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PREDICTIVE PURCHASE ORDER OPTIMIZATION IN A QUICK SERVICE RESTAURANT SUPPLY CHAIN

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ABSTRACT
In the fast-paced world of quick service restaurants (QSRs), managing inventory efficiently is vital for controlling costs and keeping operations smooth. Domino's Pizza, like many QSRs, deals with ongoing challenges such as unpredictable demand, the risk of running out of stock, high costs of storing excess inventory, and the problem of wasting perishable ingredients. Traditionally, managers have made purchase decisions by relying on experience and historical sales averages—methods that don't always account for changing consumer trends or seasonal spikes.This research explores how predictive analytics can make inventory management smarter and more cost-effective for Domino's Pizza. By analyzing sales history and ingredient usage data, the research uses statistical and predictive tools to forecast demand and recommend what to order.The analysis demonstrates that data-supported forecasting improves order accuracy, reduces surplus inventory and waste, and enhances overall supply chain coordination. Notably, even relatively straightforward forecasting methods were sufficient to strengthen purchase planning within QSR operations. In the context of Domino's operations, structured demand estimation contributes to better cost controlover inventory exposure and supports smoother day-to-day operations. From a financial standpoint, the study outlines a practical method for incorporating analytical tools into routine purchasing activities within food service organizations.

Keywords— Demand Forecasting, Inventory Planning, Predictive Methods, Purchase Order Management, Supply Chain Decision Support, Quick Service Restaurant Operations

I. INTRODUCTION

Quick service restaurants (QSRs) operate in highly competitive markets where operational efficiency directly influences profitability and long-term sustainability.Managing inventory is especially tough—customer demand changes all the time, promotions come and go, and ingredients don't last forever. When purchase planning isn't accurate, restaurants risk either running out of stock and losing sales or having too much inventory that ends up going to waste.Most managers still rely on historical averages and personal experience when deciding how much to order. These methods might work when things are steady, but they often fall short in today's fast-changing retail scene where demand is unpredictable. Fortunately, with so much sales and ingredient data now available, there's a real opportunity to move from gut-feeling decisions to smarter, data-driven forecasts.The analysis looks at how predictive analytics can be built into the purchase order process for QSRs. By digging into past sales and ingredient use, it asks whether using forecasts to guide buying decisions can help restaurants control costs and manage inventory better at the store level.

II. LITERATURE REVIEW

Inventory management in restaurant settings requires careful coordination between demand fulfillment and cost control. Maintaining sufficient stock to serve customers, while at the same time limiting storage expenses and spoilage, is an ongoing operational challenge [1]. The issue becomes more complex in food service operations due to the perishable nature of ingredients and frequent shifts in customer demand. As a result, many organizations have begun exploring predictive analytics as a means of strengthening demand estimation and supporting procurement decisions.

By leveraging historical sales and consumption data, forecasting techniques enable businesses to allocate resources more efficiently and reduce avoidable costs [2].

Waller and Fawcett [2] emphasize that the integration of data science into logistics and supply chain functions enhances organizational responsiveness, particularly in markets characterized by shifting customer preferences and competitive pressures. Likewise, Gunasekaran et al. [3] argue that the adoption of big data analytics in supply chain systems improves coordination, strengthens forecasting accuracy, and supports overall operational efficiency.

However, a substantial portion of existing research has primarily focused on manufacturing systems or large-scale distribution networks. Comparatively limited attention has been given to procurement decision-making at the individual restaurant level, where daily ordering decisions directly affect cost control and profitability. This gap highlights the need for further investigation into how data-driven demand forecasting can support more accurate purchase order planning within quick service restaurant (QSR) environments.

III. METHODOLOGY

This research follows an empirical approach to examine how predictive analytics can support purchase order decisions in a quick service restaurant (QSR) setting. Instead of depending only on managerial judgment or simple historical averages, the study relies on recorded sales transactions and detailed ingredient usage data from a pizza-focused QSR outlet. The intention is to assess whether structured analysis of past data can improve day-to-day procurement planning.

