Role of Forecast Analytics in Inventory Management

ISM Chapter - NAPM Denver Seminar

Ramon Colomina
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Agenda

- Forecast Analytics Overview and Benefits
- Case Study
  - Issues
  - Objectives
  - Approach and Roadmap
  - Algorithm selection based on history patterns
  - Simple replenishment strategy for slow moving products
Why Analytics

Changing Customer trends
- Customer base is getting more fragmented, personalized and polarized
- Tailored promotions and offerings needed to capture retail customers
- Want things convenient, simple and ready-for-consumption
- Environmental/Sustainability consciousness
- Mobile, socially interconnected and time compressed

Challenges in Global Supply Chains
- Overseas sourcing and long lead times for products
- Global/Local execution of pricing and promotional strategies
- Profit erosion due to increased markdowns at the end of the season
- Inefficiencies and lack of cohesion between assortment planning, inventory management and vendor management
- Increased competition and lower margins
- Cost equation volatility
Gradual Misalignment in Planning Models

Misalignment of planning models vs. business dynamics over a period of time

**Static planning models**

- Basic forecasting and planning models use mathematical models to project historical data into the future, and allow planners to take decisions based on those projections. These models need to evolve as the business does to avoid inaccurate projections driving inefficient decisions.

- Need for an on-going recalibration of the planning models
# Implications - Levers

<table>
<thead>
<tr>
<th>Levers</th>
<th>Some Key Questions</th>
</tr>
</thead>
</table>
| Assortment and Space Planning | • How can retailers create *personalized* products “at scale?”  
• How can retailers best use floor space and allocate the right mix of product types  
• How do retailers sell *sustainable* products while keeping costs in control? |
| Supply Chain                  | • How can retailers deliver *convenience* by delivering product where the customer wants, when he/she wants it … and at scale?  
• How can retailers reduce *environmental* impacts of distributing product? |
| Advertising and Promotions    | • How can retailers *tailor* offers to individual consumers?  
• How can promotions increase the connection between a retailer and their customer, creating a more ubiquitous customer *experience*? |
| In-Store Experience           | • How can retailers create a relevant *experience* that enhances the shopping occasion versus making it more complex?  
• How can different customer service models increase *personalization* and enable *convenience*? |
Understanding Product and Customer Characteristics

Needs

• Increased need to understand product and customer characteristics based on historical patterns
  □ Marketing perspective (Customer segmentation, Campaign management)
  □ Sales perspective (Customer profitability, Market basket analysis)
  □ Inventory and Merchandise flow (Forecasting, Pricing & Promotions analysis, Inventory Optimization)
  □ Customer perspective (Customer loyalty and satisfaction)

• Products, business processes and technologies are gradually losing out as competitive tools. High performance execution, analytics & insights are important differentiation strategies.

Enablers - Supporting Architecture

• Integrated massive data warehouses and data marts
• Mature BI architecture
• Availability of sophisticated statistical and analytical techniques
• Availability of large processing power
Forecast Analytics Overview

Forecast analytics drives to improve critical forecasting processes, such as,
analysis of historical data, forecast algorithm selection & fine tuning,
promotional analysis and external factor analysis

• Matching demand patterns with suitable algorithms to generate forecasts
• Classifying product groups based on clustering techniques
• Efficient segmentations to make the forecasting process lean
• Understanding of external casual factors and how it affects the product forecast
• Understanding and predictability of promotional effects on baseline forecast
• Improving control on processing times as segmentation techniques allow the
  business to focus on processing prioritization

“Aberdeen Research’s Supply Chain Inventory Strategies Benchmark Report states that more than 60%
of companies use overly simplistic forecasting and inventory management methods. These companies
frequently have 15-30% more inventory than they need and lower service levels”
Additionally, such analytics could lead to additional focus in the supply chain in the following areas:

- Downstream Fulfillment Strategy
- Safety Stock Analysis
- Pricing and Promotional Optimization
- SKU Rationalization

