Customer Suggested Ordering
CCSWB – MIT Collaboration
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Context

Order-taking & distribution process at CCSWB

1. Check sales floor needs
2. Check back-room inventory
3. Write an Order
4. Order preparation
5. Delivery

Ordering visit

Delivery visit
Problem statement

Current pains

- Average suggestions
  - Mental calculations & adjustments
- Experience-dependent
- Time-consuming
Problem statement

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- Average suggestions → Mental calculations & adjustments
- Experience-dependent
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Opportunities

Improve Order Suggestions:

- Can we account for trends & seasonality?
- Can we facilitate operations?
- Can we support volume growth?
Problem statement

Current pains
- Average suggestions
  - Mental calculations & adjustments
- Experience-dependent
- Time-consuming

Opportunities
- Improve Order Suggestions:
  - Can we account for trends & seasonality?
  - Can we facilitate operations?
  - Can we support volume growth?

Goal
- Develop a Customer Suggested Ordering solution that enhances CCSWB's sales & efficiency
Objective

Develop a model that provides frontline employees with **reliable suggestions**, i.e.:

1. Accounts for sales trends & seasonality
2. Prevents out-of-stocks
3. Explores full stores’ sales potential
4. Facilitates operations
Objective

Develop a model that provides frontline employees with reliable suggestions, i.e.:

1. Accounts for sales trends & seasonality
2. Prevents out-of-stocks
3. Explores full stores’ sales potential
4. Facilitates operations

4700 Home Market Retailers in Dallas-Fort Worth

7 Trade Channels:
- Superette
- Convenience Store
- Club Store
- Supermarket
- General Merchandiser
- Hyper-Merchandiser
- Mass-Merchandiser

1200 SKUs in 10 Categories:
- Core Sparkling
- Dairy/Soy Beverages
- Packaged Water
- Enhanced Water Beverages
- Fruit/Vegetables Still Drinks
- Juices/Nectars
- Energy Drinks
- Sport Drinks
- Coffee
- Tea

~1.4M Eq sold weekly

(1 Eq = 5.7 L of beverage)
Our 4-steps solution

+70 Features

Historic sales,
Out-of-stocks,
Demographics,
Nielsen,
Holidays,
Stores,
SKUs,...
Our 4-steps solution

+70 Features

Historic sales, Out-of-stocks, Demographics, Nielsen, Holidays, Stores, SKUs,…

Sales forecast per store, week & SKU groupings

1️⃣ How much will the store buy for the next week?
Our 4-steps solution

1. Sales forecast per store, week & SKU groupings
   How much will the store buy for the next week?

2. Out-of-stocks prevention
   Is there enough to avoid getting out of stock?

+70 Features
- Historic sales
- Out-of-stocks
- Demographics
- Nielsen
- Holidays
- Stores
- SKUs,...
Our 4-steps solution

1. Sales forecast per store, week & SKU groupings
   - How much will the store buy for the next week?

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3. Growth potential exploitation
   - Is the store exploiting its full sales potential?

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Our 4-steps solution

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2. Out-of-stocks prevention
   Is there enough to avoid getting out of stock?

3. Growth potential exploitation
   Is the store exploiting its full sales potential?

4. Disaggregation to days & SKU
   Are the suggestions labor efficient?

+70 Features
Historic sales, Out-of-stocks, Demographics, Nielsen, Holidays, Stores, SKUs,...
Step 1: Sales Forecast

**Goal:** Predict what stores would order during next visits

**Challenges:**
- Different trade channels
- Different schedules & visits frequency
- Different SKUs sold at each visit & store
- Sparse patterns

Forecast at the **store-week-SKUs grouping** level
One model per **trade channel**

1. **Stores segmentation**
   - Supermarket...
   - Convenience store
   - Hyper-Merchandiser

2. **Machine Learning models**
   - **Features:**
     - Historic Sales
     - Demographics
     - Holidays
     - Nielsen
   - **Models:**
     - Linear Regression
     - Decision Tree
     - Random Forest
     - XGBoost

3. **Best model selection** (per trade channel)

   - **wMAPE Evaluation**
Step 1: Sales Forecast

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   - wMAPE Evaluation

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**Application example:**

- **Week:** June 5, 2023
- **Grouping:** Glaceau Smartwater 23.7 OZ Plastic Bottle
- **Store:** El Rio Grande

Forecast 4.4 eq
Step 2: Out-of-Stocks Prevention

1. Out-of-stock Data Extraction
   - Features: Out-of-stock records, sales of the past 4 weeks, calendar

2. Logistic Regression Modeling
   - Estimate probability of out-of-stock for each SKU and store given past sales and next week forecast.

