



## Revolutionizing Demand Forecasting: The Power of AI and Machine Learning

The COVID-19 pandemic has brought significant challenges to businesses worldwide, and the retail industry is no exception. Companies have seen increased customer churn, decreased revenue, and resource depletion. To adapt to this new normal, many businesses have tried to expand their market reach and modify their product offerings to retain customers and attract new ones.

However, these efforts can only be successful if businesses are able to evaluate the exact demand and requirement of their customers. Retail businesses that provide customers with the right product at the right time can offer a delightful omnichannel buying experience. At the core of this is a retailer's ability to forecast customer demand, factoring in changing buying behaviors and market uncertainty.

In the post-pandemic era, artificial intelligence (AI) has become an inevitable market need, and many retail businesses have adopted it seamlessly. From delivering groceries in 10 minutes to offering immediate virtual consultations with doctors, businesses have made their services more accessible to customers by leveraging the emergence and advanced application of AI in their solutions.

One of the ways that AI has proven to be a disruptive solution for retail businesses is through demand-based forecasting. Demand-based forecasting uses machine learning algorithms to analyze various data points, such as sales history, promotions, weather, events, and web traffic, to predict customer demand more accurately. This helps businesses to optimize their inventory management, streamline their supply chain, and better meet the needs of their customers.

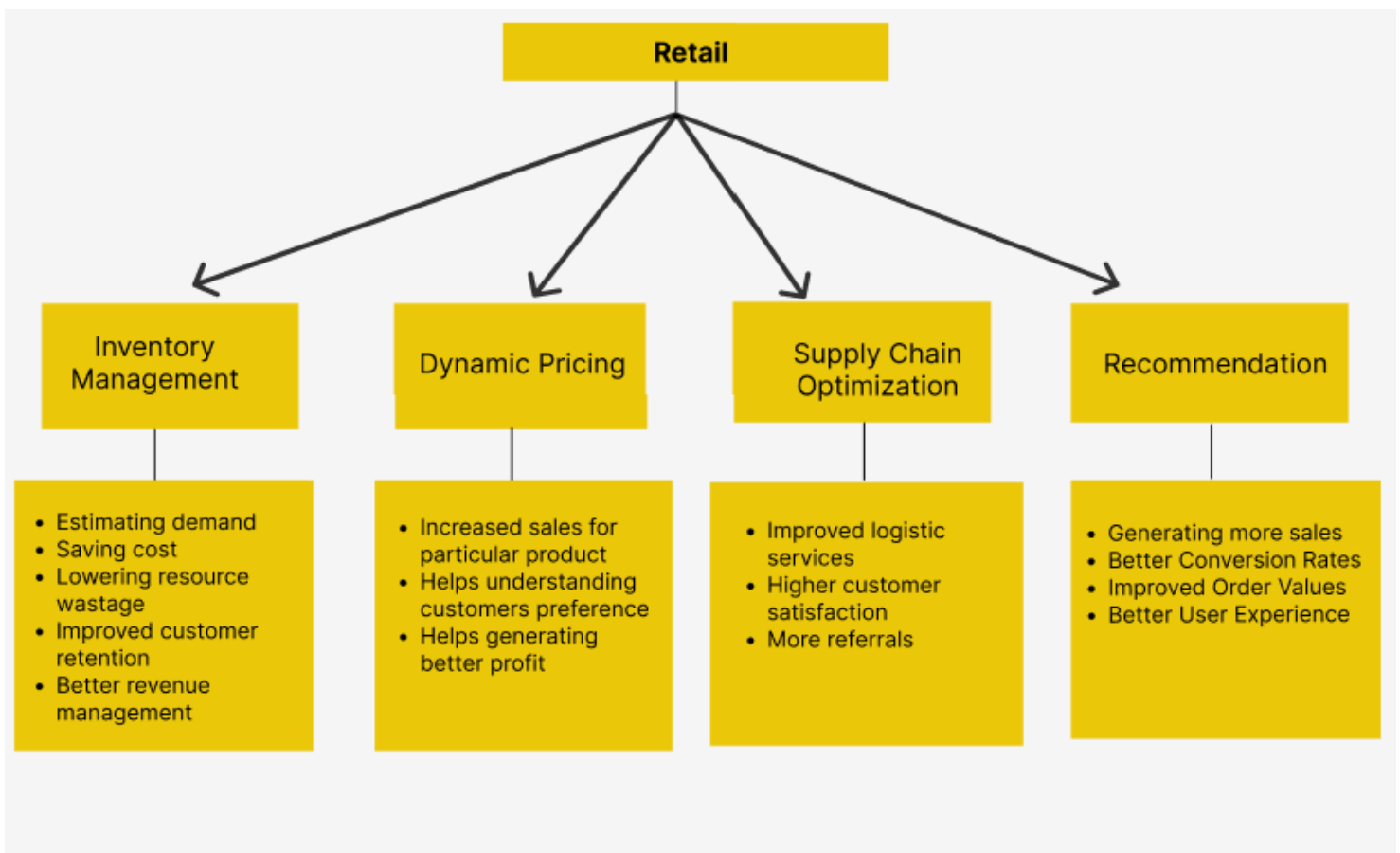
Compared to conventional methods, AI-based forecasting has several benefits, including the ability to handle large data sets, provide more accurate and timely predictions, and adapt to changing market conditions. As such, AI has become an essential tool for retail businesses in today's fast-changing environment.

