HOLT-WINTERS FORECASTING METHODS

and

JOINT OPTIMIZATION OF THE FORECASTING/INVENTORY PROBLEM

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Exponential smoothing methods are powerful tools for denoising time series, predicting future demand and decreasing inventory costs. We develop a smoothing and forecasting methods that are intuitive, easy to implement, computationally stable, and can satisfactorily handle both, additive and multiplicative seasonality, even when time series contain several zero entries and large noise component.

We start with the classical additive Holt-Winters method and first drop one occurrence of parameter alpha in equation for level and second introduce an additional smoothing parameter in the level equation. All parameters are required to lie within $[0,1]$ and estimated by minimizing the one-step-ahead forecasting errors in the sample. Doing so, the errors decrease substantially, especially for the time series with strong trend. The newly developed methods produce more accurate short-term out-of-sample forecasts than the classical Holt-Winters methods and the Holt-Winters methods with damped trend.

The performance of the method is evaluated using a battery of real quarterly and monthly time series from the M3-Competition. A simulation study is conducted for further in-depth analysis of the method under different demand patterns. We developed and justified the use of a symmetric relative efficiency measure that allows researchers ad practitioners to evaluate the performance of different smoothing and forecasting methods.

Forecasting plays a central role in the efficient operation of a supply chain – i.e., the total costs and fill rate. As forecasts of demand are required on a regular basis for a very large number of products, the methods developed should be fast, flexible, user-friendly, and able to produce results that are reliable and easy to interpret by a manager.

We show that the supply chain costs cannot be optimal if the forecasting method is treated separately from the inventory model. We analyse the performance of the joint optimization of the modified Holt-Winters forecasting methods and a stock control policy and investigate the effect of different penalties for unsatisfied demand on the total cost and fill rate of the supply chain.

From the results obtained with 1,428 real time series from M3-Competition we show that an essential reduction of supply chain costs and an increase of fill rate can be achieved if we use the joint model with the modified Holt-Winters method.