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Practical Machine Learning: How Data Can Optimize Inventory Forecasting

Rod Daugherty **August 6, 2019**

People excel at spotting patterns and making adjustments based on feedback, while computers excel at processing huge amounts of data quickly. Put those capabilities together and you have machine learning, a technique with the potential to help businesses dramatically improve their inventory planning.

While the terms “machine learning” and “artificial intelligence” are often used interchangeably, the main takeaway is that these advanced technologies offer better ways to solve complex planning problems. With interest and investment in AI growing, more organizations are recognizing the benefits of data science to improve inventory forecasting accuracy and optimize stock replenishment. A McKinsey report found that AI-enabled supply chain management can reduce forecasting errors by up to 50%, while helping businesses scale back inventory by up to 50% and slash lost sales by up to 65%.

Modern Challenges Demand Modern Tools

From changing online and offline shopping patterns to the ongoing challenges of tariffs, the current complexities of inventory forecasting and demand planning make having the right tools even more essential. In a recent survey conducted by Blue Ridge, three out of four wholesalers said increasingly volatile customer demand is a top forecasting challenge, while 72% cite understanding complex demand patterns as their biggest issue.

Without the ability to forecast demand accurately, businesses are at risk of mismanaging inventory levels, tying up cash in excess stock and losing sales. The more demand planners can improve their forecasting predictions, the more efficient and profitable their inventory investments will be. Yet many businesses are still relying on outdated forecasting techniques or even gut instinct, instead of adopting techniques that can help them keep up. The same survey found that 73% of wholesalers aren’t using machine learning to help forecast demand, a figure that’s virtually unchanged from 2018.

As businesses begin to explore these technologies, implementing a data science-based approach to inventory forecasting can create a massive advantage for forward-thinking organizations. Using inputs like customer demographics, sale prices, item promotions, competitor information and even weather, machine learning can help businesses predict and optimize demand and replenishment with far more accuracy than elementary or manual methods. The right tools can enable businesses to:

Manage demand for seasonal or slow-moving products: From air conditioning parts to furniture, products with intermittent demand are notoriously challenging for businesses to forecast. Two in three wholesalers say slow mover management is a top pain point, and 45% find it challenging to manage seasonal items. Many businesses use an exponential smoothing model to produce their forecasts, which are designed for continuous demand observations and give more weight to recent data than older observations in an effort to capture recent trends.

By using advanced data techniques like top-down forecasting, businesses can predict demand more accurately for SKUs where sales are too intermittent to generate a forecast. This approach aggregates demand to a larger group, such as product category or location; generates a forecast at the SKU and aggregate level; and measures forecast accuracy at each level to select the best one automatically.

Understand how price changes impact item sales: If you lower prices on patio sets by 25%, how many more will you sell this summer? Understanding how price affects demand for specific items is a must for every business. While price and demand for some SKUs are highly elastic (i.e., they have a significant impact on sales), they are much less correlated for other products.

Predictive analytics uses machine learning to forecast how price and demand interact based on data like previous sales, customer demographics, weather patterns and more. Armed with that knowledge, businesses can optimize inventory levels and promotional strategies.

Plan for promotion-related changes in demand: Beyond the obvious impact on sales for promoted items, promotions tend to have three additional major consequences on demand:

- **Halo:** Demand increases for non-promoted items with a relationship to the promoted item, such as an uptick in sales of rain boots when trench coats are on sale
- **Cannibalization:** Dips in demand for items or brands similar to the promoted items during the sale
- **Post-promotion dip:** Also known as pull-forward or deferred demand, sales often decrease after a promotion, since customers have already stocked up on the item

Since promotions typically cause supply chain disruptions, understanding all the related effects on sales and profitability is critical for weighing the costs and benefits of sales. Machine learning-based forecasting methods can help businesses anticipate related dips and spikes in demand, so they can plan and execute promotions more effectively.

Predict demand by location: While current tools allow business to do inventory forecasting easily by store location, some organizations are taking these techniques a step further to plan for new locations or manage e-commerce stocking needs. Taking SKUs, promotions, sales in other locations or channels, customer demographics and other factors into account, businesses can plan their inventory investments with greater accuracy. Location modeling can also help businesses predict inventory levels and timing for smaller-scale launches, such as seasonal buying plans.

Emerging Machine Learning Trends

As machine learning technology continues to evolve, emerging trends include supervised learning for classification of items and causal analysis of macro influences, like weather. One area to watch is the rise of neural networks, which are modeled after the human brain to identify patterns without being specifically programmed. These networks train themselves by observing and learning from demand behavior, helping to improve inventory forecasting accuracy for areas like seasonal pattern clustering and product affinities.

For businesses getting up to speed on the latest tools and platforms, a supply chain planning technology partner can be a helpful resource in identifying and implementing the solutions with the greatest value. As businesses juggle more products, more channels and more uncertainty in customer demand, those that invest in advanced planning capabilities will have a powerful edge.

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