## Why is there a need for integrating AI in the retail space?

The retail industry has experienced significant growth in both conventional and virtual markets, expanding their target customer segments. According to data from Fortune Business Insights, the retail market has increased by over 4.5% in 2021, with a valuation of approximately USD 8 billion. It is projected to rise by almost 17.7% between 2022-2028, with a valuation of USD 18.33 billion.

To stay competitive, businesses are adopting advanced methods, including the integration of AI into their end-to-end offerings, starting with marketing. Successful businesses are leveraging AI to match customer requirements and retain users. Today, AI is helping businesses make critical decisions related to capacity planning, resource management, market expansion, product diversification, and more.

Based on research, here are some sample use cases in retail that are relevant to most businesses.



# What is demand forecasting? And how businesses can help

Demand forecasting is the process of predicting future demand patterns by examining historical data, allowing businesses to optimize their inventory management. A successful demand forecast can help businesses make strategic decisions around stock-keeping, market expansion, and product diversification, among other things. Forecasting can be done at different levels of granularity, such as hourly, daily, weekly, monthly, or annually, depending on the product sales cycle. However, businesses generally prefer to forecast at a high level of granularity.

For example, businesses such as grocery or vegetable vendors, which need to store inventory on a daily basis, prefer to forecast at the highest level of granularity to avoid waste or spoilage of products. Seasonal data helps them identify which items customers prefer to order in which season, enabling them to maintain their inventory levels. Accuracy in forecasting is critical for businesses to analyze the sales potential in various market segments. Additionally, it helps organizations make data-driven decisions about pricing, investments, and growth strategies.

Traditionally, businesses used to analyze past data and manually estimate future demand, a short-sighted and error-prone approach that is still being used by some companies. This approach can lead to difficulties in inventory management and customer retention, resulting in loss-making businesses. However, many businesses have now recognized the benefits of AI-based forecasting, which provides high accuracy with minimal fluctuation based on data quality.

## Pain Points of Manual Demand Forecasting

- **Potential for Human Error** : One of the main pain points of manual forecasting is the potential for human error. The process typically involves a lot of data entry and calculations, which can lead to mistakes that result in inaccurate forecasts. For instance, a simple typo or transposition error can throw off an entire forecast, leading to an inefficient allocation of resources.
- **Time-Consuming Process** : The process involves analyzing large volumes of data, and doing so manually can be a time-consuming process. This can lead to delays in decision-making, which can ultimately impact the organization's ability to respond to changes in demand.
- **Limitation to Data Analysis** : The process may not allow for a thorough analysis of the data, which can limit the accuracy of the forecast. It may not be possible to analyze all the variables that impact demand, and this can lead to forecasts that are not entirely accurate or reliable.
- **Lack of Flexibility** : Furthermore, manual forecasting is often inflexible and cannot easily accommodate changes in market conditions, customer preferences, or other factors that may impact demand. For instance, sudden changes in customer demand may require adjustments to the forecast, which can be challenging to incorporate into a manual process.

