



Comparative evaluation of point process forecasts

Jonas R. Brehmer¹ · Tilmann Gneiting^{1,2} · Marcus Herrmann³ ·
Warner Marzocchi³ · Martin Schlather⁴ · Kirstin Strokorb⁵

Received: 4 May 2022 / Revised: 13 April 2023 / Accepted: 9 May 2023 /

Published online: 15 June 2023

© The Institute of Statistical Mathematics, Tokyo 2023

Abstract

Stochastic models of point patterns in space and time are widely used to issue forecasts or assess risk, and often they affect societally relevant decisions. We adapt the concept of consistent scoring functions and proper scoring rules, which are statistically principled tools for the comparative evaluation of predictive performance, to the point process setting, and place both new and existing methodology in this framework. With reference to earthquake likelihood model testing, we demonstrate that extant techniques apply in much broader contexts than previously thought. In particular, the Poisson log-likelihood can be used for theoretically principled comparative forecast evaluation in terms of cell expectations. We illustrate the approach in a simulation study and in a comparative evaluation of operational earthquake forecasts for Italy.

Keywords Consistent scoring function · Elicitability · Forecast evaluation · Proper scoring rule · Statistical seismology

Authors and Affiliations

Jonas R. Brehmer¹ · Tilmann Gneiting^{1,2} · Marcus Herrmann³ ·
Warner Marzocchi³ · Martin Schlather⁴ · Kirstin Strokorb⁵

✉ Jonas R. Brehmer
jonas.brehmer@h-its.org

Tilmann Gneiting
tilmann.gneiting@h-its.org

Marcus Herrmann
marcus.herrmann@unina.it

Warner Marzocchi
warner.marzocchi@unina.it

Martin Schlather
schlather@math.uni-mannheim.de

Kirstin Stokorb
stokorbk@cardiff.ac.uk

- ¹ Computational Statistics Group, Heidelberg Institute for Theoretical Studies, Schloss-Wolfsbrunnenweg 35, 69118 Heidelberg, Germany
- ² Institute for Stochastics, Karlsruhe Institute of Technology (KIT), Englerstraße 2, 76131 Karlsruhe, Germany
- ³ Department of Earth, Environmental, and Resources Sciences, University of Naples Federico II, Complesso di Monte Sant'Angelo, Via Vicinale Cupa Cintia, 21, 80126 Naples, Italy
- ⁴ Institute of Mathematics, University of Mannheim, B 6, 26, 68159 Mannheim, Germany
- ⁵ School of Mathematics, Cardiff University, Senghennydd Road, Cardiff CF24 4AG, UK