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BlueLinx can benefit from innovative inventory management methods for commodity forward buys☆

Andrew Manikas[a,*], Yih-Long Chang[b], Mark Ferguson[b]

[a]*The University of Wisconsin – Oshkosh, 800 Algoma Blvd. Oshkosh, WI 54901-8678, USA*
[b]*College of Management, Georgia Institute of Technology, 800 West Peachtree Street, Atlanta, GA 30308-0520, USA*

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Abstract

Commodity prices often fluctuate significantly from one purchasing opportunity to the next. These fluctuations allow firms to benefit from forward buying (buying for future demand in addition to current demand) when prices are low. We propose a combined heuristic to determine the optimal number of future periods a firm should purchase at each ordering opportunity in order to maximize total expected profit when there is uncertainty in future demand and future buying price. We compare our heuristic with existing methods via simulation using real demand data from BlueLinx, a two-stage distributor of building products. The results show that our combined heuristic performs better than any existing methods considering forward buying or safety stock separately. We also compare our heuristic to the optimal inventory management policy by full enumeration for a smaller data set. The proposed heuristic is shown to be close to optimal. This study is the first to decide both the optimal number of future periods to buy for uncertain purchase price and the appropriate purchasing quantity with safety stock for uncertain demand simultaneously. The experience suggests that the proposed combined heuristic is simple and can be very beneficial for any company where forward buying is possible.

Keywords: Decision making/process; Forecasting; Newsboy problem; Inventory management; Forward buy

1. Introduction

This paper describes a heuristic developed to improve the purchasing decisions of BlueLinx Corporation, a two-stage distributor of building product materials with annual revenues around eight billion US dollars. Purchasing and selling commodities at BlueLinx is a complex process due to both fluctuating purchase prices and highly seasonal and uncertain customer demand. The company purchases bulk commodities from suppliers such as lumber mills and sells smaller truckloads to customers as requested. The customers do not procure commodities directly from the mill because (1) they do not purchase enough volume at one time to satisfy the minimum mill quantity requirement, or (2) they do not want to give up the flexibility of shipment size and destination that is absorbed by the two-stage distributor.

BlueLinx can charge a positive margin by absorbing lead-times, breaking bulk, and providing fast deliveries. However, a highly variable portion of their profit or loss is derived solely from the difference between the price they purchase the commodities at versus the price they sell them at. Due to the competitive nature of their business, the price BlueLinx can charge for its product

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* Corresponding author. Tel.: +1 404 444 6086.
E-mail addresses: Andrew.Manikas@mgt.gatech.edu (A. Manikas), Yihlong.chang@mgt.gatech.edu (Y.-L. Chang), Mark.ferguson@mgt.gatech.edu (M. Ferguson).

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is determined by market forces and may be considered exogenous to BlueLinx's decision making. Thus, strategic purchasing that minimizes the cost of acquiring the product provides BlueLinx with the largest opportunity for improving profits.

In this paper, we provide insights into BlueLinx's problem by modeling a two-stage distributor that has a purchasing opportunity at a known, current cost with forecasts for future demands and a known distribution for future costs. The distributor's decision is whether to buy enough products to satisfy demand only in the period 0 (first or current period where inventory on hand can be increased by a purchase) or to also buy to meet demand in future periods (forward buy periods beyond the vendor delivery lead-time). We propose a heuristic for this problem that is a combination of two existing methods for determining the optimal number of future periods to buy and the order-up-to levels under an uncertain cost and demand environment. The goal is to maximize the total expected profit. We use actual sales data (simulated through a bootstrapping technique) from BlueLinx for the years 2001–2005 to demonstrate the effectiveness of the proposed heuristic. The results show that our combined heuristic performs better than any existing methods considering forward buying or safety stock separately. We also compare our heuristic to the optimal inventory management policy by full enumeration for a smaller data set. The proposed heuristic results also show our method to be close to optimal. This study is the first to decide both the optimal number of future periods to buy for uncertain purchase price and the appropriate purchasing quantity with safety stock for uncertain demand simultaneously. The study suggests that the proposed combined heuristic is simple and can be very beneficial for any company where forward buying is possible.

We begin by describing BlueLinx's purchasing environment.

1.1. BlueLinx purchasing environment

The following conditions describe the purchasing environment of BlueLinx and are based on discussions about procurement practices with the current and former directors of supply chain procurement at BlueLinx Corporation.

Condition 1: BlueLinx is a price taker. BlueLinx exists in a highly fragmented market where the largest player comprises only 10% of the total market and where there are many small players with no influence at all. Moreover, the company has little price flexibility. Selling prices cannot be raised to cover prior high priced purchases; rather, selling prices are a constant marginal addition to current market prices for the products. In fact, all players in the industry are price takers.

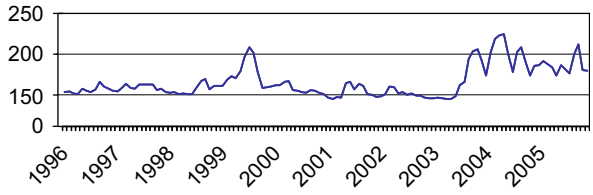

Fig. 1. Historical plywood prices 1996–2005.

Condition 2: Demand is stochastic with a known distribution. The demand distribution is non-stationary given the highly seasonal nature of building product demand.

Condition 3: The demand forecast is unbiased. Tracking signals demonstrate that the forecasting method is unbiased for the commodity products at BlueLinx.

Condition 4: The purchase price exhibits randomness as shown in Fig. 1 for the price of plywood [1]. It is the nature of commodity goods to fluctuate in price daily, and even hour to hour depending on conditions of supply and demand. Fig. 1 shows 10 years of monthly data. Each monthly figure is reported as the average of the daily price close. Note the spike near the end of 2003 has many theories from analysts; (1) U.S. Military placed large orders in August for the First Armored Division in Iraq to build barracks, (2) hurricane Isabel caused significant demand for plywood to reinforce windows, (3) strong single-family home builder demand with insufficient stock.

Condition 5: Since lead-times are significant, an order must be placed before demand is realized. Products such as rebar are often purchased internationally, requiring significant lead-times and excellent supplier relations. BlueLinx has developed strong supplier relationships as suggested in [2]. US demand for rebar, for example, exceeds domestic production. Thus, local spot purchases are not available if the original order quantity falls below realized demand. Therefore, the current period (period 0) in all models is really the first period that can have inventory increased by a purchase. For plywood at BlueLinx, the period 0 is 3 months from today initially. This period rolls forward during the horizon.

Condition 6: There are no viable substitute products. Customers (builders and industrial manufacturer) have specifications calling for certain materials and so they will not use different grades or variants. If the company is out of a particular commodity, it cannot fill demand with a substitute product; for example, a builder