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A New Look at Model Averaging of Differently Sized Time Series

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A common forecasting setting in real world applications considers a set of possibly heteregenous time series of the same domain. Due to different properties of each time series such as length, obtaining forecasts for each individual time series in a straight-forward way is challenging. A local approach models each time series on its own whereas a global approach takes into account all time series simultanously. Both approaches can lead to inappropriate result in this setting: a family of local models might not fit the individual time series while a global model may need to be very complex to achieve good results [1].

This work tackles these problems and proposes a methodology between local and global models. We propose a general framework utilizing a similarity measure in *Dynamic Time Warping* to find similar time series to build neighborhoods in a *k-Nearest Neighbor* fashion around every time series of interest, and improve their corresponding forecasts of possibly simple models by "averaging". We provide theoretical arguments why and how averaging can reduce the prediction error based on state-space models. Several types of averaging are suggested such as a simple average and distance-based averages. Those ways of averaging are compared on a motivating real world application regarding food demand forecast. Additionally, diagnostics tools are proposed allowing a deep understanding of the procedure.

[1] P. Montero-Manso and R. J. Hyndman, "Principles and algorithms for forecasting groups of time series: Locality and globality," *International Journal of Forecasting*, vol. 37, no. 4, pp. 1632–1653, 2021.