Electricity Price Analysis in Europe
The Impact of the War between Russia and Ukraine

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1.INTRODUCTION

Electricity is a crucial resource for businesses and households across Europe, powering everything from manufacturing processes to daily household activities. As a result, understanding the electricity market is essential for businesses to make informed decisions about energy procurement, pricing strategies, and capacity planning.

In this project, we aim to use **Shiny App** to explore the wholesale electricity price trends in Europe from 2015 to 2023 and the impact of the ongoing war between Russia and Ukraine on electricity prices. Using a dataset of daily wholesale electricity prices, we will analyze the overall trends, seasonal patterns, and price comparisons across different countries in Europe. Additionally, we will use various visualization techniques and forecasting models to provide insights into future electricity price trends, which can help businesses and analysts make informed decisions about their energy strategies.

2. MTHODOLOGY

The dataset used was the "European wholesale electricity price data" from EMBER. It contained information on daily wholesale electricity prices among all countries in Europe From Jan 2015 to Jan 2023.

To visualise the trends and patterns in electricity prices over time, we used **line charts**, **horizon plots**, **cycle plots** and **calendar heatmaps**.

Next, in order for our audience to quickly identify areas of high or low pricing and understand how prices vary geographically across the continent, we also used geographic map visualisation.

Lastly, a **time series forecast** was conducted on the historical data provided, in order to forecast future price changes in different countries. We used Prophet and ARIMA models to generate different forecasts for comparison.
Prophet is a forecasting tool developed by Facebook's Core Data Science team. It is designed to model time series data with seasonality, holidays, and other recurring effects. Prophet uses a decomposable model, meaning it models seasonality, trends, and holidays separately, and then combines them to create a forecast. It also includes a number of customizable parameters, such as growth and changepoints, that allow users to tailor the model to their specific data.

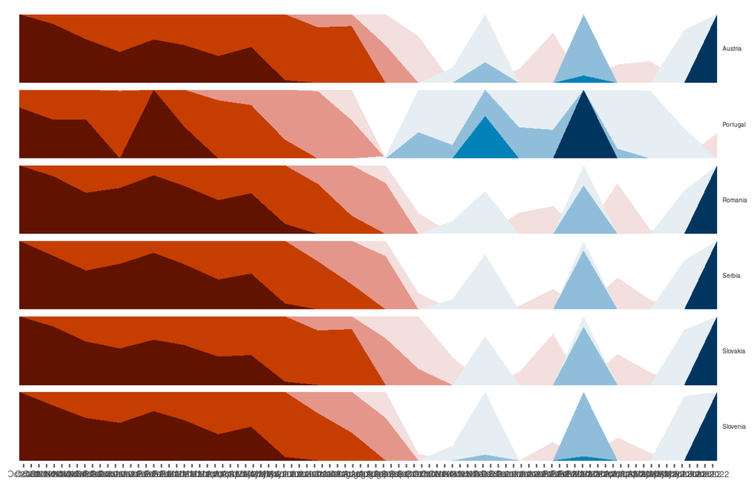
ARIMA (AutoRegressive Integrated Moving Average) is a popular statistical model used for time series forecasting. ARIMA models are based on the idea that the future values of a time series depend on its past values, as well as any random error terms. ARIMA models are typically represented as ARIMA(p,d,q), where p is the order of the autoregressive part, d is the degree of differencing, and q is the order of the moving average part. ARIMA models can be effective for modeling time series with trend, seasonality, and other patterns.

Both Prophet and ARIMA have their strengths and weaknesses and can be appropriate for different types of time series data. It's important to carefully evaluate the characteristics of your data and choose the model that best fits your needs.

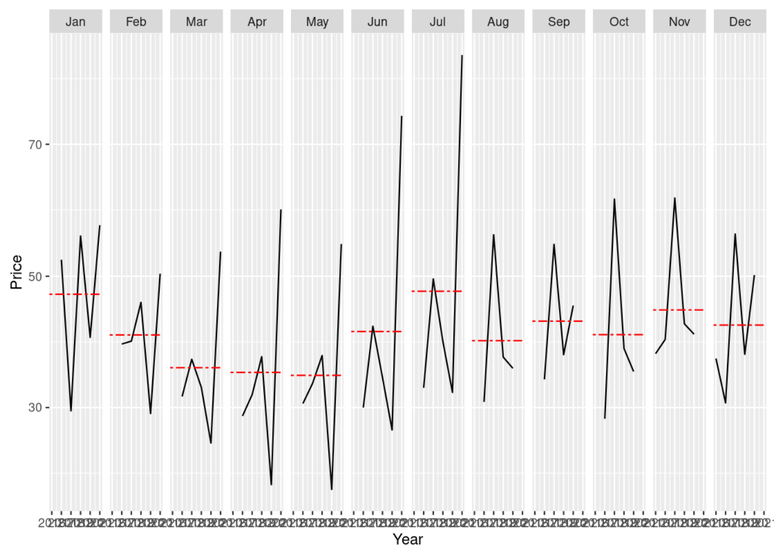
R was used for the data processing, statistical analysis and development of the web application.

