Electricity Price Prediction

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GitHub Link: https://github.com/ColonelGeneral/ElectricityPricePrediction

Introduction

Electricity price prediction is a crucial task in the energy sector, impacting economic planning and energy marketing. Appropriately forecasting electricity prices helps utilities in demand planning, pricing strategies, and operational decision-making. In recent years, machine learning and data-driven techniques have significantly improved the accuracy of electricity pricing forecasts.

Data Overview

The data utilized for this project uses day by data of Electricity Usage per dates and is is derived from multiple datasets, including but not limited to

1. dataset_tk2.csv: This dataset contains actual electricity prices recorded across different dates, including various features influencing pricing such as consumption levels, temperature, and other factors. Each row in the dataset represents electricity prices at specific timestamps.

2. describe3.csv: This file seemingly provides statistical descriptions of the data, which may aid in understanding distributions, correlations, and underlying patterns in the features influencing electricity price.

The dataset spans various dates (e.g., from January 2019 to December 2020) and includes features including but not limited to:

- Date and Time

- Price readings (from multiple sources)

- Additional environmental factors (e.g., temperature)

Sample Data Entries:

- Date: 06/08/2019

    - Prices: 259.3, 196.1, …

The datasets collectively provide a comprehensive framework for exploring historical price movements and developing predictive models.

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Methodology

Data Preprocessing

Data preprocessing is essential for ensuring high-quality input for modeling. Steps involved include:

- Cleaning: Removing any missing or erroneous entries.

- Normalization: Standardizing numerical values to aid model performance.

- Feature Selection: Selecting relevant features that have significant effects on price predictions to simplify the model and enhance interpretability.

Model Selection

For the prediction task, several machine learning models were evaluated, including:

- Linear Regression: A straightforward model for predicting continuous variables based on linear relationships.

- Decision Trees: Allowing for both regression and classification tasks, suitable for capturing non-linear relationships.

- Random Forests: Ensembles of decision trees, robust against overfitting, and effective for handling complex relationships in the data.

- Long Short-Term Memory (LSTM) Networks: A type of recurrent neural network (RNN) particularly effective for time series data, allowing the model to remember past sequences and patterns.

Model Training and Evaluation

Split the dataset into training and testing sets. The models were trained on the training set and evaluated on the testing set using metrics such as:

- Mean Absolute Error (MAE)

- Root Mean Squared Error (RMSE)

- R-squared (R^2) for assess predictive power

Results

The performance of different models varied significantly:

- Linear Regression produced acceptable results but struggled with non-linear trends.

- Decision Trees and Random Forests provided better accuracy due to their ability to model complex interactions.

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Graphs and tables comparing observed vs. predicted prices showed significant trends, indicating the potential for reducing forecast errors with the right modeling approach.

Conclusion

Electricity price prediction remains a complex yet highly significant area of research within AI and machine learning. The results of this study show that combining various machine learning techniques can yield more accurate forecasts, leading to better decision-making in the energy sector. Future work might focus on integrating more diverse datasets, including real-time environmental data and market trends, to improve prediction accuracy further.

This report contains crucial components to help convey the significance and methodologies relevant to electricity price prediction effectively.