Agenda

- SLO Overview
- Global Service Level Targets
- SKU-level Service Level Target Setting
Service Level Optimization: Basics

- Target service levels are key inputs for inventory planning
- Some industries measure service level at the global level
- Planning requires that *global* target be disaggregated to *item-location-specific* targets
- Managers try to balance conflicting pressures from
  - Reducing inventory and operating costs
  - Improving service and customer satisfaction
  - Reducing lost sales
- A tool is required to determine the item-location service levels
Service Level Optimization Purpose

- Given supply chain topology information and cost parameters, determine **stocking point-specific** service level targets to
  - Minimize total safety stocks
  - Minimize total inventory cost, or
  - Minimizing total inventory cost *and* lost margin

  - Ensuring target global fill rate, *when applicable*
  - Enforcing min-max limits on individual service levels

{ Objectives } { Constraints }
Inputs and Outputs

**Inputs**
- Replenishment characteristics
- Unit Cost, Unit Purchase Cost and Unit Transfer Price
- Service Level Measure
- Minimization Objective
- Minimum and Maximum Service Level Allowed
- Lost Sales Percentage
- Global Service Objective (Optional)

**Outputs**
- SKU Service Levels
- Inventory Targets
- Lost Demand and Margin
- Optimal Global Service Objective (When not input)
## Service Level Optimization Use Cases

<table>
<thead>
<tr>
<th>SLO Feature</th>
<th>Meet Global Target</th>
<th>Balance Costs with Lost Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimization Objective</td>
<td>Minimize Inv. Costs</td>
<td>Minimize $\sum (\text{Inv. Costs, Lost Margin})$</td>
</tr>
<tr>
<td>Global Service Constraint</td>
<td>Yes (Unit or Dollar Fill Rate)</td>
<td>No (The optimal global service level is an output based upon the tradeoff between inventory cost and lost margin)</td>
</tr>
<tr>
<td>Allowable Range for Item-Loc Service Level</td>
<td>Input</td>
<td>Input</td>
</tr>
<tr>
<td>Sales Price</td>
<td>Not required</td>
<td>Input</td>
</tr>
<tr>
<td>Lost Sales Percentage**</td>
<td>Not required</td>
<td>Input</td>
</tr>
</tbody>
</table>
Agenda

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Intuition Building Example – Meet Global Target

- Consider 3 items subject to a global fill rate of 95%

- Assume
  - PBR = 1 and LT = 1
  - Holding Cost Percentage = 20%

- Consider when all three items are set to 95%
  - Annual SS Holding Cost: $55,121
  - Annual Inv Holding Cost: $173,583

<table>
<thead>
<tr>
<th>Item</th>
<th>Case Inv. Cost</th>
<th>Weekly Demand Forecast</th>
<th>Forecast Error</th>
<th>Target Fill Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$100</td>
<td>500</td>
<td>25%</td>
<td>95%</td>
</tr>
<tr>
<td>2</td>
<td>$200</td>
<td>1000</td>
<td>25%</td>
<td>95%</td>
</tr>
<tr>
<td>3</td>
<td>$100</td>
<td>1500</td>
<td>100%</td>
<td>95%</td>
</tr>
</tbody>
</table>
Intuition Building Example – Scenario 1

- To lower cost, let’s reduce the fill rate of Item 3 by 1% to 94%

- To maintain the global fill rate, we need to adjust the fill rate of the remaining items. Let’s adjust the fill rate of Item 2 by 1.5% to 96.5%

- Annual SS Holding Cost: $54,365 (a 1% improvement)

<table>
<thead>
<tr>
<th>Item</th>
<th>Case Inv. Cost</th>
<th>Weekly Demand Forecast</th>
<th>Forecast Error</th>
<th>Target Fill Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$100</td>
<td>500</td>
<td>25%</td>
<td>95.0%</td>
</tr>
<tr>
<td>2</td>
<td>$200</td>
<td>1000</td>
<td>25%</td>
<td>96.5%</td>
</tr>
<tr>
<td>3</td>
<td>$100</td>
<td>1500</td>
<td>100%</td>
<td>94.0%</td>
</tr>
</tbody>
</table>
Intuition Building Example – Scenario 2

- However, note that Item 1 is less expensive than Item 2. Instead of adjusting Item 2, let’s adjust the fill rate of Item 1 by 3% to 98%.

- Annual SS Holding Cost: $53,248

<table>
<thead>
<tr>
<th>Item</th>
<th>Case Inv. Cost</th>
<th>Weekly Demand Forecast</th>
<th>Forecast Error</th>
<th>Target Fill Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$100</td>
<td>500</td>
<td>25%</td>
<td>98%</td>
</tr>
<tr>
<td>2</td>
<td>$200</td>
<td>1000</td>
<td>25%</td>
<td>95%</td>
</tr>
<tr>
<td>3</td>
<td>$100</td>
<td>1500</td>
<td>100%</td>
<td>94%</td>
</tr>
</tbody>
</table>
Intuition Building Example – Optimal

- The most cost-effective approach is to set
  - Item 1 to 98.36%
  - Item 2 to 96.10%
  - Item 3 to 93.15%

