

PRODUCT DEMAND PREDICTION WITH MACHINE LEARNING

PHASE 05: PROJECT DOCUMENTATION

PROBLEM STATEMENT:

"ABC Electronics, a consumer electronics manufacturer, is facing challenges in managing its inventory and production planning efficiently. They want to minimize overstocking and stockouts of their products in retail stores. To address this issue, ABC Electronics aims to develop an accurate product demand prediction system.

The objective of this project is to predict the demand for each of their electronic products for the next 12 months. This will enable ABC Electronics to optimize their inventory levels, reduce carrying costs, and ensure that products are readily available to meet customer demand.

Key Requirements and Objectives:

Develop a machine learning model that accurately predicts the monthly demand for each product in the ABC Electronics product catalog.

Utilize historical sales data, customer behavior, and external market factors (e.g., seasonality, promotions, economic indicators) to enhance prediction accuracy.

Evaluate the model's performance using relevant metrics, such as Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared (R²) values.

Provide actionable insights based on the demand predictions to assist in inventory management and production planning.

Create a user-friendly interface for stakeholders to access and interact with the demand prediction system.

Implement a feedback loop for continuous model improvement based on real-world performance.

The successful implementation of this demand prediction system will lead to cost savings, improved customer satisfaction, and better strategic decision-making for ABC Electronics. It will also enable them to respond proactively to market fluctuations and seasonal variations in demand."

This problem statement outlines the context, objectives, and expected outcomes of a product demand prediction project for ABC Electronics, providing a clear understanding of the problem and its significance.

DESIGN THINKING :

Design thinking is a human-centered approach to problem-solving and innovation. When applied to product demand prediction, it can help create a solution that not only accurately predicts demand but also addresses the specific needs and challenges of the business. Here's a design thinking approach to product demand prediction:

Empathize:

Understand the stakeholders: Identify the key stakeholders, including decision-makers, data analysts, and end-users.

Gather insights: Conduct interviews, surveys, and observations to understand the challenges they face in demand prediction, as well as their goals and pain points.

Define:

Problem statement: Clearly define the problem, taking into account the information gathered during the empathize phase. For example, "How might we predict product demand more accurately to optimize inventory and production planning?"

User personas: Create user personas for different stakeholders, such as data analysts, inventory managers, and marketing teams.

Ideate:

Brainstorm solutions: Encourage a collaborative brainstorming session to generate a wide range of ideas for improving demand prediction.

Ideation techniques: Use techniques like mind mapping, brainstorming sessions, or design workshops to explore various approaches.

Prototype:

Create a mock-up: Develop a prototype of the demand prediction system, which may include user interfaces, data pipelines, and initial algorithms.

Test with users: Share the prototype with stakeholders and gather feedback to refine the concept.

Test:

Pilot testing: Implement the prototype on a smaller scale, such as a limited product line or a specific region.

Evaluate results: Collect data during the pilot phase and assess the model's accuracy, usability, and impact on decision-making.

Iterate:

Feedback loop: Continuously collect feedback from users and make necessary adjustments to the model or system.

Refine and expand: Enhance the model, user interface, and features based on user feedback and real-world performance.

Implement:

Full-scale deployment: Once the demand prediction system is refined and tested successfully, implement it across the organization.

Training and change management: Provide training to users and ensure they are comfortable with the new system.

Measure and Learn:

Ongoing monitoring: Continuously monitor the system's performance and gather data on its accuracy.

Key performance indicators (KPIs): Define KPIs, such as demand forecast accuracy, inventory turnover, and cost savings, to measure the impact.

Share and Scale:

Share successes: Communicate the successes and impact of the new system with stakeholders and the organization.

Scale the solution: If the demand prediction system proves effective, consider scaling it to cover additional product lines, regions, or business units.

Design thinking helps ensure that the product demand prediction system is not only accurate but also user-friendly and aligned with the specific needs and goals of the organization. It promotes a user-centric and iterative approach to problem-solving, which can lead to a more effective and successful solution.

