

Uncertainty Estimation for High-dimensional Nonparametric Forecasting

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1 July 2025

Nonparametric forecasting

Sparse multiple index (SMI) model

Benchmarks

Forecast uncertainty

- Uncertainty of a forecast → **Prediction Interval (PI)**

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- Theoretical $100(1 - \alpha)\%$ prediction interval:

$$\hat{y}_{t+h|t} \pm z_{\alpha/2} \times \hat{\sigma}_h,$$

where

- ▶ y – time series y_1, \dots, y_T
- ▶ $\hat{y}_{t+h|t}$ – h -step-ahead point forecast for y_{t+h} given observations up to t
- ▶ $z_{\alpha/2}$ – $\alpha/2$ quantile of standard normal distribution
- ▶ $\hat{\sigma}_h$ – estimate of std. deviation of h -step forecast distribution

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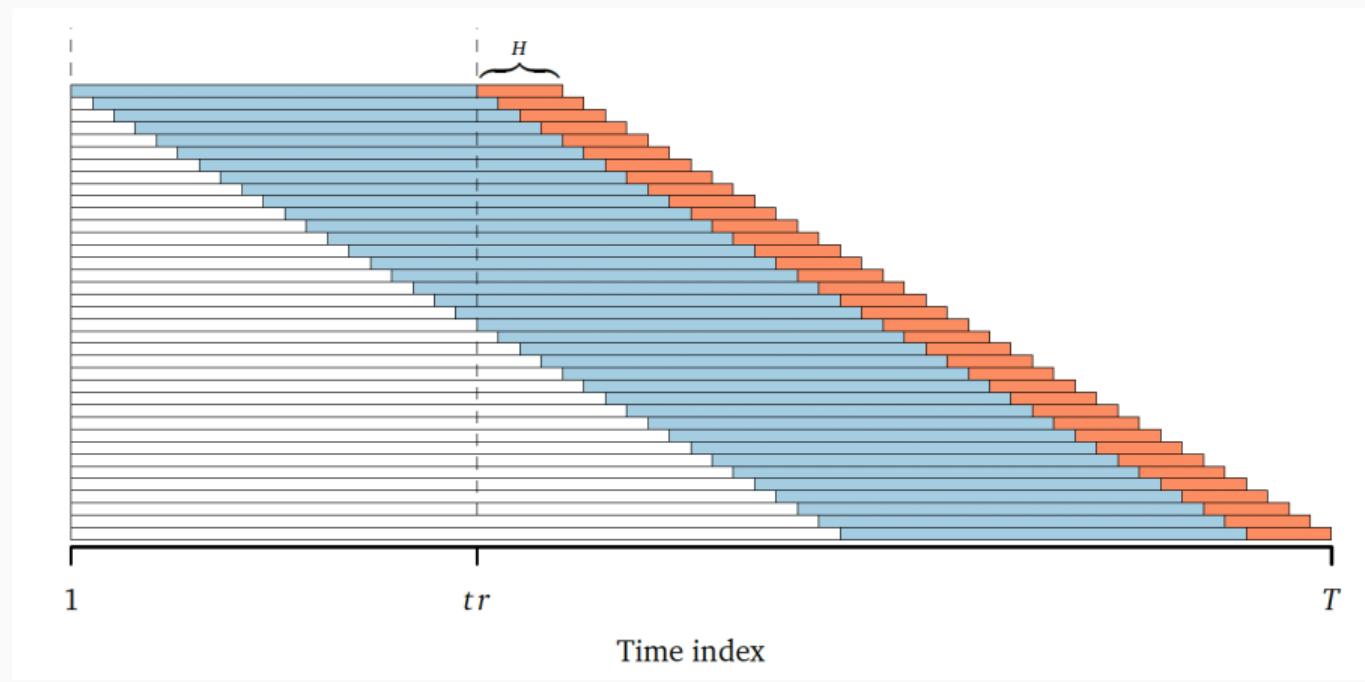
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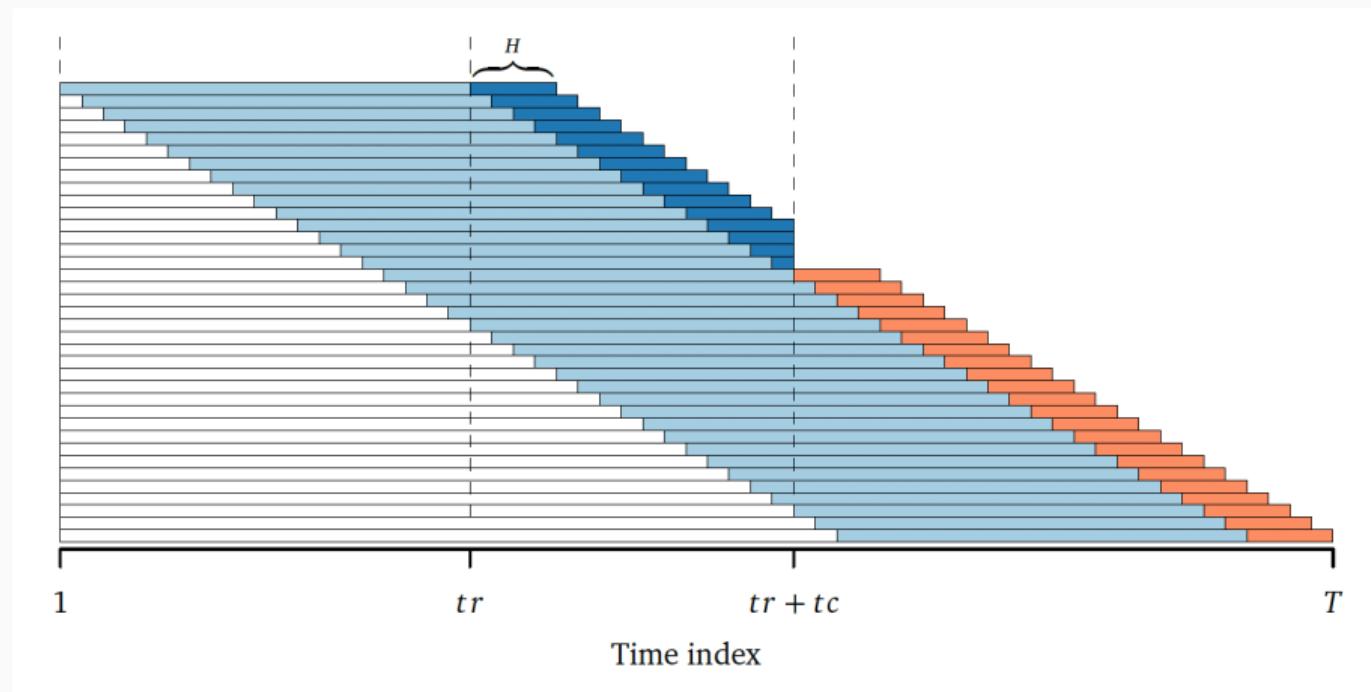
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- Main issue:
 - ▶ Difficult to analytically calculate h -step forecast variances for $h > 1$

