Are Load Forecasters Rational?

A Statistical Analysis of Electricity Demand Forecasts Issued by the New York Independent System Operator

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Acknowledgments and Disclaimer

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DISCLAIMER: *These results are tentative.*

Outline

Introduction: NYISO's load forecasts

Each day, NYISO releases forecasts of load in each of its service regions, by hour, out to six days ahead.

Thus, for each date and hour, initial forecast is updated several times.

QUESTION: Is the process *rational*?

(What does that mean?)

The concept of *rational forecasting*

Basic idea: "Call it like you see it. Don't hold information back."

Each announced forecast provides best estimate available at that time.

Direction of subsequent updates should be *unpredictable*.

"Best estimate of tomorrow's forecast is. . . today's forecast."

Reasons to be "irrational"

- Avoid "windshield-wiper effect"
- Forecaster anticipates user's risk-aversion
- Forecaster's cost of error is asymmetric in sign of error

Formal definition of rationality in forecasting

Rationality, as described above, implies testable implications — a characteristic statistical signature.

Formal definition has two parts:

- Unbiasedness: Each forecast is an unbiased estimator of the corresponding future observation.
- Uncorrelated errors: There should be no correlation between errors in forecasts valid for the same target date.

Note: Rationality is a characteristic of a forecasting *process*.
(It makes no sense to speak of whether a single forecast is "rational".)

Objectives

GOAL: Determine whether NYISO's load forecasting process is rational, in this statistical sense.

(Note that, if it is *not* rational, then one could correct for the irrationality to yield a forecasting process that had lower RMSE.)

Methods

How do we do that? Pretty simple:

1. Download historical load forecast data from NYISO web site.
2. Do a little arithmetic to translate forecast process into error process.
3. Check for bias.
4. Check for auto-correlated errors.

Data

For NYC region of NYISO grid:

- Observed load, hourly
- Forecast load, hourly, for all hours from day-of through 5-day-ahead.

Forecasts issued daily, hence each target hour is forecast six times.

Period of record: 31 January 2005–31 May 2008.

Analysis focused on demand during peak load hour of 5:00–6:00 p.m. — likely to be most sensitive to weather, hence greater volatility in forecast series.

Checking for bias

Means and Standard Deviations of Successive Forecast Adjustments

Forecasts Issued by the New York Independent System Operator of Peak Load Electricity Demand in New York City February 2005 -- May 2008

	Mean (MW)	Standard Deviation (MW)
5-day to 4-day Forecast Adjustment	11.30	193.54
4-day to 3-day Forecast Adjustment	0.65	153.38
3-day to 2-day Forecast Adjustment	6.34	155.85
2-day to 1-day Forecast Adjustment	18.39	163.89
1-day to Day-of Forecast Adjustment	22.21	161.36
Day-of Forecast and Realized Load Difference	17.17	271.62

Table 1: Means and standard deviations of successive forecast adjustments issued by the New York Independent System Operator. The data series used includes forecasts of electricity load (in MW) for New York City during the peak load hour of 5:00-6:00 p.m. issued over the period February 2005—May 2008. High standard deviations result from extreme forecast adjustments in both the positive and negative direction. All means are positive indicating possible bias in the forecasting system used by the New York Independent System Operator
Source: New York Independent System Operator (www.nyiso.com); authors' calculations.

Updating process appears to show small positive bias.

Checking for correlated errors

Table: Coefficients of variation between successive forecast updates

	0–obs	1–0	2–1	3–2	4–3	5–4
Day 0 – obs	1.00					
Day 1 – day 0	0.00	1.00				
Day 2 – day 1	0.03	**0.19**	1.00			
Day 3 – day 2	0.07	0.11	0.02	1.00		
Day 4 – day 3	0.08	0.06	0.05	-0.04	1.00	
Day 5 – day 4	0.03	0.04	0.08	0.04	0.05	1.00

Boldfaced cell is statistically significant at the 5% level.

Summary of results

1. *Forecast updates are biased.* Forecast updating process exhibits predictable upward drift.

2. *Updating process exhibits some positive autocorrelation.*

In sum: NYISO load forecasting process does not appear to be rational. Forecast updates are partially predictable from earlier forecasts.

What could explain these patterns?

Boring possibilities:

- We've made a mistake somewhere (unlikely).
- NYISO's forecasts are simply mis-calibrated.
- There's something peculiar about New York City.

More possibility: forecasters avoiding "windshield wiper".

Most interesting: Forecasters are optimizing with respect to an asymmetric cost function (not, e.g., RMSE).

This last possibility appears to be consistent with NYISO's incentives that make costs of error lower for under-estimating load than over-estimating.

Larger implications

What are forecasters supposed to be doing?

- Report best estimate, “play it as it lays”?
- Or adjust forecasts according to perceived users preferences, risk aversion, updating costs?
- If so, how to address heterogeneity between users in preferences, and capacity to “un-adjust”?

I say: Explicitly disentangle the forecasting problem (“What’s going to happen?”) from the decision problem (“What should we do about it?”).

- Give the best available *probabilistic* forecast.
- Treat the translation into a decision as a separate analytic challenge.

Thanks!

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