Probabilistic Forecasting using Deep Neural Networks

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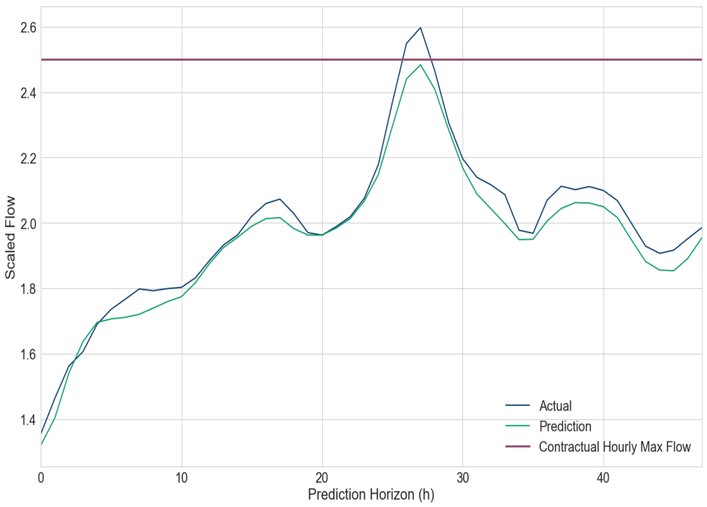
Problem Statement

- How do I generate better probabilistic forecasts for natural gas demand?
- How can I use the new available technologies to generate these predictions?

Business Problem

- Want to avoid penalty
- Want to keep flow below contractual maximum



Why Deep Learning?

- Excellent results with Natural Language processing
- Successful in image captioning
- Good results for wind[1], solar[1] and electricity[1] forecasts

Why Probabilistic Forecasts?

- Show a range of possible values
- More helpful to diagnose point forecast[4]
- Better visualization possible

Evaluation Metric

Pinball Loss Function

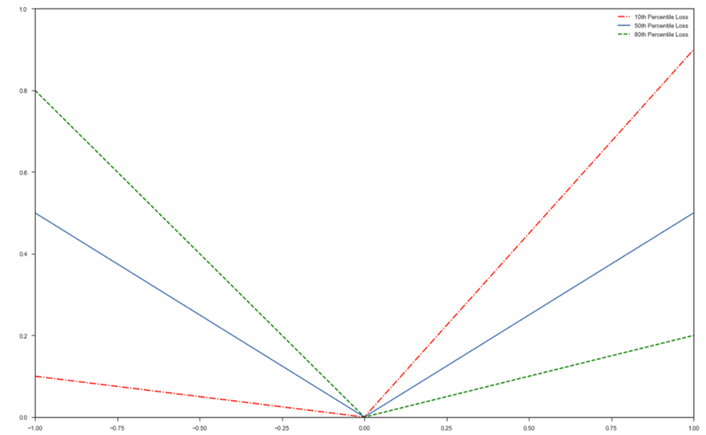
$$L(y_\tau, z; \tau) = \begin{cases} (y_\tau - z)\tau & y \geq z \\ (z - y_\tau)(1-\tau) & z > y \end{cases}$$

$$L_{avg} = \frac{1}{99}\sum_{n=1}^{99} L(y_{n/100}, z; n/100)$$

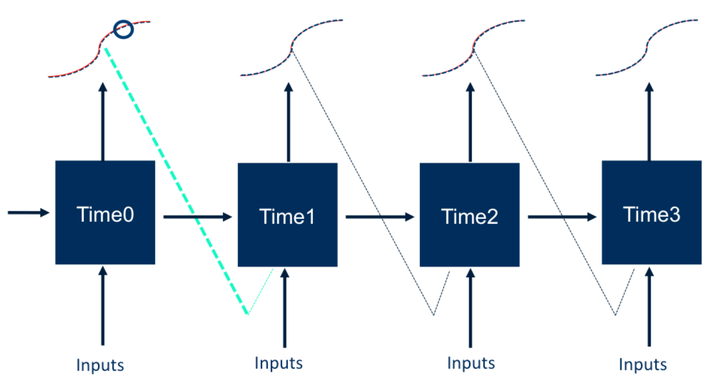
y_τ : predicted value for quantile τ

z : actual value

τ : quantile of prediction

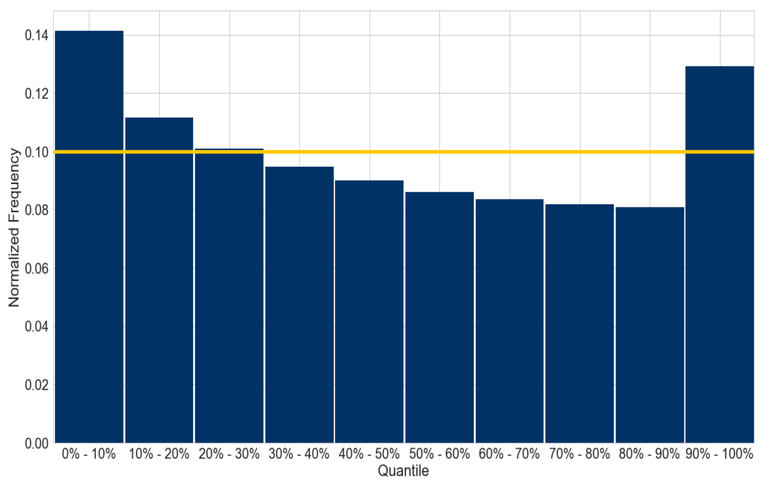


Proposed Method



- Autoregressive recurrent network
- LSTM cells
- Random Sampling from previous outputs

Result



Result using Graphical Calibration Score[2]

Conclusion

- Deep learning-good for natural gas probabilistic forecasts
- Good results in general
- Peculiar results for last two years of data

Acknowledgements

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References

[1] Din Gulam Mohi Ud, and Angelos K. Marnerdies. Short term power load forecasting using Deep Neural Networks - IEE Explorer Document

[2] Saber, “Quantifying forecasting Methods”, unpublished dissertation