Time Series Based Prediction for Isolated Power Grid Energy Consumption

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Objective

- To predict the energy consumption of power grids, given wind, temperature, solar and humidity

Time Series Forecasting

- Similar to normal prediction where patterns and observations are analyzed
- Addition of a dependent historical time variable to account for

Models

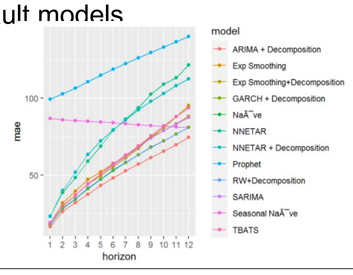
- Naïve, Snaive
- Seasonal decomposition
- Exponential smoothing
- ARIMA , SARIMA
- GARCH
- Dynamic linear models
- TBATS
- Prophet
- NNETAR
- LSTM

Analysis of Models on Univariate Datasets

- Accuracy of prediction from certain models are dependent on type of dataset
  - How many days are we predicting from?
  - How much variability does the data set have?

Key Points

- Any model + seasonal decomposition are usually more accurate than just using the default models



Multivariate Time Series Prediction

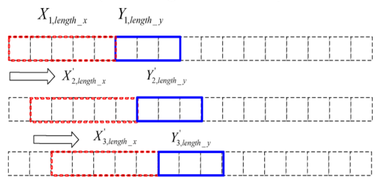
- Prediction that factors in the time component with multiple dependent tables of variables

Process

1) Data Preparation

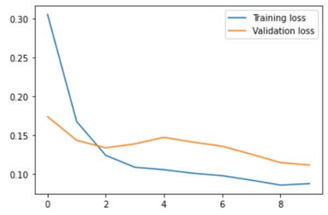
- Split the data into training and testing set (recommended: 70% split)
- Normalize the dataset to minimize redundancy and ensure that the features are weighted equally
- Apply sliding window for cross validation
  - Time series forecasting cannot use normal cross validation methods like k-fold, etc.
- Adjust the dataset for the needs for the model (reformat for input and output)

(sliding window)



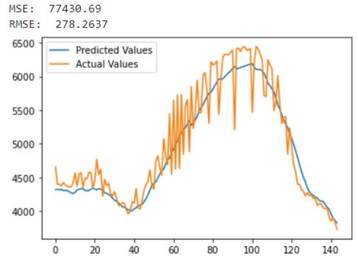
2) Fit the Model on the Training Set

- Choose a forecasting model and try to fit the training and validation loss
  - validation loss > training loss -> overfitting
  - validation loss < training loss -> underfitting
  - Validation loss = training loss -> perfect fitting



3) Use Model to Predict on the Testing Set and Evaluate

- Transform scalar back to normal form
- Plot the predicted results vs. actual results
- Use an error formula to compare between models
  - SSE
  - MSE
  - MAE
  - RMSE

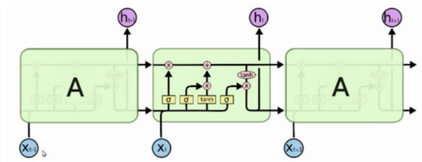


Multivariate Models of Focus

Long Short-Term Memory Networks (LSTM)

- Recurrent neural network (RNN) architecture
  - Have feedforwarding and feedbacking capabilities
  - Can process entire sequences of data, not only single data points
  - A unit is made up of a cell, an input gate, an output gate and a forget gate

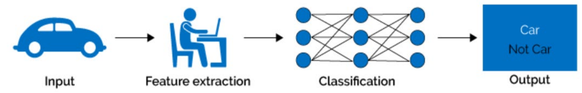
(wikimedia foundation)



(https://www.analyticsvidhya.com/blog/2021/03/introduction-to-long-short-term-memory-lstm)

Conclusion

- Time series data mining is useful in predicting things that are dependent on time (such as the weather)
- Best models are:
  - LSTM
  - ARIMA
  - Exponential smoothing
- Only sliding window works for time series for cross validation
- Accuracy is dependent upon the dataset, along with model



((https://towardsdatascience.com/why-deep-learning-is-needed-over-traditional-machine-learning-1b6a99177063)