

Assignment 2

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CS 800
Current draft: 2/10/26 at 5:41pm EDT

Look at the source `main.tex` to see how this is done.

1 URIs

This is a formatted, clickable link to my webpage: https://www.cs.odu.edu/~cs_mrost004/

2 Images

All figures must have a caption and must be referenced in the text. See the example below.

Figure 1 my googls scholar page. It shows my profile, research areas, and recent publications. The original dimensions are 1484 x 1171 (or, 3in x 2.4in). Figure 2 shows an example of cropping the image using the `trim`, `clip` options to `includegraphics`.

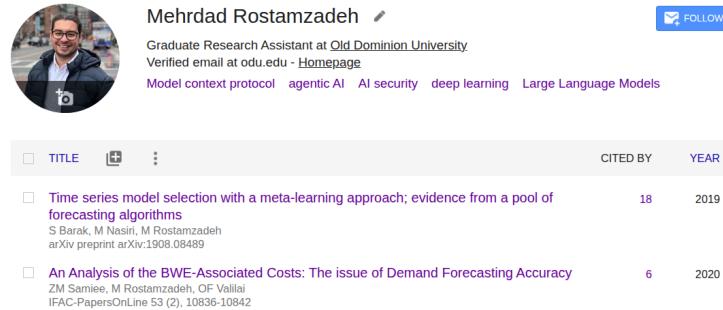


Figure 1: My google scholar page

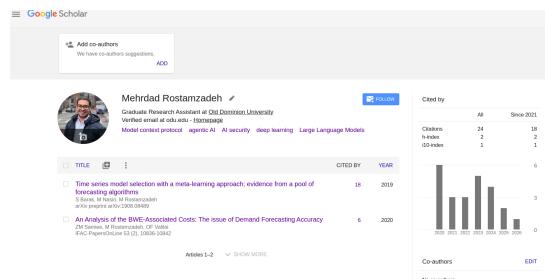


Figure 2: Cropped PNG - 0.25in from left, 0.5in from bottom, 1in from right, 0.3in from top

Figure 3 shows the same cropping as Figure 2 but scaled up. It's blurry because the original image (Figure 1 was a low resolution.)

Figure 3: Cropped and scaled PNG

We can insert PDFs into the document in the same way as images. Figure 4 is the first page of an academic paper. I've added the `\frame` command to show where the boundaries are. Figure 5 shows the margins trimmed off so that the text can be larger (scaled up).

3 Quotation Marks

Quotation marks are weird in LaTeX. Here's using "double quotes". *Not quite right.* Here's the "proper way". It's two backticks and two single quotes: ``proper way''

4 Tables

Table 1 shows a simple example table. Table 2 shows an example confusion matrix from https://en.wikipedia.org/wiki/Confusion_matrix. This employs rows that span multiple columns (multicol) and columns that span multiple rows (multirow).

Table 1: Simple Table

Week	Date	Topic
1	Sep 1, 3	Introduction, What's Vis and Why Do It?
2	Sep 8, 10	Data and Data Cleaning
3	Sep 15, 17	Marks and Channels

Table 2: Example Confusion Matrix from Wikipedia

		Actual	
		Cat	Dog
Predicted	Cat	5 (TP)	3 (FP)
	Dog	2 (FN)	3 (TN)

**Figure 4:** Inserted PDF

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An Analysis of the BWE-Associated Costs: The issue of Demand Forecasting Accuracy

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Abstract: The bullwhip effect (BWE) has a significant impact on increasing the total cost of a supply chain. Among the factors contributing to this effect, demand forecasting plays a vital role. This paper explores the role of demand forecasting accuracy on the amount of the BWE-related cost, taking an intervened demand process with stochastic perturbations into account. In this regard, a simulation study on a two-echelon supply chain is conducted to investigate the association between forecasting accuracy and the BWE-related costs. Subsequently, a new replenishment policy based on the classic order up to a target (OUT) policy is introduced to determine order values that mitigate the BWE-related costs in comparison to the classic OUT policy.

Keywords: Bullwhip Effect, Inventory Management, Simulation, Demand Forecasting, Experiment Design

1. INTRODUCTION

The bullwhip effect (BWE), also known as the Forrester effect, is defined as the variance amplification of orders from downstream members to up-stream parties in supply chains. Four factors causing this phenomenon are lead time and demand signal processing, order batching, rationing and shortage gaming, and price fluctuation (Lee, Padmanabhan & Whang 2015). Among the factors causing the BWE, the role of demand forecasting is challenging for researchers. Many studies have addressed the effect of demand forecasting on the BWE. However, some aspects still are not explored. This paper presents an experiment on the role of demand forecasting in reducing a defined cost consisted of the effect of the BWE on capacity-related plans. Different scenarios are run in a simulation model to investigate how various factors can affect BWE-related costs. In previous studies, the BWE has been quantified in the cases involving an autoregressive (AR) demand process (Chen et al. 2000), an autoregressive integrated moving average process (Chen et al. 2000; Gilbert 2005) and seasonal demand patterns (Bayraktar et al. 2008). However, exogenous perturbations have not been taken into account in the case of BWE analysis. (Sterman 1989) argued that demand spikes can act proportionally to shocks that are portable (Box, Jenkins & Reinsel 1994, Delaram and Valilai 2017).

The study explores the main factors affecting the role of spikes on BWE-related costs in different scenarios. In this regard, two distinct points of view about the upcoming perturbations are studied: the pessimistic and the optimistic approach in which the forecasters tend to underestimate and overestimate the future demand respectively in the periods of perturbation with specified forecasting accuracy. Moreover, the role of different factors on the BWE cost using the response surface method (RSM) is analyzed to observe how various factors determine the way BWE cost varies. Furthermore, a modified ordering policy suitable for the studied setup is introduced. The new policy is able to reduce the BWE-associated costs substantially.

This paper is structured as follows. In section 2, a review of related research is presented to support the study. The third section offers a complete description of the problem addressed in this paper. In section 4, the simulation process is explained. Section 5 conducts a design of experiment process for the generated output of the simulation process. Section 6 deals with the simulation analysis on the modified policy, and finally, the last section proposes concluding remarks and future extensions of the research.

Figure 5: Trimmed PDF