

# The bullwhip effect under a generalized demand process: an R implementation.

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An important problem in Supply Chain Management (SCM) is the bullwhip effect, a phenomenon in which demand variability increases as one moves up the supply chain. In this paper we investigate a theoretical and practical application of Zhang (2004b) with the purpose of quantifying the bullwhip effect. The measure commonly used for this phenomenon is the ratio of the variance of the order process to that of the demand process.

We consider a single-item in a two-stage supply chain model, where the retailer employs an order-up-to replenishment policy, and we use the optimal forecasting procedure that minimizes the mean squared forecasting error. Using this model, we measure the bullwhip effect in the case of a stationary autoregressive moving average ARMA(p,q) demand process admitting an infinite moving average (MA) representation. In some particular cases we obtain explicit formulas for this measure. Finally, a R implementation is provided.

We program a function (`SCperf`) whose output gives numerical results for the bullwhip effect and other supply chain performance variables. It is well known that measuring the bullwhip effect is difficult in practice but our function overcomes this problem thanks to the help of a R function (`ARMAtoMA`) which converts an ARMA process into an infinite MA process. It leads to a simple but powerful tool which can be helpful for the study of the bullwhip effect and other supply chain research problems.

Our contributions to this subject can be described as follows: first, this study hopes to improve the understanding of time series techniques. On the other hand, we show that for certain types of demand processes the use of the optimal forecasting method considered in the model leads to significant reduction in the safety stock level. This highlights the potential economic benefits resulting from the use of time series analysis. Next, the function `SCperf` might be used to complement other managerial support decision tools. Finally, the code is given, which makes (together with the fact that R is a freeware) the whole research reproducible by everyone. It may be as well modified for specific tasks.

## References

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