3. Reducing risk of Out-of-stock
   - Increase suggestions when probability of out-of-stock exceeds 45%

Application example:

- **Week:** June 5, 2023
- **Grouping:** Glaceau Smartwater 23.7 OZ Plastic Bottle
- **Store:** El Rio Grande
- **Forecast:** 4.4 eq
- **With OOS model:** 5.1 eq

\[ P_{oos} > 45\% \quad \text{or} \quad P_{oos} \leq 45\% \]
Step 3: Growth Potential Exploitation

1. **Estimate stores’ growth potential**
   Leveraging previous MIT-CCSWB Capstone Sales Potential model:
   - **01 Data collection**
     Collect information about store's sales & surroundings.
   - **02 Customer similarity**
     Cluster stores and identify the 30 most similar to each one.
   - **03 Sales forecasting**
     Predict stores' sales for CCSWB's & competitors' products.
   - **04 Growth potential estimation**
     Compare forecast with weighted average of similar stores' forecast.

2. **Exploit growth potential**, up to 30% suggestion increase

Application example:
- **Week:** June 5, 2023
- **Grouping:** Glaceau Smartwater 23.7 OZ Plastic Bottle
- **Store:** El Rio Grande
- **Forecast:** 4.4 eq
- **With OOS model:** 5.1 eq (+30%)
- **With Potential model:** 6.6 eq (+30%)
Step 4: Suggestions disaggregation

1. Disaggregation

Goal: Suggestions per **week & grouping** ➔ Suggestions per **day & SKU**

Using:
- Historical sales patterns
- Stores' next week schedule
Step 4: Suggestions disaggregation

1. **Disaggregation**
   - **Goal:** Suggestions per week & grouping \(\rightarrow\) Suggestions per day & SKU
   - **Using:**
     - Historical sales patterns
     - Stores' next week schedule

<table>
<thead>
<tr>
<th>Grouping</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thur</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKU 1</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
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<tr>
<td>SKU 2</td>
<td>%</td>
<td>%</td>
<td>%</td>
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<td>%</td>
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<td>%</td>
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<tr>
<td>SKU 3</td>
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2. **Layers adjustments**
   - **Goal:** Promote full layers sales to facilitate warehouse operations

   **Layer picking** is much more efficient than manual picking

   **BEFORE:**
   - Mon: 8
   - Thur: 4
   - 2 manual picks

   **AFTER:**
   - Mon: 9
   - Thur: 3
   - 1 full layer + 1 manual pick
Back-testing results

1 Better forecast performance
Our forecast model improves the baseline by **22%**

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<td>43%</td>
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Predicted vs Actual Weekly Sales

- Diet Coke 12Oz Can
- Walmart

Dec 2022 – May 2023
Back-testing results

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2. **+3.3%** Expected Sales Captured

- **+ 230k** Eq weekly with **oos prevention** (+2%)
- **+ 110k** Eq weekly with **growth potential** (+1%)

3. Simplified operations

*62%*
Suggested volume can be delivered in full layers

- Dec 2022 – May 2023
- Walmart
- Diet Coke 12Oz Can

June 2023
Next Steps

Model Fine-Tuning

Validate and refine Model to ensure it is ready for implementation.

Real-World Pilot Testing

Implement solution in controlled pilot environment for testing before deployment.

Tool Integration

Integrate order suggestion model into existing order-taking app.
Thank you for your attention!

Thanks to CCSWB’s team for hosting this Capstone project and organizing the market visits in Dallas!