Block bootstrap



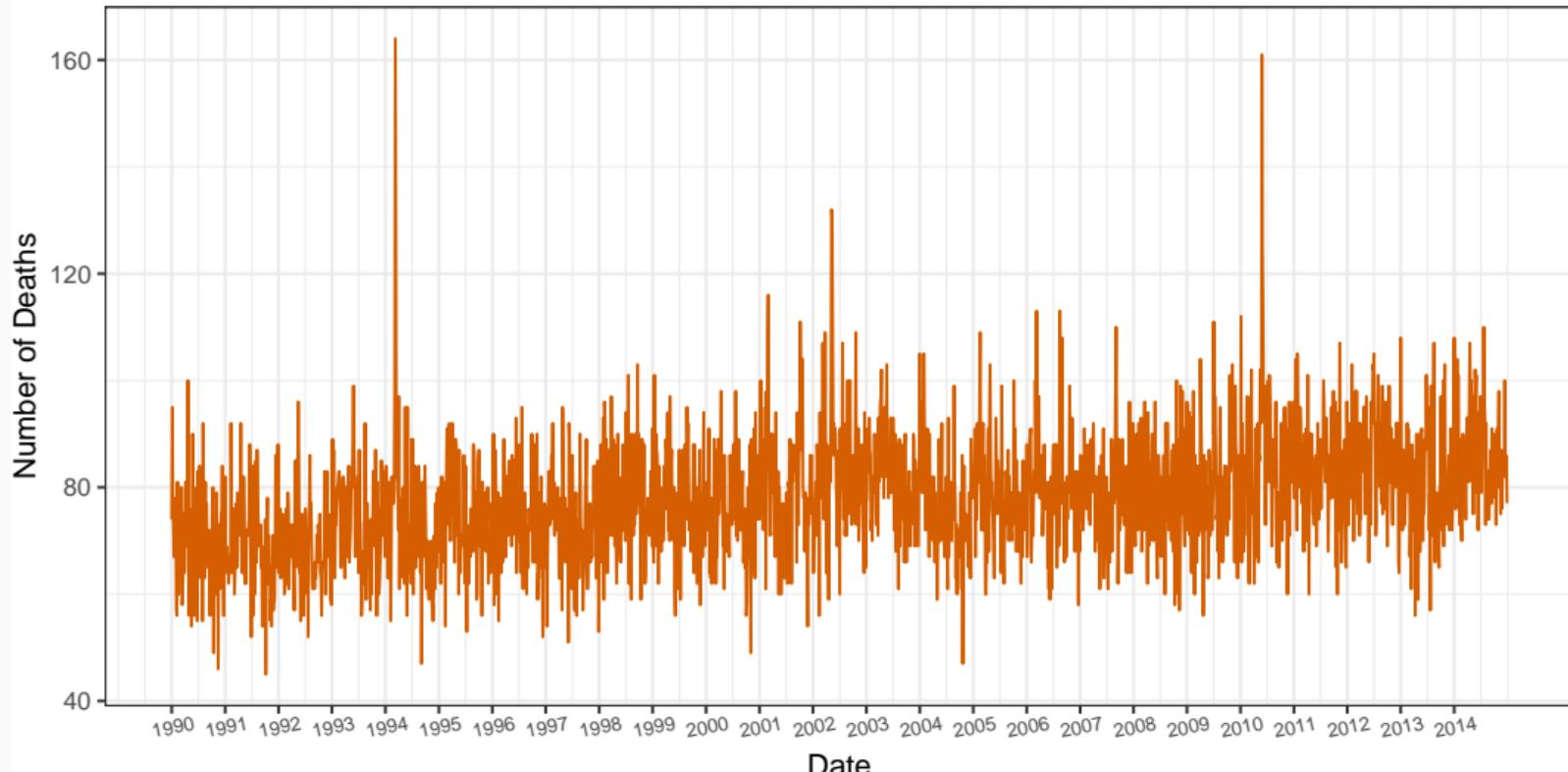
Conformal prediction



Conformal bootstrap

Forecasting heat exposure-related daily mortality

Daily Deaths in Summer – Montreal, Canada



Forecasting heat exposure-related daily mortality

Data

- **Response:** Daily deaths in Summer
 - 1990 to 2014 – Montreal, Canada
- **Index Variables:**
 - ▶ Death lags
 - ▶ Max temperature lags
 - ▶ Min temperature lags
 - ▶ Vapor pressure lags
- **Nonlinear:** DOS (day of the season),
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Data split

- **Training Set:** 1990 to 2007
- **Validation Set:** 2008
- **Test Set:** 2009 to 2014

Conclusion

i Summary of Results (work-in-progress):

- **Block Bootstrap** – Under-coverage; too narrow
- **Conformal Prediction** – Better achieves a target coverage, with acceptable sharpness



Limitations:

- Test set is not long enough for larger forecast horizons
- Hyper-parameter choices

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