- **Difficulty in Collaboration** : Manual forecasting can be a difficult process to collaborate on. Multiple stakeholders may need to provide input, and this can be challenging to manage manually. Miscommunication or delays in the process can lead to inaccurate forecasts or decisions based on outdated information.

## **Does AI-based forecasting make the process easier and more accurate?**

AI-based demand forecasting can improve forecasting accuracy by recognizing patterns and trends that human analysts may overlook. Furthermore, the models can evolve and develop over time, which can help to increase forecast accuracy over time.

AI machine learning systems will not only improve forecasts, but also improve planning across areas such as sales, supply chain, finance, and marketing. This solution will increase efficiency and inventory balance, allowing a reputable firm to meet its service levels for channel or store-level inventories.

## **Solutions to the problems associated with manual demand forecasting**

Implementing an ML-powered demand forecasting system can provide several solutions to the problems associated with manual demand forecasting. By using machine learning algorithms and advanced analytics, businesses can improve the accuracy of their demand forecasts and reduce the time and effort required for manual forecasting.

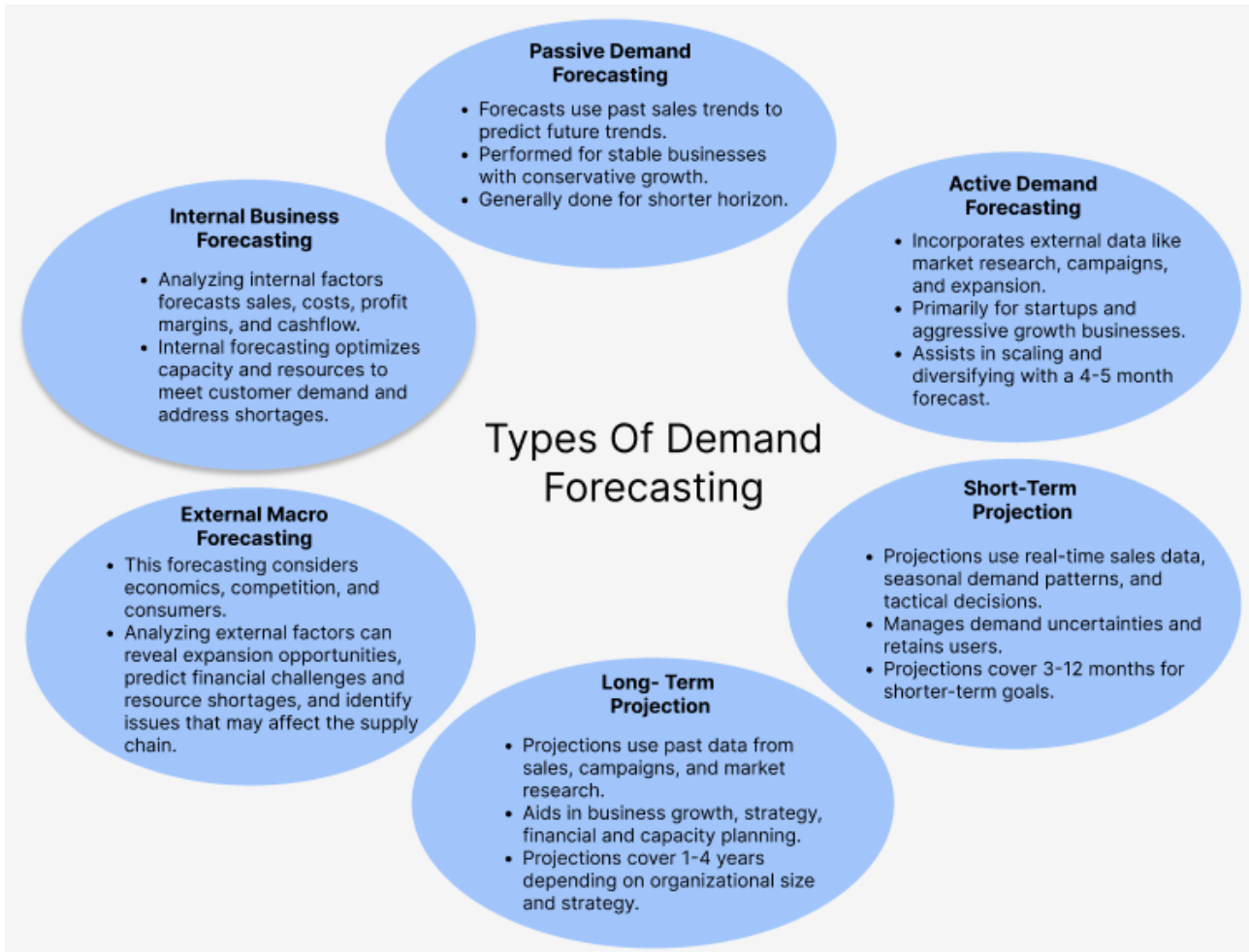
ML-powered demand forecasting can also incorporate external data sources such as economic indicators, weather data, and social media data, which can improve the accuracy of demand forecasting. It can be used as a part of collaborative planning processes that involve key stakeholders from across the organization, which can improve the accuracy of forecasts and ensure they reflect the latest market trends and customer demands.