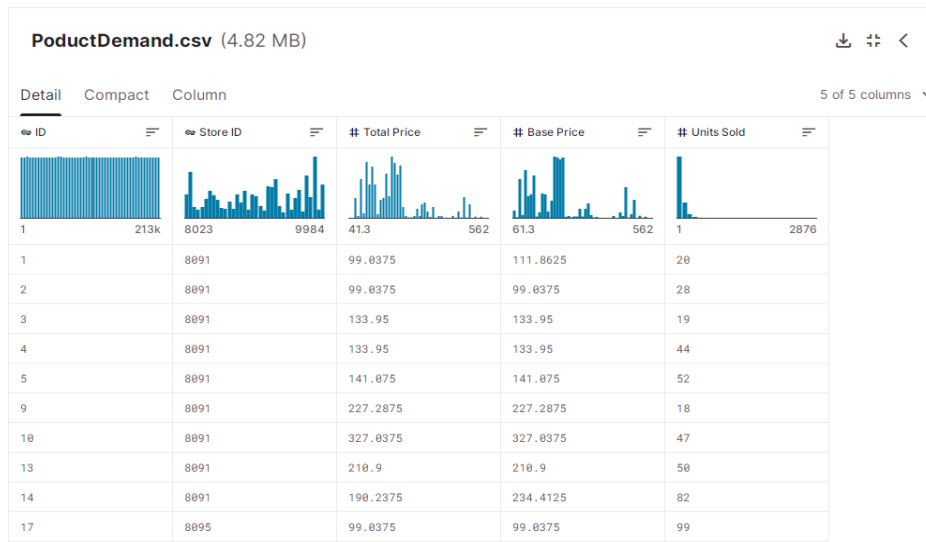
DATASET USED:

The dataset, we used are which is given already in project summision link.

The dataset link is :

<https://www.kaggle.com/datasets/chakradharmattapalli/product-demand-prediction-with-machine-learning>

DATASET SAMPLE:



DATA PROCESSING STEPS:

Data preprocessing is a critical step in product demand prediction. It involves cleaning and transforming the raw data to make it suitable for modeling. Here are the key data preprocessing steps for product demand prediction:

- 1. Data Collection*
- 2. Data Cleaning*
- 3. Data consistency*
- 4. Data Transformation*
- 5. Feature engineering*
- 6. Data normalization*
- 7. One-hot encoding*
- 8. Date and time encoding*
- 9. Data aggregation*

Data preprocessing is an iterative process, and the specific steps you need to take can vary based on the nature of your dataset and the modeling technique you plan to use. The goal is to prepare the data in a way that ensures accurate and reliable predictions in your product demand prediction model.

KEY FINDINGS:

***Demand Trends:** Begin by summarizing the key findings related to demand trends. These findings might include overall demand growth, seasonality patterns, and variations across different product categories or regions.*

***Feature Importance:** Highlight the features that have the most significant impact on demand prediction. Explain which factors are highly influential in driving product demand.*

***Accuracy Metrics:** Provide metrics such as Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared (R^2) to assess the accuracy of the model. Include any improvements achieved compared to previous methods or benchmarks.*

***Prediction Performance:** Share how well the model performs in predicting future demand, ideally with visuals like graphs showing actual vs. predicted demand.*

INSIGHTS:

***Seasonal Variations:** Identify seasonal peaks or troughs in demand and explain how these patterns affect inventory management and production planning.*

***Product Categories:** Discuss variations in demand across different product categories or SKUs. Are there products with consistent high demand, or do some products experience irregular demand patterns?*

***External Factors:** Explore the impact of external factors such as promotions, economic indicators, or market trends on demand. Understand how these factors can be leveraged for better demand forecasting.*

***Customer Behavior:** Analyze customer behavior data to gain insights into purchasing patterns, customer segments, and how they respond to marketing campaigns.*

***Model Limitations:** Acknowledge any limitations of the prediction model. Be transparent about areas where the model may not perform well.*

RECOMMENDATIONS:

***Optimized Inventory Management:** Suggest inventory optimization strategies based on demand predictions. For example, reorder points, safety stock levels, or JIT (Just-In-Time) inventory management.*

***Production Planning:** Provide recommendations for production planning. This might include adjusting production schedules to align with predicted demand fluctuations.*

***Marketing Strategies:** Recommend marketing strategies based on demand predictions. For example, identify optimal times for promotions or product launches.*

***Customer Segmentation:** Propose customer segmentation strategies based on demand insights. Tailor marketing efforts and product recommendations to different customer segments.*

***Feedback Loop:** Emphasize the importance of an ongoing feedback loop. Continuously monitor the model's performance and update it as more data becomes available.*

***Scenario Analysis:** Present "what-if" scenarios to illustrate how changes in external factors or marketing strategies could impact future demand. This helps in preparedness for various situations.*

***Visualization:** Use visuals such as graphs, charts, and dashboards to make the findings and recommendations more accessible and engaging.*

Actionable Summary: Conclude with a concise, actionable summary that outlines the most critical findings and recommendations.

SUMMARY:

The Project Summary report provides an overview of the scope of the selected project, including data sources and their analysis status, and users assigned to the project.

*Thank
you!*