

# Seminar Statistical Forecasting and Classification

## WS 2021/22

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Tuesday 14:00–15:30, SR 0.016, Geb. 20.30

### Overview

A common desire of all humankind is to make predictions for an uncertain future. Clearly then, forecasts ought to be probabilistic, i.e., they ought to take the form of probability distributions over future quantities or events. In this seminar, we will study advanced facets of the probabilistic and statistical foundations of forecasting and classification problems.

The seminar will be offered within the Master Program. Each seminar presentation will be based on a research paper, as follows.

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#### *Recent developments in forecast assessment*

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- 1 Extreme events and forecast verification (Lerch et al., 2017)
- 2 The role of the information set (Holzmann and Eulert, 2014)
- 3 Generic conditions for forecast dominance (Krüger and Ziegel, 2020)
- 4 Forecast dominance testing (Ehm and Krüger, 2018)
- 5 Scale dependence of the CRPS (Bolin and Wallin, 2019)
- 6 Cross-calibration (Strähl and Ziegel, 2017)
- 7 Testing forecast rationality (Dimitriadis, Patton and Schmidt, 2020)

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#### *Probabilistic classifiers*

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- 8 Cost curves (Drummond and Holte, 2006)
  - 9 Brier curves (Hernández-Orallo, Flach and Ferri, 2011)
  - 10 Classifier combination with logit models (Satopää et al., 2014)
  - 11 Calibrating binary probability forecasts (Kull, Filho and Flach, 2017)
  - 12 Multi-category calibration (Vaicenavicius et al., 2019)
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### Requirements for successful participation

Students are expected

- to present a 60 minute talk in English (we strongly recommend the use of  $\text{\LaTeX}$  for the slides);
- to provide a handout (two to four pages) in either English or German, with the contents of the presentation summarized in their own words, and with all references used properly cited;
- to replicate (or develop) data and/or simulation studies in (or related to) the assigned paper. A description of the code used needs to be included in the presentation.

### Prerequisites

Prerequisites include an introductory course in probability and statistics (Einführung in die Stochastik or equivalent) and an advanced course in probability and measure (Wahrscheinlichkeitstheorie or equivalent). Successful completion of the course sequence “Forecasting: Theory and Practice I and II” is expected and strongly recommended. In particular, participants need to be familiar and confident with the contents of the papers by Gneiting and Ranjan (2013) and Gneiting and Katzfuss (2014).

## References

- Bolin, D. and Wallin, J. (2019). Local scale invariance and robustness of proper scoring rules. Preprint, <https://arxiv.org/abs/1912.05642v3>.
- Dimitriadis, T., Patton, A. J. and Schmidt, P. W. (2020). Testing forecast rationality for measures of central tendency. Preprint, <https://arxiv.org/abs/1910.12545v2>.
- Drummond, C. and Holte, R. C. (2006). Cost curves: An improved method for visualizing classifier performance. *Machine Learning*, **65**, 95–130.
- Ehm, W. and Krüger, F. (2018). Forecast dominance testing via sign randomization. *Electronic Journal of Statistics*, **12**, 3758–3793.
- Gneiting, T. and Katzfuss, M. (2014). Probabilistic forecasting. *Annual Review of Statistics and its Application*, **1**, 125–151.
- Gneiting, T. and Ranjan, R. (2013). Combining predictive distributions. *Electronic Journal of Statistics*, **7**, 1747–1782.
- Hernández-Orallo, J., Flach, P. and Ferri, C. (2011). Brier curves: A new cost-based visualisation of classifier performance. In: *Proceedings of the 28<sup>th</sup> International Conference on Machine Learning*.
- Holzmann, H. and Eulert, M. (2014). The role of the information set for forecasting—with applications to risk management. *The Annals of Applied Statistics*, **8**, 595–621.
- Krüger, F. and Ziegel, J. F. (2020). Generic conditions for forecast dominance. *Journal of Business & Economic Statistics*, in press, <https://doi.org/10.1080/07350015.2020.1741376>.
- Kull, M., Silva Filho, T. M. and Flach, P. (2017). Beyond sigmoids: How to obtain well-calibrated probabilities from binary classifiers with beta calibration. *Electronic Journal of Statistics*, **11**, 5052–5080.
- Lerch, S., Thorarinsdottir, T. L., Ravazzolo, F. and Gneiting, T. (2017). Forecaster’s dilemma: Extreme events and forecast evaluation. *Statistical Science*, **32**, 106–127.
- Satopää, V. A., Baron, J., Foster, D. P., Mellers, B. A., Tetlock, P. E. and Ungar, L. H. (2014). Combining multiple probability predictions using a simple logit model. *International Journal of Forecasting*, **30**, 344–356.
- Strähl, C. and Ziegel, J. (2017). Cross-calibration of probabilistic forecasts. *Electronic Journal of Statistics*, **11**, 608–639.
- Vaicenavicius, J., Widmann, D., Andersson, C., Lindsten, F., Roll, J. and Schön, T. B. (2019). Evaluating model calibration in classification. In: *Proceedings of the 22<sup>nd</sup> International Conference on Artificial Intelligence and Statistics*.