CSCI 6991 – Data Engineering Capstone
Project Proposal

Supply Chain Optimization Using Machine Learning

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Project Description:

Supply chain management is a critical function in modern businesses, but inefficiencies often rises from inaccurate demand forecasting, suboptimal inventory control and poor optimized logistics. Manual decision-making can result in holding high costs, frequent stockouts and delayed deliveries.

We propose a Machine Learning based supply chain optimization platform that integrates demand forecasting, inventory management, logistics optimization and supplier evaluation into a single system. Using Python, Scikit-learn, TensorFlow and optimization libraries like OR-Tools, the system will provide data-driven decision support for improving operational efficiency, reducing costs and mitigating supply chain risks.

Problem Statement:

Businesses often face challenges in balancing demand and supply, resulting in excess stock causing waste and higher costs or stockouts causing revenue loss and dissatisfaction. Logistics inefficiencies and unreliable suppliers further complicate the supply chain. A data driven optimization system is needed to improve forecasting, streamline operations and ensure resilience against disruptions.

Methodology:

1. Data collection and Preprocessing - Using real-world datasets, applying cleaning and feature engineering.
2. Demand Forecasting - Applying ML models (XGBoost, LSTMs) to predict demand.
3. Inventory Optimization – Implement stock level prediction models to minimize carrying costs.

4. Logistics Optimization – Use route optimization (Google OR-Tools, PuLP) to minimize carrying costs.

5. Supplier Evaluation – Develop a scoring system based on cost, quality and reliability using ML classification.
6. Visualization & API – Build an interactive dashboard with Streamlit and provide APIs for enterprise integration.
7. Testing and Validation – Conduct unit testing, scenario simulations and stress testing with synthetic demand spikes.

Project Plan and Timeline:

Week	Activities
1 - 2	Research and requirement analysis
3 - 4	Data Preprocessing and Exploratory Data Analysis (EDA)
5 - 6	Demand Forecasting model development like time series
7 - 8	Inventory Optimization and supplier selection algorithms
9 - 10	Logistics Optimization with OR-Tools
11 - 12	Testing, validation, documentation and final deployment

Expected Results:

- Accurate demand forecasts reducing stockouts and excess inventory.
- Optimized logistics routes minimizing transportation costs and delivery times.
- Automated supplier evaluation ensuring high-quality, reliable procurement.
- End-to-end integration through dashboards and APIs for real-time decision making.
- Scalable framework adaptable to different industries like retail, manufacturing etc.