**Forecast Analytics - Value at Multiple Stages**

- Pre-Demand Implementation
  - Initial Hierarchy and Clustering of Products
  - Determine Forecastability of Products
  - Reduced risk and complexity

- Demand Implementation
  - Hierarchy Modeling
  - Algorithm Selection and Configuration
  - KPI’s and Accuracy measures modeling

- Post-Demand Implementation
  - Algorithm Fine tuning
  - KPI’s and Accuracy measures modeling
  - Cluster and hierarchy fine tuning

**Analytics at multiple stages**

- Tuned Forecast Models with Forecast Analytics
- Un-tuned Forecast Models without Forecast Analytics

(ILLUSTRATIVE)
We typically see companies achieve a range of benefits when focusing on Forecast analytics.

**Benefits**
- Improved forecast accuracy of 5-20% at different levels of the hierarchies
- 10-20% improvement in batch times
- 10-20% reduction in obsolescence with improved life cycle management
- 5-15% reduction in stock-outs
- Improved understanding of product groups behaviors based on historical tendencies
- Improved understanding of the influence of external causal factors

**Improvement Opportunities**
- Improved forecast accuracy
- Better understanding of market behaviors based on product clusters
- Improving understanding of external causal factors
- Improved control on processing times
- Increased understanding of promotional effects
- Reduced inventory
- Reduced IM risk and improved ROI
Case Study
About the Retailer

- Midwest Retailer is a $12 billion Regional Super Center
- More than 40 departments including Grocery, Fashion, Automotive, Home Decor, Health and Beauty Care, Pharmacy, Electronics, Pets and more)
- Retailer has 181 stores, 164 Gas Stations and 7 Convenience Stores serving the Mid-western United States
- Retailer has over 60,000 people employed across the organization
- Retailer is in the midst of a major Merchandise Transformation program to enable the organization to best meet its mission - Price, Product, Promotion, People, Place, Presentation
- Retailer began implementing systems suite comprised of both custom and JDA packaged systems – Product Master, Financial & Assortment Planning, Space Planning, Promotions Planning, Demand and Replenishment Planning
## Common Forecasting Issues at the Retailer

### Typical Product Characteristics
- Highly seasonal products
- Sporadic demand
- Irregular demand
- New product introductions
- New store introductions
- Promotional triggers
- Causal factors

### Typical Process Characteristics
- Inadequate understanding of history data
- Limited knowledge on forecasting models
- Non-standard forecasting processes
- Limited knowledge on applying external factors
- Limited statistical skill sets in Demand Planning Organization
- Insufficient time to perform statistical analysis

### Typical Business Responses
- Using generic parameters sets for forecasting models
- Treating Seasonal products same as Continuous products
- Executing non-standard forecasting processes
- Application of Causal factors was limited
- Insufficient time and skills to perform statistical analysis

### Cost Impacts
- Excess inventory levels
- Inefficient pre-build of products
- Excess clearance and markdowns

### Service Impacts
- Out-of-Stock and lost sales
- Inadequate safety stock levels
- Product obsolescence
Forecast Analytics Objectives

- Improve the understanding of product characteristics based on historical analysis
- Provide sustainable forecasting processes and models
- Provide a process for forecast algorithm selection
- Provide initial set of optimized forecast model parameters
- Provide a process of promotional impact analysis
- Provide replenishment strategies for slow moving products
  - Whether to forecast products or use simple re-ordering?

Algorithm Selection

Replenishment strategy for Slow moving products
Approach for Analytics

Program Management Steps

Prepare
- Define Objectives and Preparation
- Define Optimization Process

Set Up
- Gather/Validate/Prepare Data
- Establish Benchmarks

Model
- Develop Model and Scenarios
- Perform Analysis

Recommend
- Evaluate/Recommend

Develop/Implement the following: Communication Plan, Status Report, Issue & Risk Management, Recommendation and Findings, Effort schedule with Timeline

Key Activities

Prepare
- Conduct kick-off meeting and set forecast optimization objectives
- Scope confirmation
- Hold workshop to set objectives and high level tasks and processes

