



# Challenges in forecasting peak electricity demand

Part 2

Rob J Hyndman

Challenges in forecasting peak electricity demand

1

## Challenges

- 1 How to evaluate forecast distributions**
- 2 How to select the best forecasting method**
- 3 How to account for off-grid generation**
- 4 How to use smart metre data and network data when forecasting**
- 5 How to improve forecasts**

Challenges in forecasting peak electricity demand

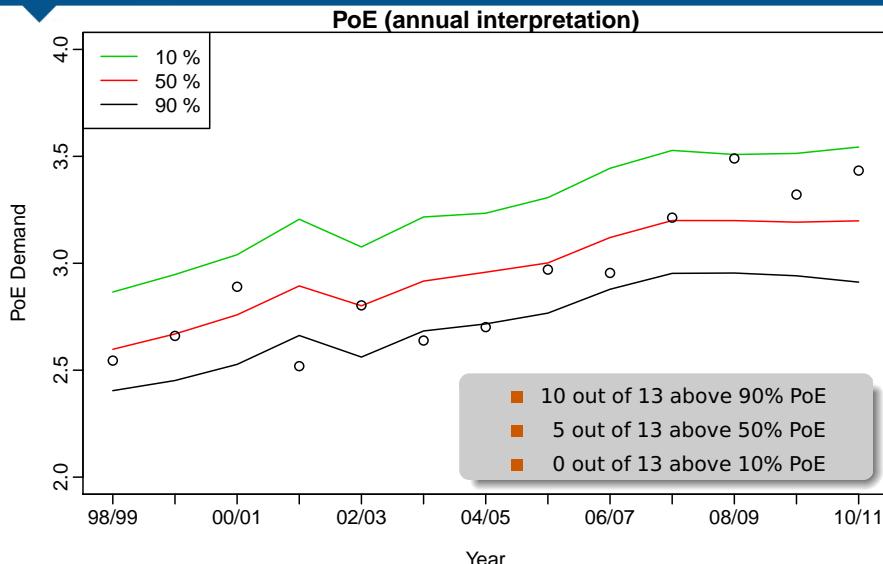
2

## Forecast accuracy measures

- MAE: Mean absolute error
- MSE: Mean squared error
- MAPE: Mean absolute percentage error

- ➔ Good when forecasting a typical future value (e.g., the mean or median).
- ➔ Useless for evaluating forecast percentiles (probability of exceedance values) and forecast distributions.

## Evaluating forecast distributions



Challenges in forecasting peak electricity demand

How to evaluate forecast distributions

4

## Evaluating forecast distributions

$Q_t(p) = \text{PoE of } y_t, \text{ to be exceeded with percentage } p.$

$G(p) = \text{percentage of times } y_t \text{ greater than } Q_t(p) \text{ in the historical data.}$

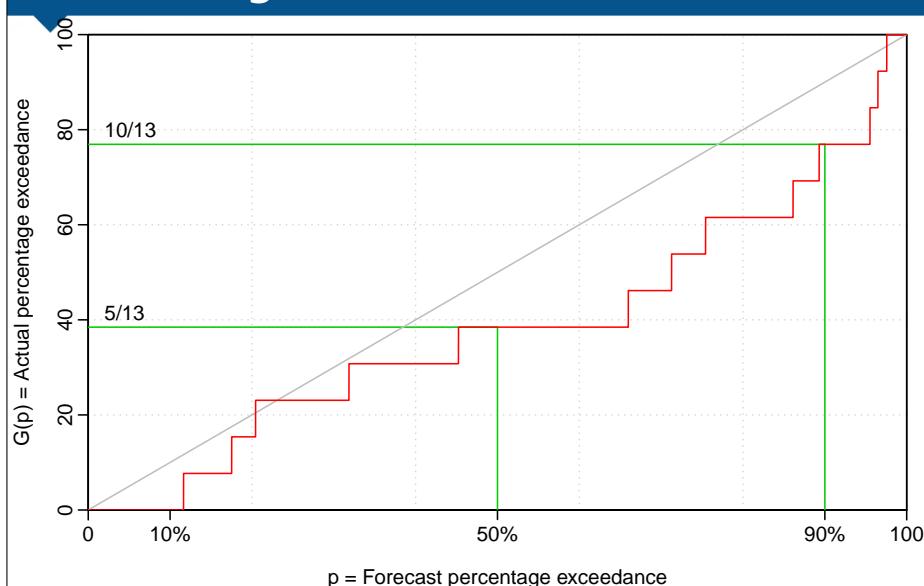
If  $Q_t(p)$  is accurate, then  $G(p) \approx p$