3. RESULTS

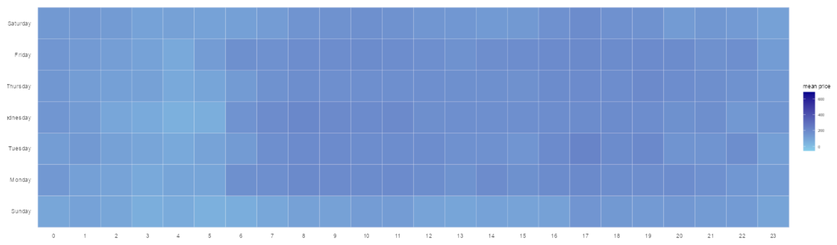
3.1 REGIONAL INSIGHTS



Monthly cycle plot



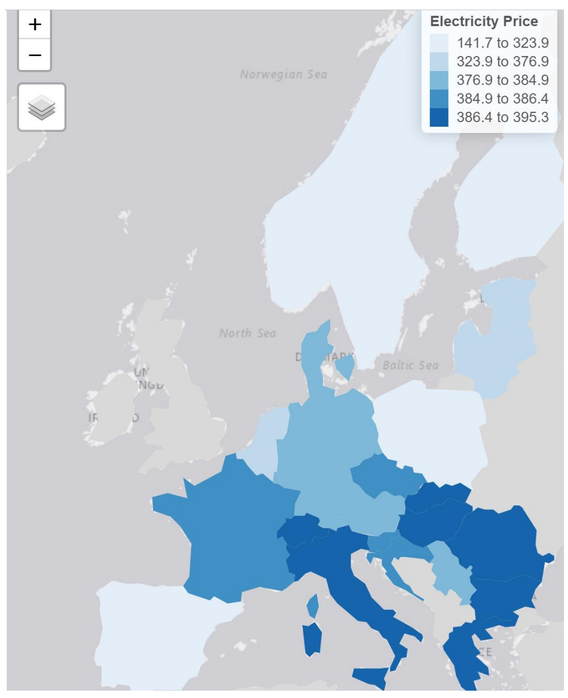
calendar heatmaps for 24 hours in weekdays



3.2 GEO-VISUALIZATION

Tmap package

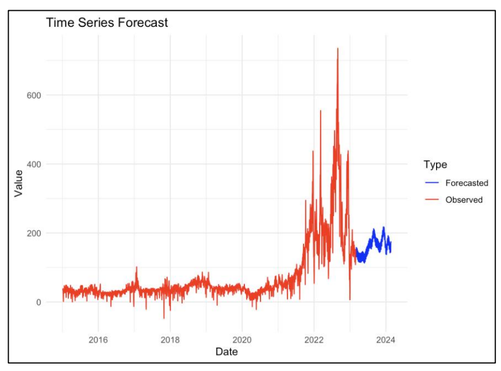
Our datadet 'World is a spatial object of class sf from the sf package; it is a data.frame with a special column that contains a geometry for each row, in this case polygons.

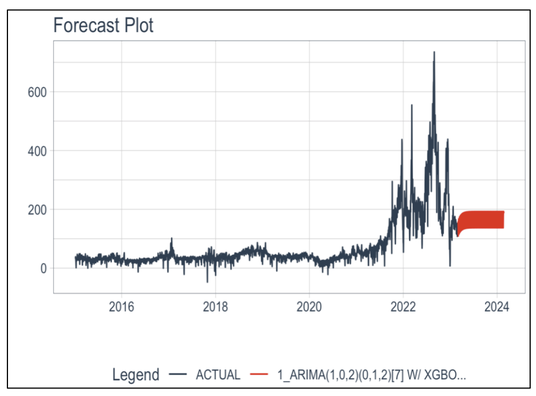


3.3 PREDICTIVE ANALYSIS

Upon examining the historical data and forecast plots depicted in the left and right plots below, we can observe that the Prophet and auto ARIMA models were utilized respectively. It is evident that the electricity price forecast for the next 365 days is expected to remain relatively stable. This is likely due to the fact that after experiencing a significant price surge in 2021 and 2022 as a result of the ongoing war between Russia and Ukraine, the electricity price has dropped to nearly one-quarter of the peak level and has remained stable for over three months. As a result, the forecast indicates that this trend is expected to continue and the price of electricity is likely to remain stable in the next year.

Prophet





Auto ARIMA

4. FUTURE WORK AND CONCLUSION

In the future, there are several areas that could be explored to further understand the impact of the ongoing war between Russia and Ukraine on electricity prices in Europe. Post-war effects may continue to impact electricity prices, and it would be important to monitor these changes and identify any new patterns or trends that may emerge.

In addition, the trend towards a clean energy transition in Europe is likely to have a significant impact on electricity prices in the future. As countries continue to adopt renewable energy sources and phase out traditional fossil fuels, this is likely to have implications for the overall supply and demand dynamics of the electricity market and may lead to changes in pricing patterns.

Further research and analysis will be needed to fully understand the complex and dynamic factors influencing electricity prices in Europe, including the post-war effects and the transition to clean energy sources. By continuing to monitor and analyze the data, businesses and analysts can make informed decisions about energy procurement, pricing strategies, and capacity planning, and remain competitive in an increasingly complex and unpredictable energy landscape.