## **Integrated Retail Analytics for Store Optimization and Demand Forecasting**

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### **Objective:**

To utilize machine learning and data analysis techniques to optimize store performance, forecast demand, and enhance customer experience through segmentation and personalized marketing strategies.

### **Project Components:**

**Anomaly Detection in Sales Data:**

Identify unusual sales patterns across stores and departments.

Investigate potential causes (e.g., holidays, markdowns, economic indicators).

Implement anomaly handling strategies to clean the data for further analysis.

**Time-Based Anomaly Detection:**

Analyze sales trends over time.

Detect seasonal variations and holiday effects on sales.

Use time-series analysis for understanding store and department performance over time.

**Data Preprocessing and Feature Engineering:**

Handle missing values, especially in the MarkDown data.

Create new features that could influence sales (e.g., store size/type, regional factors).

**Customer Segmentation Analysis:**

Segment stores or departments based on sales patterns, markdowns, and regional features.

Analyze segment-specific trends and characteristics.

**Market Basket Analysis:**

Although individual customer transaction data is not available, infer potential product associations within departments using sales data.

Develop cross-selling strategies based on these inferences.

**Demand Forecasting:**

Build models to forecast weekly sales for each store and department.

Incorporate factors like CPI, unemployment rate, fuel prices, and store/dept attributes.

Explore short-term and long-term forecasting models.

**Impact of External Factors:**

Examine how external factors (economic indicators, regional climate) influence sales.

Incorporate these insights into the demand forecasting models.

**Personalization Strategies:**

Develop personalized marketing strategies based on the markdowns and store segments.

Propose inventory management strategies tailored to store and department needs.

**Segmentation Quality Evaluation:**

Evaluate the effectiveness of the customer segmentation.

Use metrics to assess the quality of segments in terms of homogeneity and separation.

**Real-World Application and Strategy Formulation:**

Formulate a comprehensive strategy for inventory management, marketing, and store optimization based on the insights gathered.

Discuss potential real-world challenges in implementing these strategies.

Integrate MLFlow model serving APIs into production deployment pipelines for seamless model deployment and serving.