Challenges in forecasting peak electricity demand

How to evaluate forecast distributions

5

## Evaluating forecast distributions

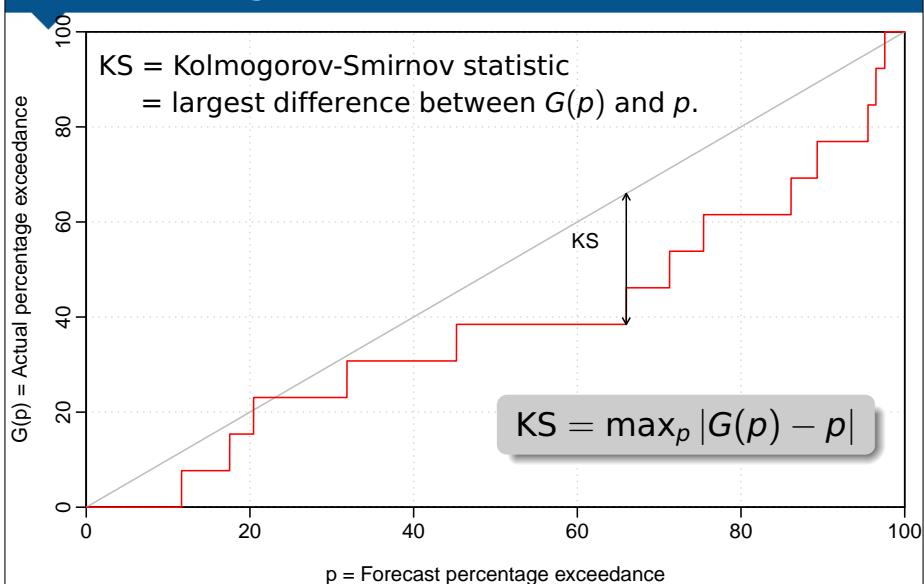


Challenges in forecasting peak electricity demand

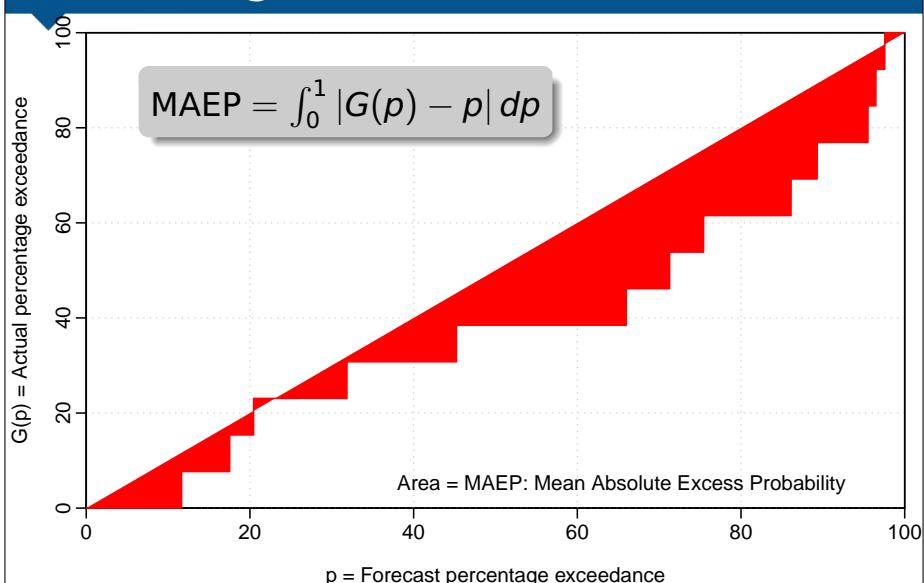
How to evaluate forecast distributions

6

## Evaluating forecast distributions



## Evaluating forecast distributions

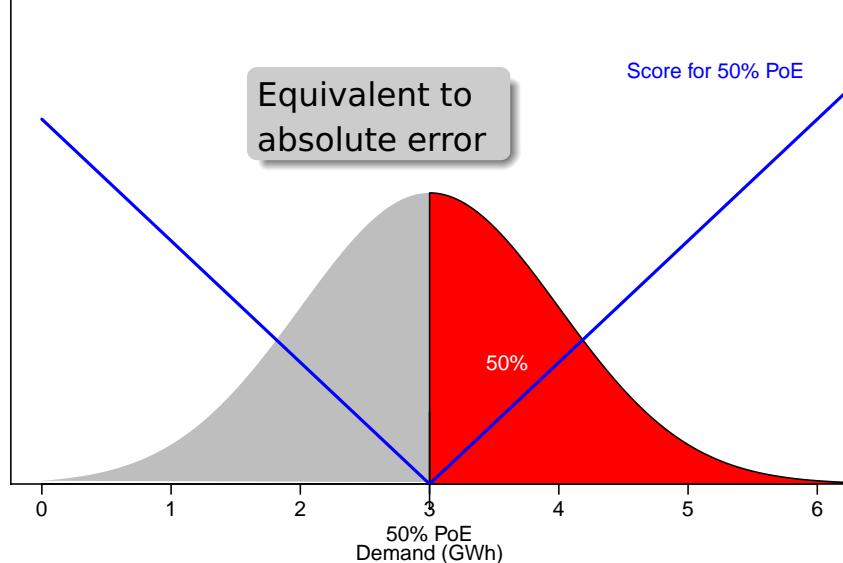


## Evaluating forecast distributions

- MAEP more sensitive and less variable than KS.
