AI-Powered Dead Stock Prediction

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What Is Dead Stock?

- DEAD STOCK REFERS TO PRODUCTS THAT REMAİN UNSOLD FOR AN EXTENDED PERİOD DESPİTE BEİNG LİSTED İN THE İNVENTORY.
- IT TİES UP WORKİNG CAPİTAL, İNCREASES WAREHOUSE COSTS, AND REDUCES OVERALL İNVENTORY TURNOVER.
- DEAD STOCK TYPİCALLY OCCURS DUE TO POOR DEMAND FORECASTİNG, İNCORRECT PRİCİNG, İNEFFECTİVE PROMOTİONS, OR SEASON MİSMATCH.
- AS UNSOLD İTEMS ACCUMULATE, BUSİNESSES FACE FİNANCİAL LOSS, LİMİTED CASH FLOW, AND OPERATİONAL İNEFFİCİENCY.

Why Dead Stock Matters

- Unsold inventory leads to increased storage costs and wastes valuable warehouse space.
- Dead stock locks up working capital, limiting the ability to invest in high-demand products.
- Low-performing items reduce overall inventory turnover and negatively impact cash flow.
- Customer experience suffers as outdated or irrelevant products remain in the catalog.
- The core problem:
- “How can we predict which products are likely to become dead stock before losses occur?”

Dataset and Key Features

THE MODEL İS TRAİNED ON A STRUCTURED DATASET CONTAİNİNG APPROXİMATELY 70,000 PRODUCTS.

CORE ATTRİBUTES USED İN THE ANALYSİS:

Price, Inventory Level, Units Sold, Discount, Seasonality (Autumn, Winter, Spring, Summer), Category (Electronics, Home, Clothing, Cosmetics), Date Added

FEATURE ENGİNEERİNG İNCLUDES:

Stock-to-Sales Ratio (SSR)
Days Since Added
Price-to-Average Ratio
Category Weight & Season Weight

These features capture product demand patterns, inventory behavior, and seasonal performance, enabling accurate dead stock prediction.

Machine Learning Approach (Random Forest Classifier)

A Random Forest Classifier is used to predict the dead stock risk level of each product.

A preliminary PreRisk score is generated using:

- SSR (Stock-to-Sales Ratio)
- Days Since Added
- Price-to-Average Ratio
- Category Weight
- Season Weight

The PreRisk score is converted into three classes:

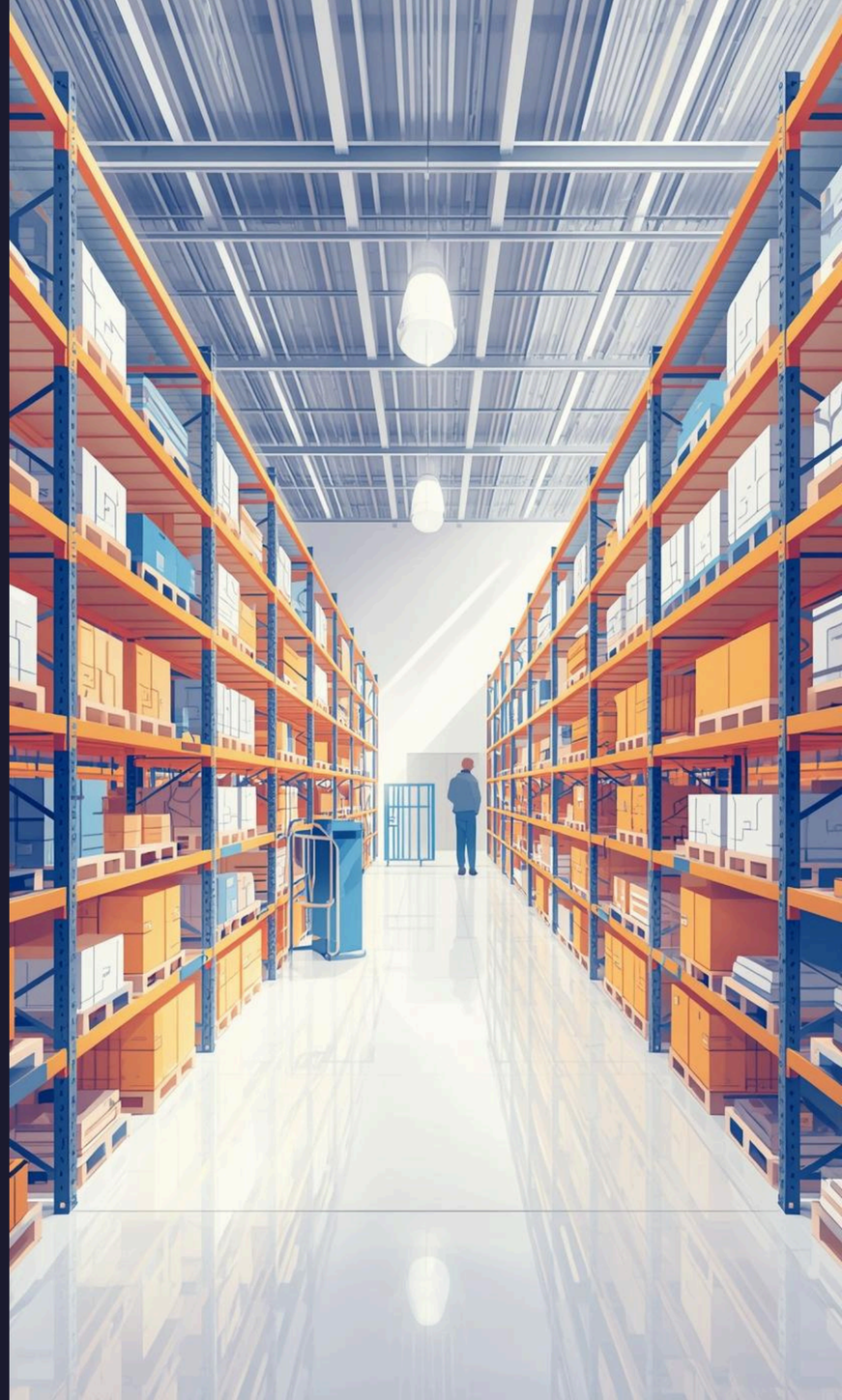
- Low Risk (< 0.33)
- Medium Risk (0.33–0.66)
- High Risk (> 0.66)

Final output:

- Predicted Risk Class (Low, Medium, High)
- Probability scores for each class

System Architecture & Tech Stack

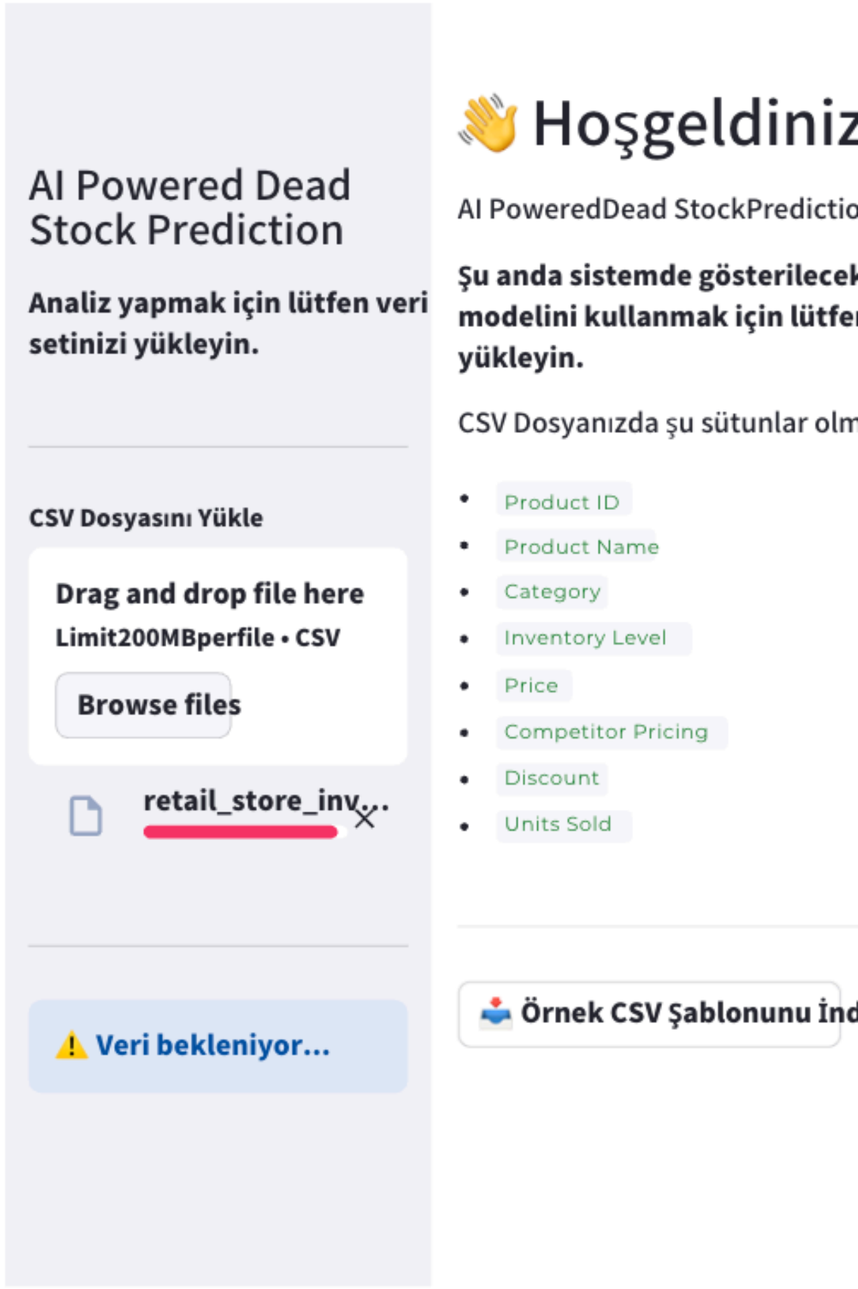
The system follows a clear pipeline that begins with preparing the dataset through date processing, normalization, and encoding. Engineered features such as Stock-to-Sales Ratio, Days Since Added, Price Ratio, Category Weight, and Season Weight are then passed into a Random Forest classifier, which predicts whether a product carries low, medium, or high dead-stock risk. The entire workflow is implemented in Python using pandas, NumPy, and scikit-learn, and can be extended into an API or simple dashboard for real-time inventory decision support.



Demo Showcase: Innovative AI Dashboard Design

KEY FEATURES OVERVİEW

The prototype demonstrates how the system analyzes each product and assigns a dead-stock risk level using the trained Random Forest model. A sample dashboard displays the predicted class—Low, Medium, or High—for every item in the catalog, along with overall distribution percentages. This allows users to quickly identify which categories or seasons contain the highest-risk products. The demo illustrates how the model processes real dataset values and produces actionable insights that can support inventory planning and decision-making.



