**Ideation Phase**

**Defining the Problem Statements**

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| **Team ID** | **3872** |
| **Project Name** | **Product Demand Prediction using ML** |

**Product Demand Prediction using ML**

**Problem Definition and Design Thinking**

**Introduction:**

To meet customer demands, businesses must successfully manage their inventory and production planning in today's dynamic market environment. We suggest creating a machine-learning model that predicts product demand to address this. With the help of this model, businesses can optimize their operations and raise customer satisfaction by making timely predictions based on historical sales data and outside variables that influence demand such as Marketing campaigns, holidays, and economic indicators.

**Problem Statement:**

Goal: To Create a machine learning model that forecasts product demand for businesses to optimize inventory management correctly using historical sales data and outside external factors.

Data: We have a dataset that includes total price, base price, and unit sold historical sales data. Our machine-learning model will be trained and evaluated using this dataset as its basis.

**Key Challenges:**

Data Quality:

1. Perform data audits to find and correct discrepancies or missing numbers.

2. Use data validation checks to confirm the accuracy of the data.

Feature Selection:

1. Using techniques like feature significance scores and domain knowledge to prioritize pertinent features.

2. When working with high-dimensional datasets, think about using dimensionality reduction techniques.

Model Selection:

1. Compare different algorithms, taking into account how well they work for applications like time series forecasting and regression analysis.

2. Investigate ensemble techniques to integrate the benefits of various models.

Model Evaluation:

1. Use cross-validation techniques to evaluate model performance across various data subsets.

2. In addition to utilizing traditional evaluation criteria, think about adopting metrics that are relevant to your industry (like revenue effect or inventory cost reductions).

Deployment:

1. Make the model as efficient as possible for inference, possibly experimenting with methods like model quantization or serving it through a cloud-based service.

2. Implement access controls and user authentication for the web interface.

**Design Thinking Approach**

**Empathize:**

Understanding the end-users' needs requires empathy before the solution can be implemented. Inventory managers, production planners, and supply chain experts are some of our key consumers in this context. It is essential to comprehend their requirements and how precise demand forecasts might help them.

1. To learn about specific preferences for interface design, conduct A/B testing or user surveys.

2. Use user journey mapping to pinpoint trouble spots and potential areas for enhancement in the stock management procedures that are in place.

**Define:**

We'll establish specific goals and success criteria for this project based on our comprehension of the issue and the demands of the users.

**Objectives:**

1. Create a machine learning model that, when applied to the test data, produces a Mean Absolute Percentage Error (MAPE) of fewer than X%.

2. Create a user-friendly interface that enables users to enter pertinent data and get demand forecasts.

3. Success Criteria: Ensure that the web interface can properly handle multiple user queries without experiencing too much latency.

**Ideate:**

During this stage, prospective solutions are outlined and various algorithms and demand forecast techniques are examined.

For real-time data updates on market movements and economic indicators, take into account connecting external APIs.

Consider integrating reinforcement learning to enable the model to adapt to shifting market conditions over time.

**Prototype:**

Create a prototype of the machine learning model and the user interface for demand prediction.

1. Adding a dynamic visualization element to show how demand projections have changed over time.

2. To improve usability, add user-friendly tooltips and instructions for input fields.

**Test:**

Evaluating the model's performance using appropriate metrics and gathering feedback from users.

1. Implementing the A/B testing with a control group to compare the new interface against the previous system.
2. Conducting load testing to ensure the web application can handle peak usage times without performance degradation.

**Implement:**

Start the complete implementation process after the prototype has achieved the specified goals and received favorable feedback.

1. Utilize logging and monitoring tools to keep track of user activities and spot potential improvement areas.
2. Creating automated data pipelines for routinely updating models with fresh sales data.

**Iterate:**

Continuous development is necessary. Get user feedback and iterate on the model and interface to improve accuracy and usability.

Create a feedback loop with users to allow for ongoing improvement, perhaps via in-app feedback features.

Keeping up with machine learning methodologies and technology developments to implement cutting-edge techniques when necessary.

**Conclusion:**

In this document, we've shown how we plan to use machine learning to address the issue of predicting product demand. We've outlined a design thinking methodology that includes empathizing with users, setting objectives, brainstorming alternative ideas, prototyping, testing, and iterating to solve and identify major problems.

In a nutshell our ultimate goal is to provide a precise and user-friendly solution that offers useful information to supply chain experts, production planners, and inventory management. By using this methodical approach like diverse ensemble modeling we develop a solid solution that enhances inventory management and production scheduling to a great extend.