The Best of the Best
Optimal Dynamic Portfolios for Most-Valuable-Products

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Problem Statement

Context: Every year, the Revenue Growth Management team at CCSWB defines a priority portfolio of beverages, known as **Most-Valuable-Products (MVPs)**, for sales teams to focus on. MVPs include products that have high sales volume and profitability, as well as strategic products that help grow the business.

Current Approach
- By Trade Channel
- Updated Yearly
- Determined by business insights

Opportunities
- What if 2 supermarkets have different demand?
- What if we want MVPs to adjust seasonally?
- How can we use Big Data to inform MVPs?

Goals
- **Customization** — Multiple MVP portfolios per trade channel
- **Dynamic** — Can be updated monthly, quarterly, bi-annually, to capture seasonality
- **Data-Driven** — Determine with optimization, considering historical demand and demographic data

Objective
Create Dynamic, Customer-level Product Portfolios of MVPs to Maximize Profitability.

Project Charter

March	April	May	June	July	August
Onboarding and Stakeholder Meetings		Optimization Formulation		Market Visit	CEO Presentation
	Exploratory Analysis	Clustering	Prediction	Optimization	Solution Validation

Data

- **4 Trade Channels**
- **4200 Retailers**
- **24 Months of Transactions**

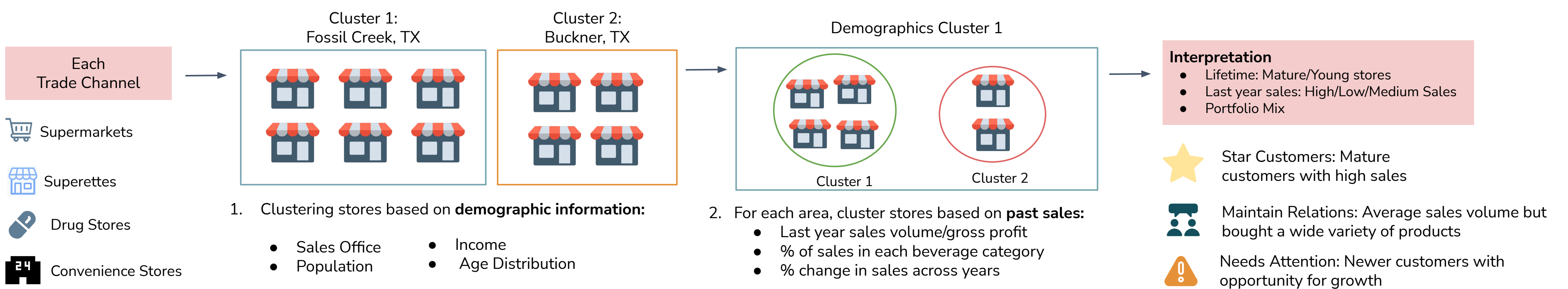Scope: Supermarkets, Superettes, Drug Stores, and Convenience Stores in the **Dallas Fort-Worth Area (DFW)**

Internal Sales — Profit, Volume, Product Information

Retailers — Location, Lifetime, Trade Channel Characteristics

Nielsen — Market Share and Size by beverage category

Demographic — Census Data for Income, Age, Race, Gender

87M Rows in Sales Data

26 Market Districts

Methodology

Clustering

Each Trade Channel
- Supermarkets
- Superettes
- Drug Stores
- Convenience Stores

1. Clustering stores based on **demographic information**:
   - Sales Office
   - Population
   - Income
   - Age Distribution

2. For each area, cluster stores based on past sales:
   - Last year sales volume/gross profit
   - % of sales in each beverage category
   - % change in sales across years

Interpretation
- Lifetime: Mature/Young stores
- Last year sales: High/Low/Medium Sales
- Portfolio Mix

