Joint Replenishment and Base Stock Policy for the U.S. Beer Industry

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## Introduction

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MillerCoors Overview

- US business unit of Molson Coors
- 55 million barrels annual production
- 7 large-scale breweries
- 7 craft breweries
- 50+ brands
- #1 craft beer

<table>
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<tr>
<th>PREMIUM</th>
<th>IMPORT/INT’L</th>
<th>FMB/CIDER</th>
<th>CRAFT</th>
<th>ECONOMY</th>
</tr>
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<tbody>
<tr>
<td>Coors Light</td>
<td>Peroni</td>
<td>Redds Apple Ale</td>
<td>Saint Archer</td>
<td>Miller High Life</td>
</tr>
<tr>
<td>Lite</td>
<td>Canadian</td>
<td>Henry’s Hard Soda</td>
<td></td>
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Beer Industry’s Three Tier Distribution Network

MillerCoors Brewery Network

- Golden, CO
- Leinenkugel’s Chippewa Falls, WI
- Milwaukee, WI
- Fort Worth, TX
- Elkton, VA
- Albany, GA
- Trenton, OH
- Terrapin Beer Co. Athens, GA
- Blue Moon Brewing Co. Denver, CO
- Revolver Brewing Grandbury, TX
- Saint Archer Brewing Co. San Diego, CA
- Hop Valley Brewing Eugene, OR

BREWER → DISTRIBUTOR → RETAIL OUTLET → CONSUMER

Container Operation Joint Ventures Support Manufacturing
• *How does a Joint Replenishment approach improve the way we determine inventory policy for multi-echelon supply chains?*
By answering the research question, we should be able to:

- Understand how to link optimal production frequency with inventory policy
- Make better decisions when determining inventory policy for new products
Relevance/Motivation

Increasing Number of SKUs

Difficulty rationalizing portfolios

Increasing complexity of portfolio with low volume SKUs

Full Truckload Requirements
Methodology

1. Collect and Clean Data
2. Calculate Run Strategies (JRP)
3. Calculate Base Stock Policy
Joint Replenishment

- Focuses on determining the economic production frequency of each SKU
- Transformation of the Economic Order Quantity (EOQ) Formula

1. \( \bar{n}_i = \sqrt{\frac{hC_iD_i}{2(S+s_i)}} \)

2. \( \bar{n}_i = \sqrt{\frac{hC_iD_i}{2s_i}} \)

3. \( m_i = \left\lfloor \frac{n}{\bar{n}_i} \right\rfloor \)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
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<tbody>
<tr>
<td>h</td>
<td>Inventory holding cost %</td>
</tr>
<tr>
<td>C</td>
<td>SKU Unit Cost</td>
</tr>
<tr>
<td>D</td>
<td>Annual Demand</td>
</tr>
<tr>
<td>S</td>
<td>Setup Cost</td>
</tr>
<tr>
<td>s</td>
<td>SKU specific cost</td>
</tr>
<tr>
<td>m</td>
<td>Frequency to produce each SKU</td>
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Joint Replenishment Process

1. Calculate Economic Production Frequency for All SKUs
2. Determine SKU with highest number of runs and isolate
3. Recalculate Production Frequency for all other remaining SKUs
4. Calculate the ratio of runs for every SKU compared to most frequently produced
5. Map economic frequency to a run strategy
Run Strategies

Produced weekly (Weeks 1, 2, 3, 4)

Produced bi-weekly, on odd weeks (Weeks 1 and 3)

Produced bi-weekly, on even weeks (Weeks 2 and 4)

Produced one out of four weeks, on first odd (Week 1)

Produced one out of four weeks, on first even (Week 2)

Produced one out of four weeks, on second odd (Week 3)

Produced one out of four weeks, on second even (Week 4)
Base Stock Model

• Focuses on determining the appropriate inventory level to deliver a chosen level of service.

\[ \text{Target Level of Inventory (DC)} = \frac{R \cdot \mu_i}{2} + z \sigma_i \sqrt{R + L} \]

\[ \text{Target Level of Inventory (Distributor)} = R \cdot \mu_i + z \sigma_i \sqrt{R} \]

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<thead>
<tr>
<th>Variable</th>
<th>Description</th>
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<tbody>
<tr>
<td>R</td>
<td>Review Period</td>
</tr>
<tr>
<td>( \mu_i )</td>
<td>Average Weekly Demand</td>
</tr>
<tr>
<td>z</td>
<td>Service Level</td>
</tr>
<tr>
<td>( \sigma_i )</td>
<td>Standard Deviation of Weekly Demand</td>
</tr>
<tr>
<td>L</td>
<td>Lead Time</td>
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Results

- 52% of SKUs classified with same run strategy
- 39% of SKUS classified in an adjacent run strategy
- 9% of SKUs shifted from weekly to one-in-four or vice versa

<table>
<thead>
<tr>
<th>Actual Run Strategy</th>
<th>4wk Cycle</th>
<th>Every Other Week</th>
<th>Weekly</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>4wk Cycle</td>
<td>23</td>
<td>10</td>
<td>2</td>
<td>35</td>
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<tr>
<td>Every Other Week</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>11</td>
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<tr>
<td>Weekly</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>8</td>
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<tr>
<td>Total</td>
<td>35</td>
<td>14</td>
<td>5</td>
<td></td>
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- Inventory reduced for 80% of SKUs
- Inventory reduced by 8,600 Barrels
Managerial Implications

Smooths Run Strategy Variability

Brewery
- Run Strategy
  - Weekly
  - Bi-Weekly
  - One-In-Four

Distribution Center
- Base Stock
  - Review Period + Lead Time

Distributor
- Base Stock
  - Review Period

Constant Review Period and Lead Time
Conclusion

Distribution centers can help buffer customers from variations in production frequency

Base Stock Model improves inventory policies in three-tier system

Linking the JRP with Base Stock model helps manage inventory of low-volume high complexity SKUs
Q&A