A. Data Source and Sampling

The data used for analysis includes several months of transaction-level records. These records capture both the quantity of products sold and the corresponding ingredient consumption measured in grams. For the purpose of the current work attention is given primarily to information that directly influences ordering and inventory decisions.

The dataset includes periods of varying demand intensity, covering both slower business cycles and peak sales intervals. This variation allows the analysis to reflect practical operating conditions rather than isolated or unusually stable periods.

B. Variables Considered

Sales volume across time serves as the central variable for forecasting demand. Ingredient usage is examined in relation to these sales figures, since it directly determines procurement requirements. By linking product-level sales data with raw material consumption, the study establishes a measurable connection between customer demand and purchasing needs.

By mapping sales quantities to ingredient usage levels, the study establishes a direct relationship between revenue-generating activities and raw material demand.

In addition, the analysis considers factors such as seasonal fluctuations and short-term demand variations to better approximate real-world conditions. Inventory-related performance indicators, including potential reductions in excess stock and associated holding costs, are evaluated to assess the financial implications of improved forecasting accuracy.

C. Analytical Techniques

The methodological process begins with descriptive statistical analysis to identify demand patterns across different product categories. Ingredient consumption data is then aggregated to determine which raw materials contribute most significantly to overall inventory usage.

Correlation analysis is subsequently employed to examine the relationship between sales trends and ingredient requirements. Based on these insights, a predictive purchase order model is developed. The model estimates procurement quantities using forecasted demand rather than

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relying solely on historical averages.The focus of this methodology is practical application rather than technological complexity. The study aims to show that even structured forecasting methods, when applied consistently, can support better procurement decisions and contribute to improved financial outcomes in everyday restaurant operations.

IV. RESULTS AND DISCUSSION

A. Descriptive Insights

The analysis of sales data shows that demand is not evenly spread across all menu categories. A small group of pizza variants contributes to a large share of total ingredient usage. This pattern indicates that certain products have a stronger influence on inventory requirements than others. Focusing forecasting efforts on these high-demand items could therefore help improve purchasing accuracy and reduce avoidable procurement costs.Month

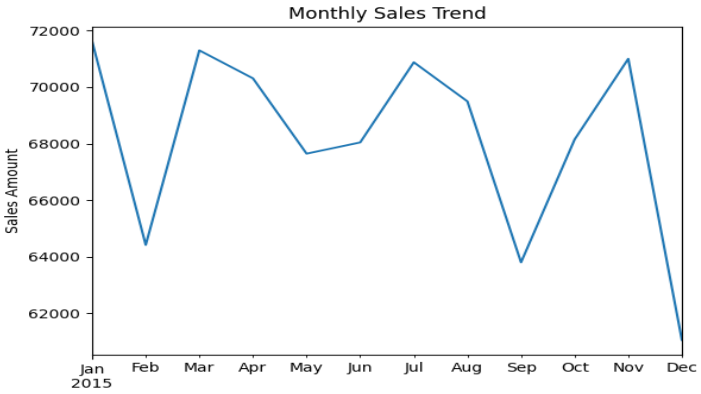

Fig. 1. Monthly Sales Trend

B. Ingredient Consumption Patterns

A closer review of ingredient consumption patterns shows that only a few raw materials account for a large share of overall inventory usage. Figure 2 highlights this imbalance, indicating that certain ingredients are repeatedly used across multiple menu items. Because these inputs appear frequently in product preparation, they play a central role in procurement planning and cost control.

From an operational perspective, forecasting errors related to these high-consumption ingredients can significantly increase procurement costs and wastage risk. Therefore, ranking ingredients based on usage volume provides a practical basis for prioritizing forecasting efforts. Placing greater attention on ingredients that drive the highest usage can support tighter cost monitoring and more balanced inventory levels.

