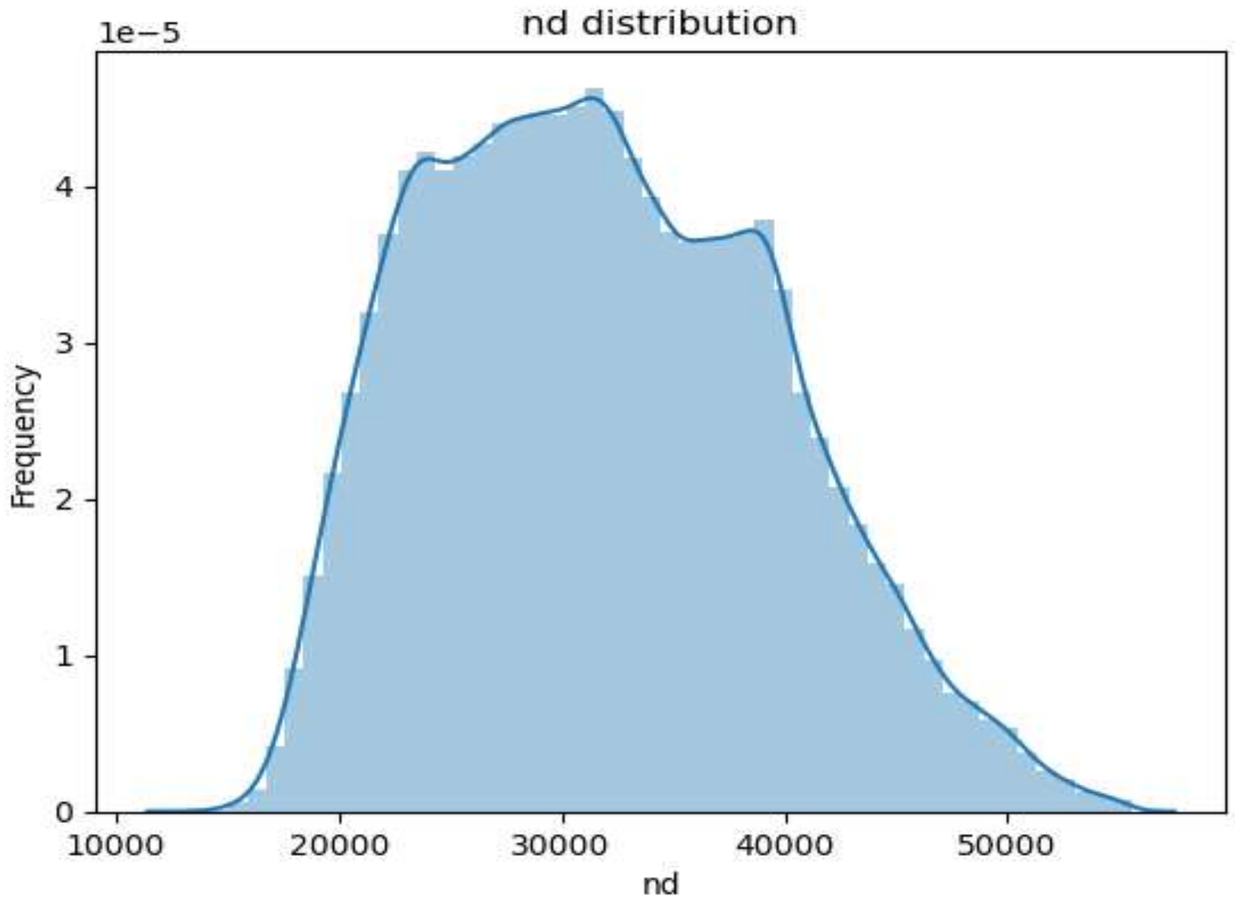
Utilities Auto-ML Case Study

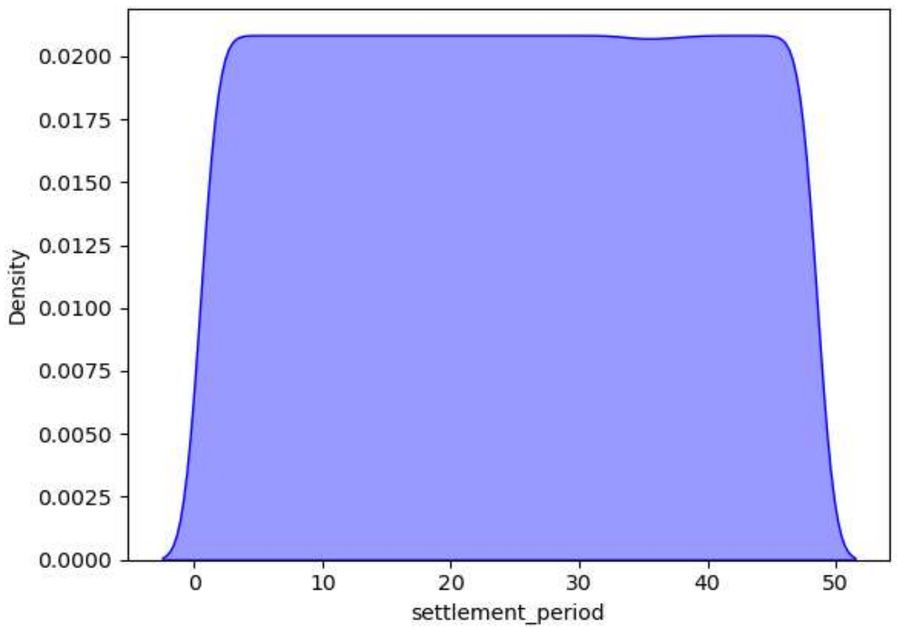
Energy utilities face a number of challenges in delivering reliable and affordable energy services to customers. One key challenge is optimizing the operation of the energy grid to ensure that energy is supplied efficiently and without interruptions. This involves managing the flow of electricity across the grid, predicting demand, and adjusting supply in real-time to match it. To address this challenge, energy utilities are increasingly turning to data science