Furthermore, investing in training and development for employees on how to use advanced analytics and machine learning tools can also help improve the accuracy of demand forecasting. Continuous monitoring and refinement is an essential part of the ML-powered demand forecasting process, which can ensure that the forecasts remain accurate and relevant as market conditions change.

## **Does AI-based forecasting make the process easier and more accurate?**

### **Let's dive deep into it:**

Businesses of all sizes, ranging from large enterprises to small and medium-sized enterprises (MSMEs), are increasingly adopting AI-based forecasting to reduce the risk of losing customers and gain insight into the success of their products with minimal human intervention. AI-based forecasting offers greater precision in forecasting compared to manual methods and allows for a wide range of capabilities, such as forecasting with large volumes of data, forecasting at different levels of detail, and forecasting based on various types of data in a simple and effortless manner.



Above figure represents the types of forecasting a business can do for planning various strategies at different levels.

To gain clarity on how AI-based demand forecasting fits into your business, you could contemplate any of the subsequent advantages:

- **Big data analysis**

Machine learning has the capability to handle large volumes of data and generate forecasts for various stock-keeping units (SKUs) by breaking down the forecast into specific units. With machine learning, only a few human configurations are required to train the forecasting model, while the remaining processes can be automated.

- **Comfortable and accurate forecasting**

Unlike manual forecasting, businesses do not have to go through all the steps involved in the process when using AI-based forecasting. AI is capable of internally managing all the necessary processes and delivering the final outcome with metrics such as MAPE (Mean Absolute Percentage Error), which provides a highly accurate result.

- **Control over each and every process**

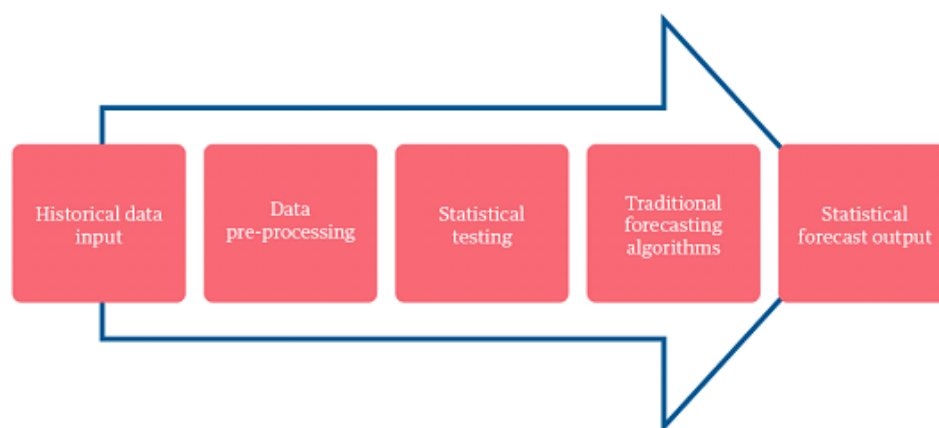
Machine-based forecasting offers comprehensive control, ranging from SKU selection to data exploration, allowing one to gain insights into the actual data by eliminating missing values and cleaning up the dataset without any difficulty. The advanced filtering capabilities of machine-based forecasting also enable you to examine the forecast more closely.

