Blending as a Time Series Forecasting Tool

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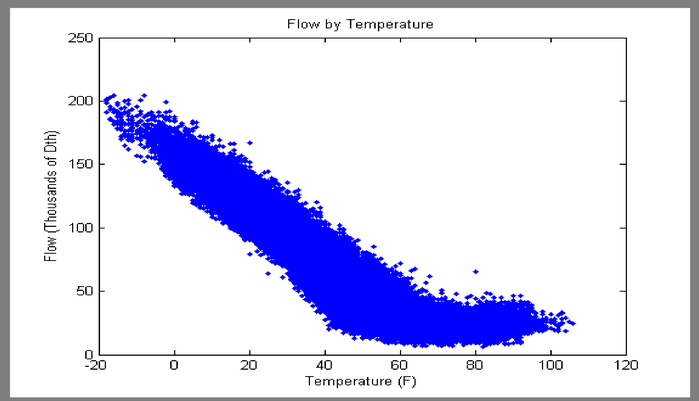
Background

Regression models are constructed using a process known as ordinary least squares.

Regression models are much better at making forecasts on extreme data than other Types of forecasts.

Artificial neural networks use high powered computers and back propagation to create nonlinear modeling functions.



$$heatingdegree = max(0,65 - temp)$$

Problem

Improve hourly gas flow forecasting accuracy by combining multiple forecasting strategies at multiple time horizons

Importance

Hourly gas flow forecasts allows for efficient continuous operation

Saves companies and consumers money

A generalized forecasting improvement tool benefits anyone making multi-horizon forecasts

Current Method

GasDay Labs at Marquette University provides many forecasting services to natural gas utilities. One of these services is GasHour, which forecasts hourly gas flow.

GasHour takes advantage of the near linearity between temperature and gas flow as well as otherweather and time inputs.

GasHour makes forecasts up to 106 hours ahead using 106 distinct models for each time horizon

Proposed Method

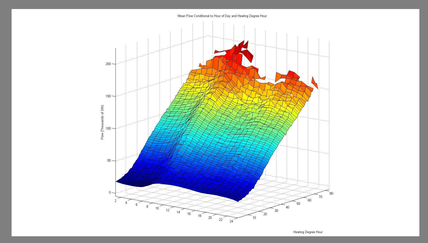
Combine daily profile and multi-horizon model over multiple time horizons

Daily Profile

Construct mean flows table by averaging flows with at the same hour of day and heating degree

Determine heating degrees and hours of forecast data

Use mean flows table and heating degrees and hours to produce mean daily profile



Blended Model

Use first n-2 years to generate multi-horizon regression forecasts for last two years

Use forecasts from last two years to train a neural network

Generate current forecasts and use as inputs for neural network to obtain blended forecast

Future Work

Incorporate more forecasts into the blended model

Improvements to daily profile

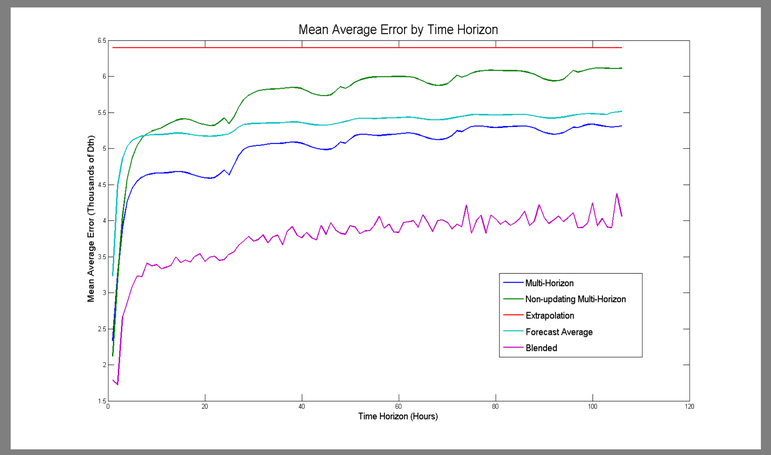
Faster implementation (parallelization)

Further testing on more data

Apply to entirely different multi-horizon time series forecasts

Analysis

Used software to produce predicted flows based on the multi horizon model, daily profile model, an extrapolation model, a model which simply averages the models and then the blended model.



All errors are less than the extrapolation forecast

Updating the parameters of the multi-horizon forecast at every hour decreases the error significantly

Averaging the forecasts is better than non-updating multi-horizon

Blended forecast decreases error by 30%

Results are similar with different natural gas data

Conclusions

For natural gas hourly forecasting, blending offers a substantial increase in accuracy over both equal averages and straight multi-horizon forecasting

Error appears to be leveling off

An MAE between 3 and 4 is still significant

Special Thanks

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References

Francis X. Diebold. 2006. *Elements of Forecasting*. South-Western College Publishing.

Brian M. Marx. 2007. *Fitting a Continuous Profile to Hourly Natural Gas Flow Data.* Marquette University.