30 April 2022

To: Mor Peleg,

Editor-in-Chief, Journal of Biomedical Informatics

**Re**: Probabilistic forecasting of hourly Emergency Department arrivals

Dear Editor-in-Chief,

We would be grateful if you could consider for publication our manuscript entitled “Probabilistic forecasting of hourly Emergency Department arrivals” as an Original Research article in Journal of Biomedical Informatics.

In this paper, we aim at filling various gaps identified in the literature, and our contributions to the literature are summarised as follows:

1. We produce probabilistic forecasts, in addition to the point estimation, quantifying uncertainties in future hospital admission, and comparing different forecasting methods using a suite of well-established evaluation metrics;

2. We develop an advanced dynamic model to forecast ED arrivals based on exponential smoothing family of models accounting for intermittent nature of series and exogenous variables with a modification for multiple frequencies, which produced highly-accurate point forecasts;

3. We develop a novel model to produce a probabilistic forecast of ED arrivals based on Generalised Additive Models for Location Scale and Shape, which accounts for i) the bounded and non-Gaussian distribution of arrivals, ii) multiple seasonalities, weather and holiday effects, and iii) variation in forecast uncertainty;

4. We benchmark the accuracy of our model against appropriate models used when multiple seasonality is present, i.e. Prophet, TBATS, Poisson Regression, Exponential Smoothing State Space model (ETS) and the simple empirical distribution of the arrivals;

5. We provide data and code enabling reproduction and refinement of the proposed approach and benchmarks. The proposed approach could also be generalised to forecast hourly requirements in other services, such as inpatient and outpatient care services, the number of attended incidents in ambulance services, or call volumes in clinical desk services.

Thank you very much for your consideration of this manuscript. We are looking forward to hearing from you in due course.

Sincerely,

Bahman Rostami-Tabar, *Cardiff University*

Jethro Browell, *University of Glasgow*

Ivan Svetunkov, *Lancaster University*