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Expanding optimization ensemble model methods for forecasting seasonal influenza in the U.S.

Each year, the seasonal influenza epidemic sees significant variability in its evolution. Accurate forecasts of future influenza cases are important for planning public health responses. The United States Centers for Disease Control and Prevention (CDC) has annually organized the FluSight competition to solicit forecasts from teams over forecast horizons (0–3). Using these data, the CDC produces an ensemble forecast of all submitted forecasts. In this paper, we introduce a weight-based ensemble forecasting method to predict laboratory-confirmed influenza hospital admissions for the 2024–2025 season. The method consists of determining optimal weights that are updated week-by-week throughout the FluSight competition to minimize the mean squared error (MSE) of a blend of teams' previous forecasts compared to the truth data. Using these weights over an expanding time window starting at the beginning of the season, we produce our own future forecasts; we call our method the *expanding window optimization* (EWO). To improve EWO's performance vis-a-vis the CDC ensemble model, we further introduce the *Adjusted-Weights EWO* (Adw-EWO) method. This new forecast is obtained by adding a correction term to the original EWO forecast, controlled by a parameter $\pi \in (0, 1)$. The correction term is computed using only the forecast errors at horizon 0 and is then applied uniformly across all forecast horizons. Our results show that the Adw-EWO method consistently outperforms the EWO across all horizons. Moreover, the Adw-EWO outperforms the CDC ensemble model at horizons 0, 1, and 2, while at horizon 3, the Adw-EWO and the CDC ensemble were roughly comparable.