Set Up
- Gather, validate, cleanse all data, if applicable
- Define Optimization procedure and tasks
- Assess and define segmentation and hierarchy

Model
- Load/run/validate baseline and document assumptions
- Potential quick wins
- Load/run scenarios and perform high level check
- Summarize data in appropriate comparison chart

Recommend
- Assess impact on process, people and technology.
- Summarize quantitative and qualitative comparisons
- Assess operational, change readiness and any implementation risk

Key Outputs/Deliverables

Prepare
- Stakeholder buy in
- Communication plan
- Initial findings/issues
- Prioritized assessment area

Set Up
- Detail flow diagram of optimization processes
- Summary of generated scenario
- Sign off on approach with key assumptions
- Customer/Product segmentation & Hierarchy

Model
- Summary validation statistics
- Signed off validation document with key assumptions
- Scenario run log
- Scenario analysis statistics

Recommend
- Shortlist of solution for in-depth impact assessment
- Final recommendation on Forecast Optimization
- Implementation plan for pilot and high level deployment plant
- Summary of potential quick win opportunities.
High Level Analytics Roadmap

1. Database
   - History & Volume Classification
   - Algorithm Recommendation
     - Optimal Algorithm Parameters
   - Forecast using Recommended Algorithms
     - Continuous Products
     - Seasonal Products
   - Store Clustering
     - Forecast-ability Analysis
     - Slow Moving Products
     - End of Life Cycle or Obsolete
     - SKU Rationalization
     - Adjust Assortment Strategy
     - Markdown Optimization
     - Safety Stock & Re-Order Point
     - Replenish using Optimal Stocking & Ordering Policies
     - Aggregate Forecast
       - Seasonal Forecasting
       - Optimal Allocation to Stores
       - Replenish using Optimal Stocking & Ordering Policies
     - Replenish using Optimal Stocking & Ordering Policies
   - Aggregate Forecast
     - Safety Stock & Re-Order Point
     - Replenish using Optimal Stocking & Ordering Policies
   - SKU Rationalization
     - Adjust Assortment Strategy
     - Markdown Optimization
     - Disposition
Data Selection
- Database
- 4 million product x store combinations

Classification criteria definition

Define History Classes
- Continuous, Erratic, Lumpy and Management Control

Define Volume classification
- High Volume – Items that sell > 7 units per week
- Medium Volume – Items that sell between 1 and 7 units per week
- Low Volume – Items that sell < 1 unit per week

Volume classification process

- DFUs Clustering
- Algorithm recommendation

Analysis
- Analysis by:
  - Category
  - Sub Category
  - Product Class
- Analysis of clusters based on algorithms
- Create algorithm parameter files for recommended algorithms

<table>
<thead>
<tr>
<th>Cluster classification</th>
<th>Algorithm recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>D_Class 1</td>
<td>% DFUs Lewandoski</td>
</tr>
<tr>
<td></td>
<td>% DFUs Crostons</td>
</tr>
<tr>
<td></td>
<td>% Holt Winters</td>
</tr>
<tr>
<td>D_Class 2</td>
<td>% DFUs Lewandoski</td>
</tr>
<tr>
<td></td>
<td>% DFUs Crostons</td>
</tr>
<tr>
<td></td>
<td>% Holt Winters</td>
</tr>
<tr>
<td>D_Class 3</td>
<td>% DFUs Lewandoski</td>
</tr>
<tr>
<td></td>
<td>% DFUs Crostons</td>
</tr>
<tr>
<td></td>
<td>% Holt Winters</td>
</tr>
<tr>
<td>D_Class 4</td>
<td>% DFUs Lewandoski</td>
</tr>
<tr>
<td></td>
<td>% DFUs Crostons</td>
</tr>
<tr>
<td></td>
<td>% Holt Winters</td>
</tr>
<tr>
<td></td>
<td>...</td>
</tr>
</tbody>
</table>
Algorithm Selection – History Classes

**Continuous**
- Good number of history points available. Less than 13-15% of history points are zero or invalid history points

**Erratic**
- Fair number of history points available. Between 15-40% of history points are zero or invalid history points

