Title: Probabilistic forecasting of hourly Emergency Department arrivals

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Abstract: An accurate forecast of Emergency Department (ED) arrivals by an hour of the day is critical to meet patients' demand. It enables planners to match ED staff to the number of arrivals, redeploy staff, and reconfigure units. This can have many advantages for healthcare staff and the quality of care delivered to patients. In this study, we develop an innovative model based on Generalised Additive Models and an advanced dynamic model based on exponential smoothing to generate an hourly probabilistic forecast of ED arrivals for a prediction window of 48 hours. We compare the forecast accuracy of these models against appropriate benchmarks, including TBATS, Poisson Regression, Prophet, and simple empirical distribution. We use Root Mean Squared Error (RMSE) to examine the point forecast accuracy and assess the forecast distribution accuracy using Quantile Bias, PinBall Score and Pinball Skill Score. Our results indicate that the proposed models outperform their benchmarks for point and probabilistic forecasts. Our developed models can also be generalised to forecast hourly arrivals in other services such as hospitals, ambulances, or clinical desk services.

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