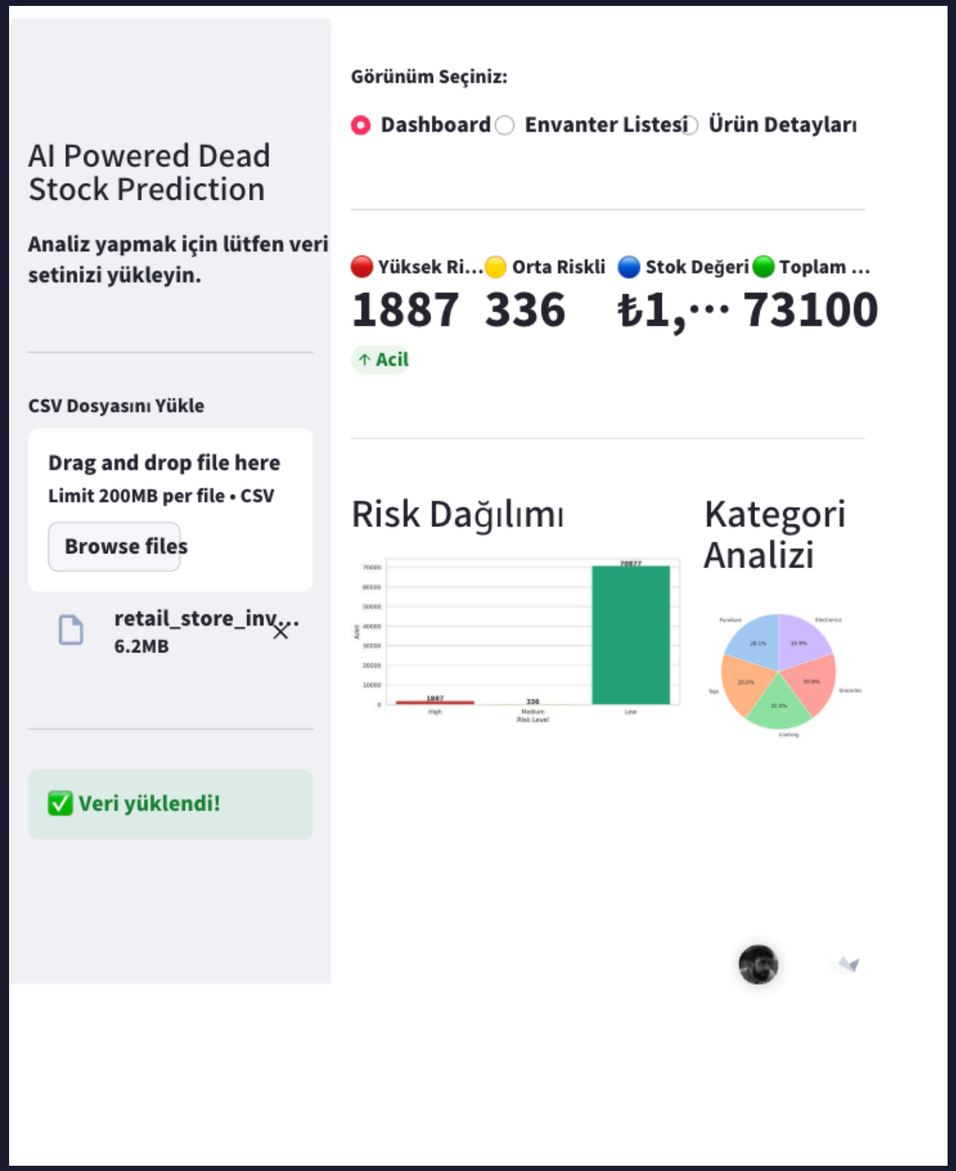
Demo Showcase: Mockups and Features

USER INTERFACE DESİGN

The user interface is designed for **intuitive navigation**, featuring clear data visualizations and interactive elements to enhance user experience.

KEY FEATURES

Our solution includes predictive analytics, real-time stock monitoring, and automated alerts for **potential dead stock**, streamlining inventory management processes.



Business Impact of AI Solutions

COST REDUCTİON

Implementing AI can significantly reduce costs associated with dead stock by providing accurate predictions and optimizing inventory management strategies effectively.

IMPROVED EXPERİENCE

Enhanced forecasting improves customer satisfaction by ensuring product availability, minimizing stockouts, and delivering a seamless shopping experience throughout the e-commerce journey.

Conclusion & Next Steps

This project demonstrates how machine learning can effectively predict dead-stock risk using a comprehensive product dataset and a Random Forest classifier. The model successfully identifies items with low, medium, and high risk levels, enabling smarter inventory decisions and preventing financial losses. Moving forward, the system can be enhanced with hyperparameter tuning, real-time data integration, and a user-friendly dashboard or API. These improvements would allow the model to operate dynamically within an e-commerce environment and provide continuous decision support for stock management.