**Lumpy**
- Poor number of history points available. Between 40-90% of history points are zero or invalid history points

**Management Control**
- Almost no history available. Less than 10% of history points are valid history points

For each of the above history patterns, the system determines if the items are SEASONAL or NON-SEASONAL
Algorithm Selection – Product Analysis

Typical Volume and History Class distribution for General Merchandise products

<table>
<thead>
<tr>
<th>Volume Class</th>
<th>Criteria</th>
<th>% of DFUs</th>
<th># of DFUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100 units per week</td>
<td>0.009%</td>
<td>959</td>
</tr>
<tr>
<td>B</td>
<td>Between 50 and 100 units per week</td>
<td>0.024%</td>
<td>2,426</td>
</tr>
<tr>
<td>C</td>
<td>Between 14 and 50 units per week</td>
<td>0.243%</td>
<td>25,000</td>
</tr>
<tr>
<td>D</td>
<td>Between 7 and 14 units per week</td>
<td>0.622%</td>
<td>64,000</td>
</tr>
<tr>
<td>E</td>
<td>Between 1 and 7 units per week</td>
<td>42.750%</td>
<td>4,400,000</td>
</tr>
<tr>
<td>F</td>
<td>Less than 1 unit per week</td>
<td>43.722%</td>
<td>4,500,000</td>
</tr>
<tr>
<td>G</td>
<td>Less than 1 unit per month</td>
<td>12.631%</td>
<td>1,300,000</td>
</tr>
</tbody>
</table>

- More than 80% of items sell less than 7 units per week
- The bulk of the items (almost 57%) sell less than 1 unit per week
- Classes F and G are termed as LOW VOLUME
- Classes E is termed as MEDIUM VOLUME
- Classes A, B, C and D are termed as HIGH VOLUME

<table>
<thead>
<tr>
<th>History Class</th>
<th># of DFUs</th>
<th>% of DFUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Control</td>
<td>7,624,695</td>
<td>73.2%</td>
</tr>
<tr>
<td>Lumpy Non Seasonal</td>
<td>2,099,752</td>
<td>20.2%</td>
</tr>
<tr>
<td>Lumpy Seasonal</td>
<td>347,588</td>
<td>3.3%</td>
</tr>
<tr>
<td>Obsolete</td>
<td>217,317</td>
<td>2.1%</td>
</tr>
<tr>
<td>Erratic Non Seasonal</td>
<td>85,070</td>
<td>0.8%</td>
</tr>
<tr>
<td>Erratic Seasonal</td>
<td>25,861</td>
<td>0.2%</td>
</tr>
<tr>
<td>Continuous Non Seasonal</td>
<td>12,330</td>
<td>0.1%</td>
</tr>
<tr>
<td>Continuous Seasonal</td>
<td>3,789</td>
<td>0.04%</td>
</tr>
<tr>
<td>Total</td>
<td>10,416,402</td>
<td></td>
</tr>
</tbody>
</table>
Algorithm Selection - Results

- Optimal Algorithm selection for each product cluster
- Recommended forecast frequency cadence