- Annual SS Holding Cost: $53,081 (a 4% improvement)
- Annual Inv Holding Cost: $171,543

<table>
<thead>
<tr>
<th>Item</th>
<th>Case Inv. Cost</th>
<th>Weekly Demand Forecast</th>
<th>Forecast Error</th>
<th>Target Fill Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$100</td>
<td>500</td>
<td>25%</td>
<td>98.36%</td>
</tr>
<tr>
<td>2</td>
<td>$200</td>
<td>1000</td>
<td>25%</td>
<td>96.10%</td>
</tr>
<tr>
<td>3</td>
<td>$100</td>
<td>1500</td>
<td>100%</td>
<td>93.15%</td>
</tr>
</tbody>
</table>
Example Recap: Meet Global Target

- Customer Service level: unchanged
- Business saves money with no adverse customer impact
- Optimal solution found within Global Service level constraint
Agenda

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Service Level Optimization: Balance Costs with Lost Margin

• How is an inventory target set?
• Managers try to balance conflicting pressures from
  – Reducing inventory and operating costs
  – Improving service and customer satisfaction
  – Reducing lost sales
• How can we run the calculation to determine optimum service level in the absence of a Global service level?
  – Balance cost of lost sales with cost of higher service
  – Use EIS granular, item-location-time period approach
• A tool is required to determine the item-location service levels
SLO Intuition Building Example 2 – Minimizing inventory cost and lost margin

- Consider unit purchase cost, unit transfer (sell) price and lost sales percentage when service is not perfect

<table>
<thead>
<tr>
<th>Item</th>
<th>Case Inv. Cost</th>
<th>Weekly Demand Forecast</th>
<th>Forecast Error</th>
<th>Case Purchase Cost</th>
<th>Case Transfer (Sell) Price</th>
<th>Lost Sales Perc.</th>
<th>Optimal Fill Rate Based on Min Inv Alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$100</td>
<td>500</td>
<td>25%</td>
<td>$80</td>
<td>$120</td>
<td>10%</td>
<td>98.36%</td>
</tr>
<tr>
<td>2</td>
<td>$200</td>
<td>1000</td>
<td>25%</td>
<td>$150</td>
<td>$250</td>
<td>15%</td>
<td>96.10%</td>
</tr>
<tr>
<td>3</td>
<td>$100</td>
<td>1500</td>
<td>100%</td>
<td>$100</td>
<td>$130</td>
<td>15%</td>
<td>93.15%</td>
</tr>
</tbody>
</table>
Intuition Building Example – Minimizing inventory cost and lost sales

- Consider item 3 (“yellow” item)
- Total cost of inventory holding and lost sales is $132,278
Intuition Building Example – Minimizing inventory cost and lost sales

- Let’s vary the service level target

![Total Cost of Inventory Holding and Lost Sales](chart)

- **Lost Sales $**
- **Other Holding $**
- **SS Holding $**
Intuition Building Example – Minimizing inventory cost and lost sales

- The most cost-effective approach is to set Item 3 to 97.59%
- Total cost of inventory holding and lost sales become $122,566 from $132,278
Intuition Building Example – Minimizing inventory cost and lost margin

- Across all items, we get optimal fill rates as below

<table>
<thead>
<tr>
<th>Item</th>
<th>Case Inv. Cost</th>
<th>Weekly Demand Forecast</th>
<th>Forecast Error</th>
<th>Case Purchase Cost</th>
<th>Case Price</th>
<th>Loss Perc.</th>
<th>Optimal Fill Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$100</td>
<td>500</td>
<td>25%</td>
<td>$80</td>
<td>$135</td>
<td>10%</td>
<td>98.86%</td>
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<tr>
<td>2</td>
<td>$200</td>
<td>1000</td>
<td>25%</td>
<td>$150</td>
<td>$230</td>
<td>15%</td>
<td>99.49%</td>
</tr>
<tr>
<td>3</td>
<td>$100</td>
<td>1500</td>
<td>100%</td>
<td>$100</td>
<td>$130</td>
<td>15%</td>
<td>97.59%</td>
</tr>
</tbody>
</table>

The overall global fill rate will be 98.44%, showing the optimal cost structure existing at a higher service level than the previous estimated 95% global target.
Sample SLO Results

Recommended Service Level Target Changes by Stocking Point

Change in Service Level

-8.0%
-6.0%
-4.0%
-2.0%
0.0%
2.0%

Service Increases
Service Decreases
Service Level Optimization Summary

EIS’ Service Level Optimization module (SLO) is designed:

- to determine the right *item-location-specific* service targets
- to minimize inventory investment and lost margin
- while meeting a global service objective, or
- while setting service level objectives based on the balance between cost-to-serve and cost of lost sales

SLO evaluates the true cost drivers with its EIO backbone:

- Product volume
- Product cost
- Demand and supply variability
- Batch and lot sizes
- Coordinated multistage inventory planning
- Trades off lost margin versus holding cost

Service Level Optimization has provided:

- an additional 5-10% on hand inventory reduction *on top of EIO*
- better understanding and decision-making capability around the trade off between service and inventory

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Thank you