasonal variations. We will perform climate impact assessment to quantify how changes in climate variables like temperature affect energy demand.

In addition, we will perform holiday and special event Analysis to understand the impact of holidays and special events on energy consumption, aiding in better planning.

Based on the analysis, we will provide policy recommendations to offer actionable insights that can assist in energy policy formulation, including the diversification of energy sources for balancing demand. We will create a machine learning model that can predict future energy demand with high accuracy, incorporating all the identified variables.

## 0.2 Brief Literature Review

Need to fill in this section.

Reference examples: [1].

## 0.3 Methods, Software and Data Description

Regression Analysis will be utilized to determine the relationship between the attributes of temperature, holidays, days of week against demand.

Pandas, Matplotlib, Python, Seaborn, R, RStudio, RMarkdown

The data provided has demand data in 5 minute intervals from 1 Jan 2010 to 1 August 2022.

The temperature data is in 30min intervals from 1 Jan 2010 to 1 August 2022. Temperatures which don’t seem valid should be removed from the analysis. Temperature of -9999 has been removed.

The data will need to be cleaned, i.e. invalid and out-lying data removed.

## 0.4 Activities and Schedule

### 0.4.1 Main tasks and activities

To achieve the objectives as discussed in the previous sections, the following main tasks and activities will need to be completed:

* Perform literature reviews.
* Assess the provided data set, including: temperature\_nsw.csv and totaldemand\_nsw.csv.
* Research algorithms: identify appropriate machine learning algorithms to use for the project.
* Data cleaning: to identify and exclude irrelevant data in the provided data set.
* Data enriching: to identify additional data to integrate with and enrich the provided data set.
* Integrate the data.
* Perform data analysis using machine learning algorithms.
* Analyse the output and provide recommendations.
* Create visualisations to communicate the findings from the above analysis.
* Write report.
* Create video presentations.

### 0.4.2 Activities and Schedule

Each team member will go away with one task to analyse and we will meet and discuss our findings in Week 2.

Cleaning, enriching, and integrating the data – Week 3 (2-3 days)

Data mining – find patterns and hidden relationships - Week 3/4 (4-5 days)

From these findings a new plan will be implemented depending on the data and analysis found. Decisions on what visualizations will be useful to be noted as the project progresses. Gather more research and in-depth understanding to add to the story.

The aim is to have all analysis and conclusions completed by end of week 4. Week 5 and 6 will be used to refine the report, and video.

Below are the main project activities with attentive timetable for the activities:

Below is the Gantt chart representing our activities and schedule:

# 1 References

1. Lafaye de Micheaux P, Drouilhet R, Liquet B. [The r software: Fundamentals of programming and statistical analysis](https://books.google.fr/books?id=Ji-8BAAAQBAJ). Springer New York; 2013.