and machine learning to develop predictive models and algorithms that can help them optimize their operations.

The main goal of this project is to predict the national demand of electricity and find the features which determine the national demand of electricity.

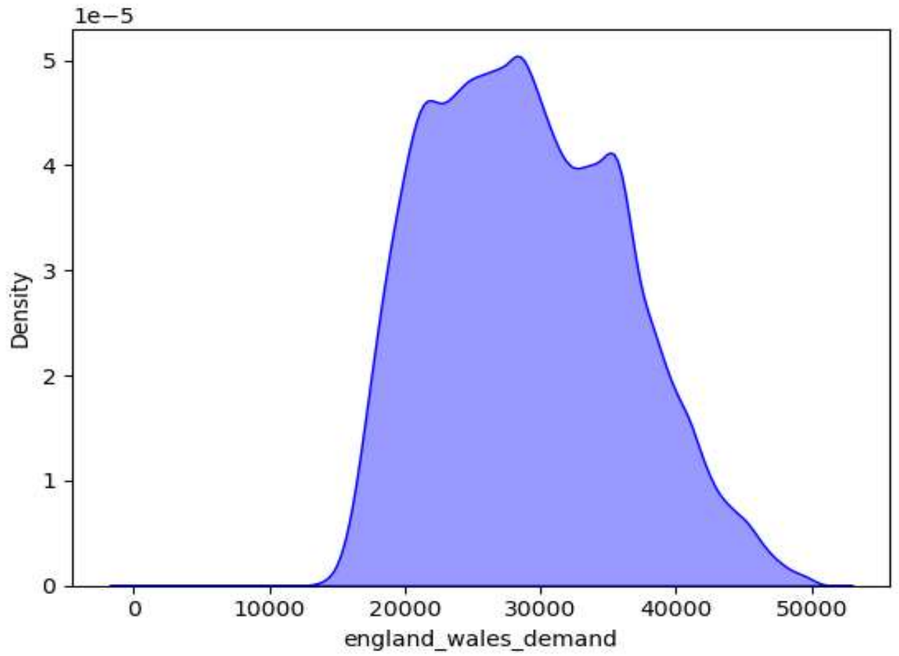


- The business feature used for this industry is ‘nd’ (National Demand of Electricity)
- National Demand is calculated as a sum of generation based on National Grid ESO operational generation metering (MW)
- The most nd distribution is in the range of 20000 to 40000