- Weekly or monthly maximums are better because there are more of them to evaluate.
- What is a good value of KS or MAEP?
- We could restrict the range of  $p$  to “interesting” values such as  $p > 0.5$ .
- These only measure **whether** the PoEs were exceeded, not **how much** they were exceeded.

## Forecast scoring

Demand distribution



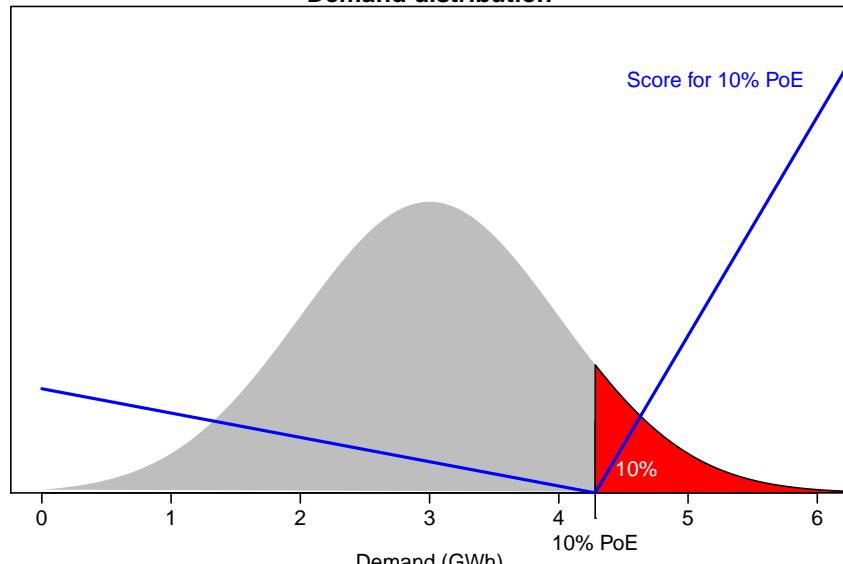
Challenges in forecasting peak electricity demand

