1 Introduction

Forecasts can play an important role in informing public policy and personal decision making. During the Covid-19 pandemic, for example, governments and public support for political action, relied heavily on predictions of future case and death numbers. As epidemic developments depend on numerous factors including the decision processes of individuals, there is inherent uncertainty in epidemic forecasts. Thus, there is a growing consensus that these infectious disease forecasts should be probabilistic in nature (Bracher et al. 2021).

Many forecasts, however, tend to be overconfident: A comprehensive review found that observed values were within the 95% confidence intervals for only 75% of predictions (Gnanvi et al. 2021). One approach to improve forecasts in terms of their confidence interval coverage, is *post-processing*. The idea is to adjust forecast uncertainty in form of prediction quantiles systematically, e.g. by a fixed value or a certain factor based on the percentage of observations which were covered by the prediction intervals in the past.

We apply post processing methods to human forecasts from the UK Covid-19 Crowd Forecasting Challenge as well as model based forecasts provided by the European Covid-19 Forecast Hub. Using these data sets we examine the contributions post-processing techniques can provide and their effects among varying *models*, *target types* (i.e. Covid-19 Cases or Deaths), forecast *horizons* and *quantiles*.

In order to provide a well-organized infrastructure for our analysis, simplify further extensions and provide a basis which other researchers can use to investigate post-processing methods, we developed the `postforecasts` R package. This report introduces the package, its use and provides examples through our analysis of the Covid-19 forecasts.

The report is divided into the following sections: **??** introduces the two data sets and the main functions of the `postforecasts` package. **??** presents post-processing methods based on *Conformalized Quantile Regression*, including a theoretical introduction as well as an analysis of their performance on the data. **??** builds on top of this structure by introducing *Quantile Spread Adjustment* based post-processing methods and explores their results. **??** compares all implemented methods and proposes an ensemble model. Finally, **??** summarizes the results and discusses their implications.

Bracher, Johannes, Evan L. Ray, Tilmann Gneiting, and Nicholas G. Reich. 2021. "Evaluating Epidemic Forecasts in an Interval Format." *PLOS Computational Biology* 17 (2): e1008618. https://doi.org/10.1371/journal.pcbi.1008618.

Gnanvi, Janyce Eunice, Kolawolé Valère Salako, Gaëtan Brezesky Kotanmi, and Romain Glèlè Kakaï. 2021. "On the reliability of predictions on Covid-19 dynamics: A systematic and critical review of modelling techniques." *Infectious Disease Modelling* 6: 258–72. https://doi.org/10.1016/j.idm.2020.12.008.