- **Easier to identify various sales processes**

Machine-based forecasting is an easy way to figure out the different sales processes and how any product can be presented to the user. It helps to account for sales cannibalization (negative impact of sales of one product on another's) and helps businesses to avoid this phenomenon. It also helps businesses strategies their planograms (design of supermarkets) by forecasting the products that are most and least popular.

Thus, we understood how AI-based forecasting can help businesses in more different ways than manual forecasting and how it can conserve resources and increase profits. Let's look into the technologies used in machine-forecasting of demand.

## Machine Learning Setup required behind a Demand Forecasting Solution



To get a forecast for any kind of product there are certain steps that machine learning follows to provide an accurate forecast. We'll discuss the steps to learn more precisely about the processes.

- **Extraction of historical inputs:** The initial and crucial step in the forecasting process is to extract the historical dataset that will be used for forecasting. Machine learning algorithms will process this dataset to ensure that all the necessary requirements are met before proceeding with the forecasting process.
- **Data Pre-processing:** After uploading the dataset, the machine learning system will perform various checks to determine whether the dataset is suitable for processing or if any changes are required from the user's end. The validation process can be quickly performed by artificial intelligence, and the results are provided to the user. Once the dataset is validated, it is prepared for forecasting by shaping and adjusting it. To achieve this, machine learning uses a series of steps, including removing outliers from the dataset, reducing data fluctuations by transforming it using a logarithmic function, and removing columns with over 70% NaN values. Additionally, any missing values in the columns are imputed to ensure the dataset is complete.

- **Statistical Testing:** The objective of this procedure is to provide a summary of the uploaded data, which usually displays the types of columns contained in the dataset. After shaping the data, the process identifies the columns suitable for forecasting and those that are not. Additionally, it prompts the user to specify several configurations, including the required forecasting horizon and which product categories necessitate forecasting.
- **Forecasting algorithm training:** After going through all the processes and customization, the machine-learning model takes the required information into account and processes the training data, which performs for a while before providing the final result.
- **Statistical forecasting output:** This is the final step of the process; It provides the final estimation of the future trend along with some technical specifications about how the model has performed for the forecasting and what is the accuracy level. This result can be visualized properly for each individual SKU and future customer's demand can be calculated accordingly.

## Designing the Technical Architecture for a Machine Learning Model: Key Considerations and Components

- **Data Storage:** To train the model, a vast amount of historical data is required. To store the data, a data storage solution such as a relational database, NoSQL database, or a data lake is required.
- **Cloud infrastructure:** Cloud providers like as AWS, GCP, Azure, and others can be utilized for storage, computation, and resource management.
- **Version Control:** To track changes to the codebase and collaborate with other team members, a version control system such as Git is employed.
- **Deployment and monitoring:** Deployment tools like Docker or Kubernetes can be used to deploy the model in a production environment, and monitoring tools like Prometheus or Grafana can be used to monitor the model's performance.
- **Visualization:** Tools for visualizing and analyzing demand forecasting projections, such as graphs, charts, or dashboards, should be provided by the solution.

## ROI of AI-powered demand forecasting:

ROI may be measured in AI-based demand forecasting by comparing the costs of the AI system to the benefits it provides. Some of the potential advantages of AI-based demand forecasting include:

- **Improved forecasting accuracy:** AI-based demand forecasting systems can give more accurate forecasts than traditional techniques, leading to cost savings and revenue growth.
- **Automation:** AI-based demand forecasting systems can automate the forecasting process, lowering the labor costs associated with human forecasting.
- **Real-time forecasting:** AI-based demand forecasting systems can deliver real-time forecasts, allowing enterprises to make smarter decisions more quickly.
- **Scalability:** AI-based demand forecasting systems can handle massive amounts of data and can be readily scaled up or down based on the situation.
- **Flexibility:** AI-based demand forecasting systems can be adapted to an organization's individual requirements.





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