How to evaluate forecast distributions

10

## Forecast scoring

Demand distribution



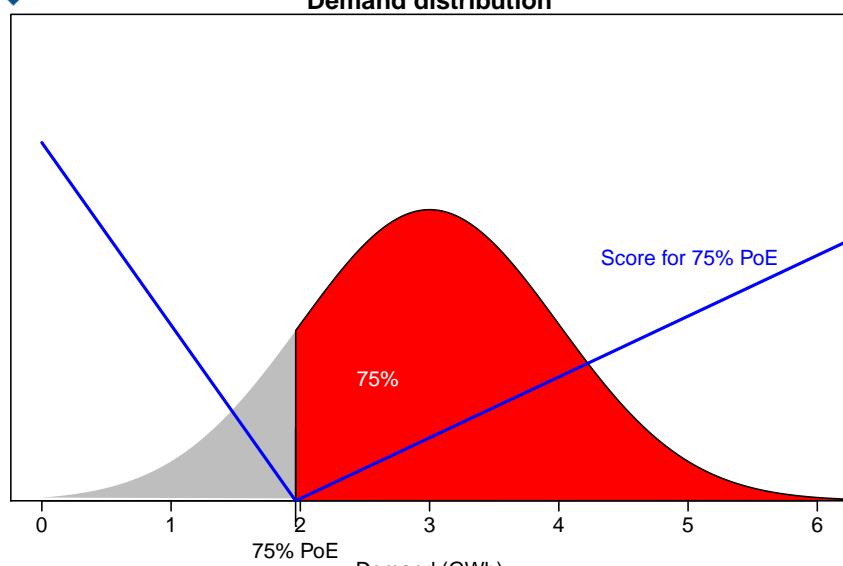
Challenges in forecasting peak electricity demand

How to evaluate forecast distributions

11

## Forecast scoring

Demand distribution



Challenges in forecasting peak electricity demand

How to evaluate forecast distributions

12



- Probabilistic forecasting of demand, price, wind, and solar.
- Forecasts to be submitted in the form of percentiles of future distributions.
- Accuracy measured by scoring.
- Rolling forecasts with incremental data update on a weekly basis.
- Prizes for student teams, and for best methods.
- Winning methods to be published in the IJF.

## How to account for off-grid generation?

- Locally generated power may not be recorded.
- But forecasts better if they are total demand.
- Need a model for PV generation that is linked to the model for demand.
- Better: measure the off-grid generation via smart metres.



## How to use smart metre data?



- Smart metre data allow prediction of usage at household level based on household characteristics: number of occupants, ages, etc.
- So we could build a model for individual usage, and scale it up for the entire network.
- How to allow for demand response?
- Need aggregate information on household characteristics for the network.
- Combine network and smart forecasts to improve accuracy

## Ten steps to improving your forecasts

- 1** Look after your data
- 2** Understand how your forecasts will be used
- 3** Find the right forecasting tools
- 4** Use appropriate accuracy measures
- 5** Do not set targets
- 6** Do not adjust dishonestly
- 7** Keep it simple, stupid
- 8** Combine forecasts
- 9** Share ideas and mix with other forecasters
- 10** Adopt a process of continuous improvement

## Some resources

### Blogs

- [robjhyndman.com/hyndtsight/](http://robjhyndman.com/hyndtsight/)
- [blog.drhongtao.com/](http://blog.drhongtao.com/)

### Organizations

- International Institute of Forecasters:  
[forecasters.org](http://forecasters.org)
- IEEE Working Group on Energy Forecasting:  
[linkedin.com/groups/  
IEEE-Working-Group-on-Energy-4148276](https://www.linkedin.com/groups/IEEE-Working-Group-on-Energy-4148276)

### Books

- Dickey and Hong (2014) *Electric load forecasting: fundamentals and best practices*,  
OTexts. [www.otexts.org/book/elf](http://www.otexts.org/book/elf)