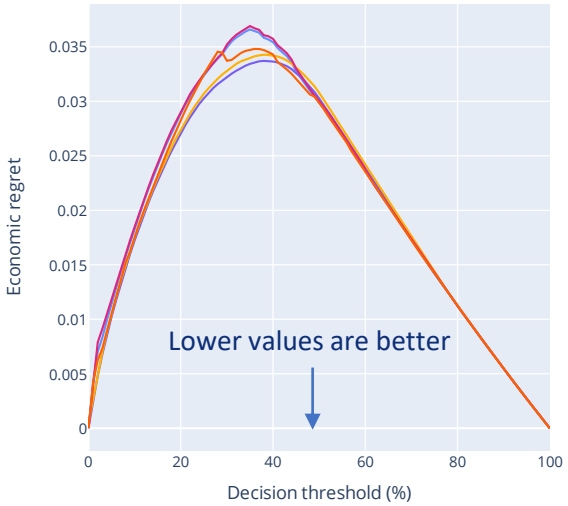
Evaluating probabilistic thunderstorm forecasts

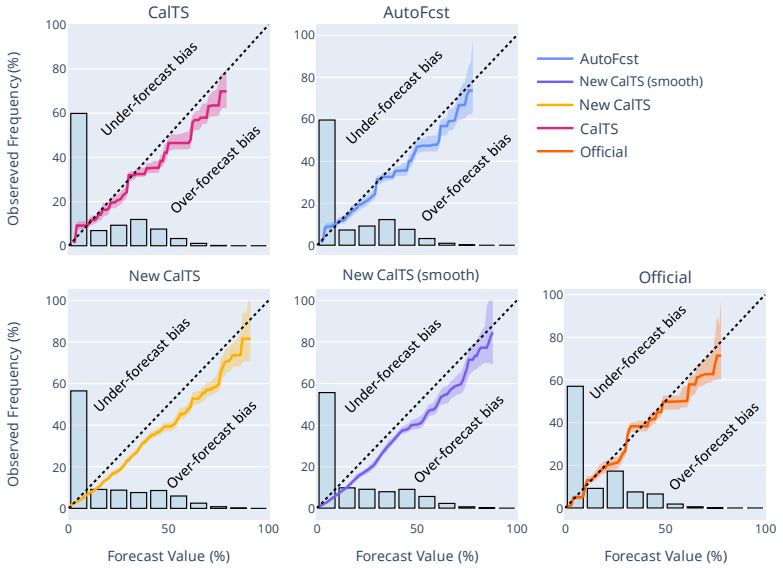
How three complimentary plots help us understand performance at user-decision thresholds

Murphy Diagram



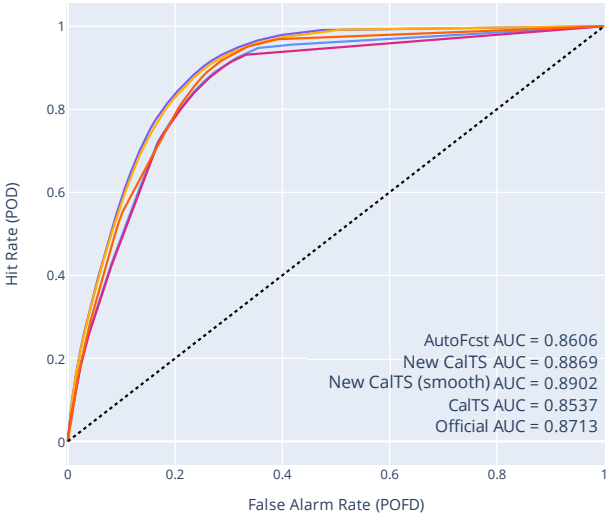
- The area under the Murphy Diagram is proportional to the Brier score.
- It shows which forecast system performs best at each user-decision threshold.
- A proper scoring function that focuses on key customer decision thresholds can be created by weighting the area under the curve.

Reliability Diagrams



- These curves show biases for each user-decision threshold.
- A calibrated forecast lies along the diagonal line.
- These diagrams are created using isotonic regression. This approach yields reproducible curves that do not depend on the choice of bins, unlike classical reliability diagrams.
- Confidence intervals are generated via block bootstrapping.

ROC Curve



- The ROC curve measures discrimination ability and not overall performance.
- Larger area under the curve indicates better discrimination ability.
- The ROC curve is calculated on forecasts recalibrated via isotonic regression. This ensures that the ROC curves are concave.

- To understand the differences in performance for key user decision thresholds, we can calculate the difference in the murphy curves between two forecast systems and convert it to lead days of skill.
- Decision thresholds 10% and 30% are key thresholds for thunderstorm forecasting.
- Forecasters clearly perform better at the 10% decision threshold compared to the automated alternative.

Data – Lead day 1 over the entire Australian region Summer 2022-2023

- Observations = WZTLN (lightning within 10km radius of point)
- CalTS = Production Calibrated Thunder (probabilistic thunderstorm guidance)
- Official = The official Bureau forecast
- AutoFcst = The automated alternative to the official Bureau forecast. It is a smoothed version of CalTS.
- New CalTS = hindcast of the new Calibrated Thunder version in development
- New CalTS (smooth) = The new CalTS with a smoothing filter.

Nicholas Loveday – nicholas.loveday@bom.gov.au

This work was inspired by https://arxiv.org/abs/2301.10803