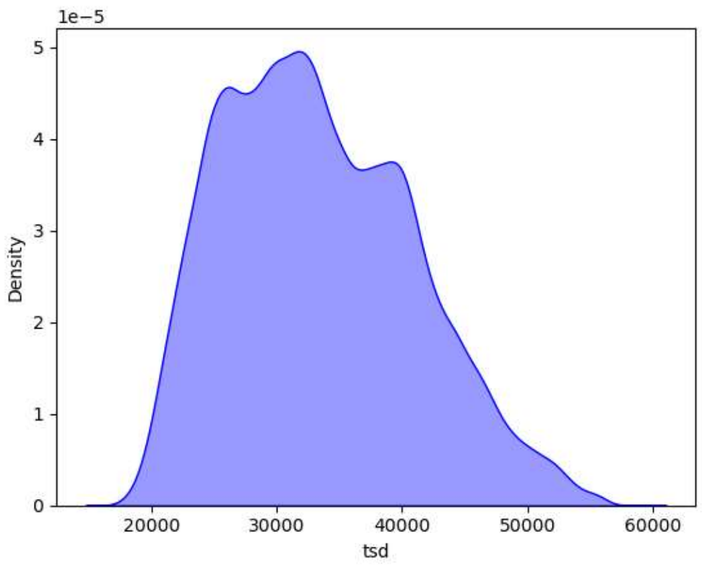
Features Responsible



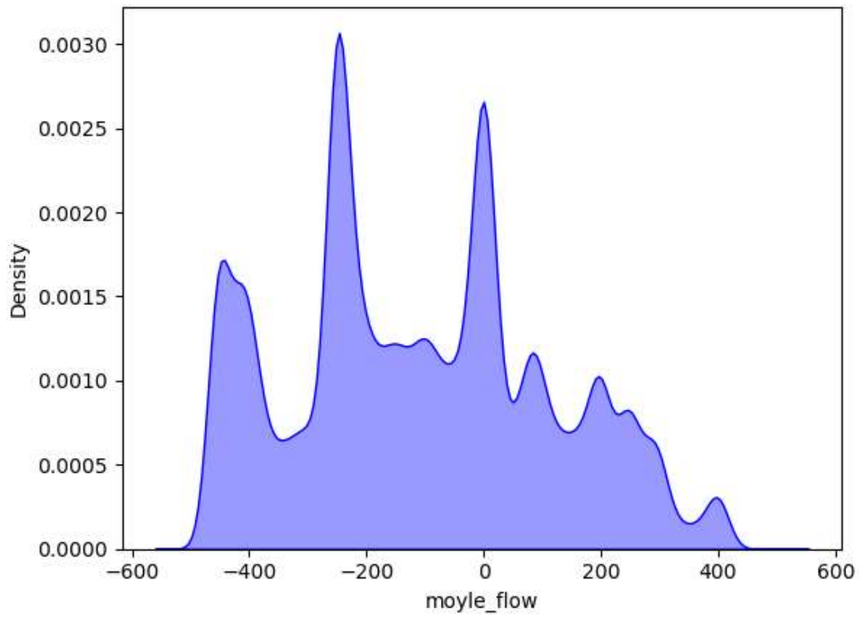
- **settlement_period** = half hourly period for the historic demand occurred
- The settlement period is shows to be done with 50 days



- **england_wales_demand** = England and Wales Demand, as ND above but on an England and Wales basis. Measured in MW



- **tsd** = Transmission System Demand is equal to the ND plus the additional generation required to meet station load, pump storage pumping and interconnector exports. Measured in MW.



- **moyle_flow** (Moyle Interconnector FLow) = The flow on the respective interconnector. -ve signifies export power out from GB; +ve signifies import power into GB. Measured in MW

Auto-ML Methodology Results

Algorithms	Test Accuracy (25 percentile)	Test Accuracy (50 percentile)	Test Accuracy (75 percentile)	Test Accuracy (90 percentile)
Lasso	99.8	99.8	99.8	99.9
Random Forest	99.9	99.9	99.9	100
XGBoost	99.9	99.9	99.9	100
MLP	99.9	99.8	99.9	100
RNN	98.79	74.58	99.29	99.41
Total Features	5	9	13	16
Avg. Accuracy	99.658	94.796	99.758	99.862

- **Based on our observation from the standard ML algorithms, 90th percentile has the best average accuracy.**
- **XGBoost, Random Forest and MLP as the best performing algorithm accuracy with 100% accuracy in 90 percentile.**

Conclusion

Auto-ML models can analyze historical data on energy consumption patterns and use this information to forecast future demand. This allows utilities to better anticipate spikes in demand and adjust their supply accordingly, reducing the likelihood of blackouts or brownouts. It can be used to detect faults in the energy grid and predict when maintenance is required. This allows utilities to fix problems before they cause service disruptions and reduces the need for costly emergency repairs. The dataset has 2,45,099 records with all 19 features as Numerical.

For regression, models were created with algorithms using Auto-ML techniques like Lasso, Random forest, XGBoost, Multilayer Perceptron and Recurrent Neural Network. With these models, performance measurement values were obtained for feature sets of 5, 9, 13 and 16. The Auto-ML algorithms were able to predict National Demand of electricity with an average accuracy between 94% – 100% and helped to identify factors that determine the national demand. The major factors include settlement_period, england_wales_demand, tsd and moyle_flow. The Random forest with 100 % accuracy in 90th percentile where tree showed a threshold of England wales demand>=41786 MW which leads to highest national demand of electricity.

Overall, Auto-ML models has the potential to help utilities improve the efficiency and reliability of their operations, reduce costs, and provide better service to their customers.