Star Customers: Mature customers with high sales

Maintain Relations: Average sales volume but bought a wide variety of products

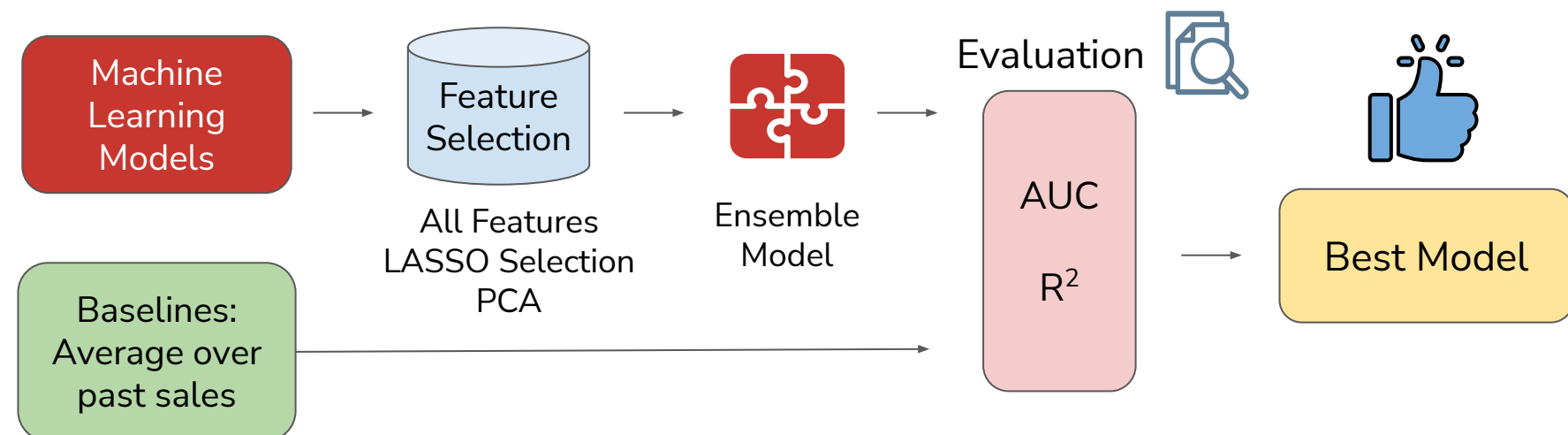**Needs Attention:** Newer customers with opportunity for growth

Prediction

For each product in our dataset, we predicted the **monthly gross profit** and **purchase probability** (propensity), for each store.

Features
- Last 1/3/6/12/24 Month Sales
- Holiday Indicators
- Sales Office Indicators
- Market Share and Size

Models Used
- Linear/Logistic Regression
- Decision Trees
- Random Forest
- XGBoost

Machine Learning Models → Feature Selection (All Features, LASSO Selection, PCA) → Ensemble Model → Evaluation (AUC, R²) → Best Model

Baselines: Average over past sales

Average Out-of-sample AUC **0.91**

Average Out-of-sample R² **0.86**

Optimization

Input:
- ρ_{sj}: Profit Forecast = Predicted gross profit by product for each store
- p_{sj}: Propensity Forecast = Probability of purchase by product for each store

Expected Gross Profit = **Predicted Gross Profit** × **Predicted Propensity**

Formulation:

$$Max \sum_{i=1}^{n_{clusters}} \sum_{j=1}^{n_{products}} x_{ij} \sum_{s \in k_i} p_{sj} * \rho_{sj}$$

Maximize the expected gross profit across all stores in all clusters

Determined by market trends and past sales

$$\sum_{j=1}^{n_{products}} x_{ij} C_{jc} \geq X_c\% \sum_{j \in P} x_{ij}, \forall i \in \{1,...,n_{clusters}\}, c \in PC$$

Variety Constraints

$$\sum_{j=1}^{n_{products}} x_{ij} \leq n_i, \forall i \in \{1,...,n_{clusters}\}$$

Size Constraints

Output: List of core products to be included in a store's portfolio

Opportunity:
Using the optimization allows us to have a smaller size of core products that captures the same percentage of profit – leaving space for strategic products that have high potential to growth

Results

+5.3%
Expected Gross Profit Captured

Trade Channel	% of Expected Gross Profit Captured in June 2021	
	Current Portfolio	Optimal Portfolio
Supermarket	87.5%	93.5% (+6.0%)
Superette	92.0%	94.1% (+2.1%)
Convenience	86.9%	91.2% (+4.3%)
Drug	85.6%	94.3% (+8.7%)

Example: New MVPs suggested (for mature customers, Supermarkets)
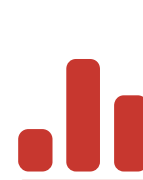
2L Sodas   12 oz Sports Drinks   16.9 oz Enhanced Water

Solution Validation

Backtesting for June 2021 and December 2021:

Run our models 2x to obtain optimal MVP portfolios for June and December

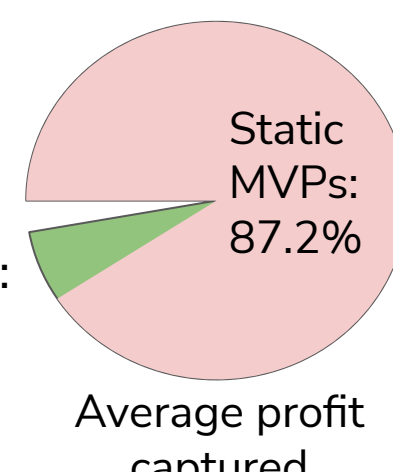Apply June portfolio from June 2021-November 2021; December portfolio from December 2021-May 2022

Compare profit captured between our solution and the current approach

+4.3%
Gross Profit Captured with Dynamic Portfolio

Static MVPs: 87.2%
Our suggestion: 91.5%
Average profit captured

Impact

Since our optimal MVPs capture more profit with the same number of MVPs, the company can choose between strategies:

Option 1 Continue pushing the same number of products

Operate profitable MVPs that are more likely to be purchased

Option 2 Push a smaller portfolio of optimal products

More flexibility to include seasonal packages, innovation SKUs, or high potential products, with same profitability as current MVPs