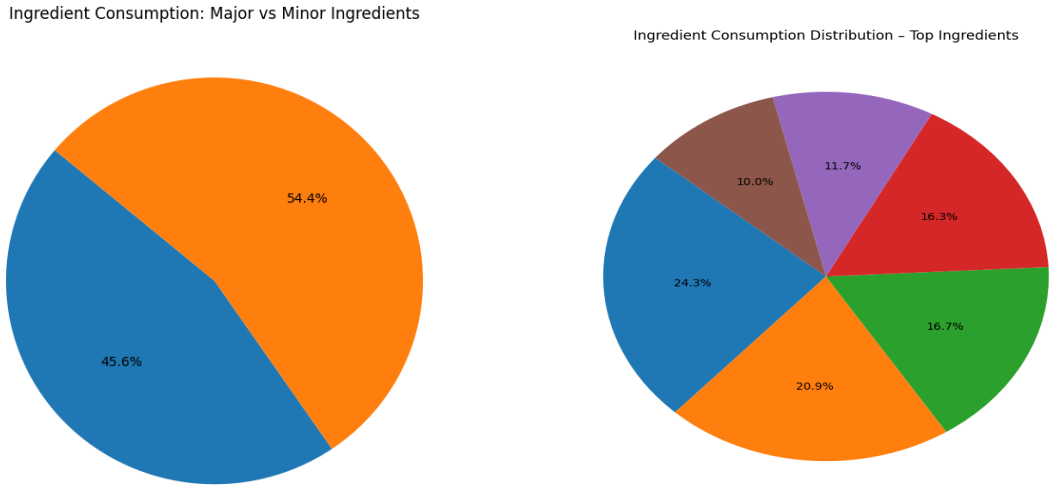

Fig.2 .Ingredient Consumption Distribution

C. Impact of Predictive Purchase Planning

- The predictive purchase ordering approach was evaluated by comparing it with traditional average-based procurement methods. The results, summarized in Fig.3, indicate that forecast-based planning results in purchase quantities that better reflect actualdemand levels.

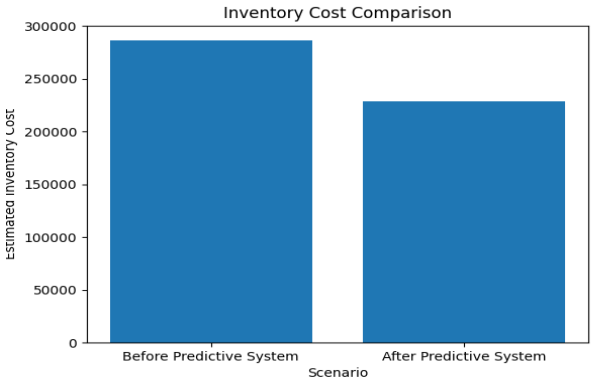

Fig. 3. Inventory Cost Comparison

- Reduced excess inventory accumulation
- Lower ingredient wastage risk

• Better utilization of working capital
• Greater consistency in inventory turnover

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The analysis shows that improvements in forecasting accuracy were associated with noticeable reductions in overall inventory-related costs. These findings suggest that structured demand estimation can contribute meaningfully to financial performance within QSR operations.

V. CONCLUSION

The increasing availability of operational and transactional data presents significant opportunities for improving inventory planning within quick service restaurant (QSR) environments. This evaluated the application of predictive analytics to purchase order decision-making at the store level and demonstrated measurable operational and financial benefits. The findings indicate that forecast-based procurement can improve order accuracy, reduce excess inventory, and minimize ingredient wastage.

By establishing a structured relationship between historical sales patterns and ingredient consumption levels, the proposed approach supports more informed supports more informed and systematic purchasing decisions. Overall, the analysis indicates that this approach strengthens cost control practices and suggest that integrating demand forecasting into routine procurement processes enhances cost control and improves working capital utilization in QSR operations.

The observationsadds to existing discussions on analytics in supply chain management by examining inventory planning at the restaurant level, an area that has received comparatively less focused attention. The analysis indicates that structured use of sales and consumption data can improve procurement outcomes without requiring highly complex artificial intelligence systems.

Further investigation could explore the application of advanced machine learning models, integration of real-time demand signals, and cross-location comparisons to assess scalability of predictive inventory approaches across different QSR environments.

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