Forecasting: Theory and Practice I

Prof. Dr. Tilmann Gneiting

Winter Semester 2022/23

Lecture: Tuesday 14:00–15:30, 20.30 SR 0.16 (Tilmann Gneiting)
Problem class: Monday 15:45–17:15, 20.30 SR 3.61 (Benedikt Schulz)

Course contents

A common desire of all humankind is to make predictions for the future. As the future is inherently uncertain, forecasts ought to be probabilistic, i.e., they ought to take the form of probability distributions over future quantities or events. In this class, which comprises Part I of a two semester series, we will study the probabilistic and statistical foundations of the science of forecasting.

The goal in probabilistic forecasting is to maximize the sharpness of the predictive distributions subject to calibration, based on the information set at hand. Proper scoring rules such as the logarithmic score and the continuous ranked probability score serve to assess calibration and sharpness simultaneously, and relate to information theory and convex analysis. As a special case, consistent scoring functions provide decision-theoretically coherent tools for evaluating point forecasts. Throughout, concepts and methodologies will be illustrated in data examples and case studies.

Prerequisites

A firm understanding of the contents of module Probability Theory is essential.

Tentative Weekly Schedule

Classes will be held partly on site, and occasionally online via Zoom, but not in hybrid mode. Meeting IDs and passwords for the Zoom sessions will be shared on ILIAS; please sign up there. Fell free to use the class room during Zoom sessions.

October 25	on site
November 1	holiday, no lecture
November 8	on site
November 15	on site
November 22	on site
November 29	on site
December 6	on site
December 13	on site
December 20	on site

January 10	on site
January 17	on site
January 24	W2W review, no lecture
January 31	via Zoom
February 7	via Zoom
February 14	on site

This schedule is tentative and subject to change, possibly at short notice. Anticipated dates for the problem classes are November 7, November 21, December 5, December 19, January 16, January 30, and February 13.

Exams

There will be oral exams (30 minutes) covering both Part I and Part II at dates announced toward the end of summer semester [MATHST28: 8 ECTS in total]. However, there will be no exams prior to the end of summer semester.

Statistical software for forecasting

The problem sets will frequently require the use of a suitable statistical programming language. Any code discussed in class meetings will be in the R language. While you are encouraged to also use R, feel free to work with your standard language if it is suitable.

Literature

Non-technical overviews of the topics covered are available in an editorial (Gneiting 2008) and a review paper (Gneiting and Katzfuss 2014). Key technical references include the papers by Gneiting and Raftery (2007), Gneiting (2011), Gneiting and Ranjan (2013) and Henzi, Ziegel and Gneiting (2021).

Gneiting, T. (2008). Editorial: Probabilistic forecasting. *Journal of the Royal Statistical Society Series A: Statistics in Society*, **171**, 319–321.

Gneiting, T. (2011). Making and evaluating point forecasts. *Journal of the American Statistical Association*, **106**, 746–762.

Gneiting, T. and Katzfuss, M. (2014). Probabilistic forecasting. *Annual Review of Statistics and its Application*, **1**, 125–151.

Gneiting, T. and Raftery, A. E. (2007). Strictly proper scoring rules, prediction, and estimation. *Journal of the American Statistical Association*, **102**, 359–378.

Gneiting, T. and Ranjan, R. (2013). Combining predictive distributions. *Electronic Journal of Statistics*, **7**, 1747–1782.

Henzi, A., Ziegel, J. F. and Gneiting, T. (2021). Isotonic distributional regression. *Journal of the Royal Statistical Society Series B: Statistical Methodology*, **83**, 963–993.