<table>
<thead>
<tr>
<th>CLUSTER</th>
<th>History Class</th>
<th>Volume Class</th>
<th>% of DFUs</th>
<th>Model</th>
<th>Forecast Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>LN - M_V</td>
<td>Lumpy Non Seasonal</td>
<td>Medium Velocity</td>
<td>12.596%</td>
<td>Crostons</td>
<td>Weekly</td>
</tr>
<tr>
<td>LN - L_V</td>
<td>Lumpy Non Seasonal</td>
<td>Low Velocity</td>
<td>6.221%</td>
<td>Crostons</td>
<td>Weekly</td>
</tr>
<tr>
<td>LN - H_V</td>
<td>Lumpy Non Seasonal</td>
<td>High Velocity</td>
<td>0.862%</td>
<td>Crostons</td>
<td>Weekly</td>
</tr>
<tr>
<td>EN - M_V</td>
<td>Erratic Non Seasonal</td>
<td>Medium Velocity</td>
<td>0.573%</td>
<td>Crostons</td>
<td>Weekly</td>
</tr>
<tr>
<td>ES - M_V</td>
<td>Erratic Seasonal</td>
<td>Medium Velocity</td>
<td>0.207%</td>
<td>Lewandowski</td>
<td>Weekly</td>
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<tr>
<td>ES - H_V</td>
<td>Erratic Seasonal</td>
<td>High Velocity</td>
<td>0.141%</td>
<td>Lewandowski</td>
<td>Weekly</td>
</tr>
<tr>
<td>CN - M_V</td>
<td>Continuous Non Seasonal</td>
<td>Medium Velocity</td>
<td>0.050%</td>
<td>Lewandowski</td>
<td>Weekly</td>
</tr>
<tr>
<td>CN - H_V</td>
<td>Continuous Non Seasonal</td>
<td>High Velocity</td>
<td>0.041%</td>
<td>Lewandowski</td>
<td>Weekly</td>
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<tr>
<td>ES - L_V</td>
<td>Erratic Seasonal</td>
<td>Low Velocity</td>
<td>0.039%</td>
<td>MLR</td>
<td>Weekly</td>
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<tr>
<td>EN - H_V</td>
<td>Erratic Non Seasonal</td>
<td>High Velocity</td>
<td>0.034%</td>
<td>Lewandowski</td>
<td>Weekly</td>
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<tr>
<td>CS - H_V</td>
<td>Continuous Seasonal</td>
<td>High Velocity</td>
<td>0.022%</td>
<td>Lewandowski</td>
<td>Weekly</td>
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<tr>
<td>CS - M_V</td>
<td>Continuous Seasonal</td>
<td>Medium Velocity</td>
<td>0.018%</td>
<td>Lewandowski</td>
<td>Weekly</td>
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<td>EN - L_V</td>
<td>Erratic Non Seasonal</td>
<td>Low Velocity</td>
<td>0.009%</td>
<td>Crostons</td>
<td>Weekly</td>
</tr>
<tr>
<td>CN - L_V</td>
<td>Continuous Non Seasonal</td>
<td>Low Velocity</td>
<td>0.000%</td>
<td>Lewandowski</td>
<td>Weekly</td>
</tr>
<tr>
<td>CS - L_V</td>
<td>Continuous Seasonal</td>
<td>Low Velocity</td>
<td>0.000%</td>
<td>Lewandowski</td>
<td>Weekly</td>
</tr>
<tr>
<td>Mc - L_V</td>
<td>Management Control</td>
<td>Low Velocity</td>
<td>46.725%</td>
<td>Lewandowski</td>
<td>Monthly</td>
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<td>Mc - M_V</td>
<td>Management Control</td>
<td>Medium Velocity</td>
<td>18.386%</td>
<td>Lewandowski</td>
<td>Monthly</td>
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<td>Mc - H_V</td>
<td>Management Control</td>
<td>High Velocity</td>
<td>6.597%</td>
<td>Lewandowski</td>
<td>Monthly</td>
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<tr>
<td>LS - M_V</td>
<td>Lumpy Seasonal</td>
<td>Medium Velocity</td>
<td>2.623%</td>
<td>MLR</td>
<td>Monthly</td>
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<tr>
<td>LS - L_V</td>
<td>Lumpy Seasonal</td>
<td>Low Velocity</td>
<td>0.721%</td>
<td>MLR</td>
<td>Monthly</td>
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<td>LS - H_V</td>
<td>Lumpy Seasonal</td>
<td>High Velocity</td>
<td>0.112%</td>
<td>Lewandowski</td>
<td>Monthly</td>
</tr>
</tbody>
</table>
Some Early Benefits…

• Forecast Accuracy has improved by 11% this year compared with the same period last year

• Dropped 15-20% of inventory at the DC. This resulted in around $8-9 Million in annualized savings

• The client starting seeing a drop in inventory at the DC within 4 months of the initial analysis

• Service level remained constant/slightly above an average

• Better management of Daily and Weekly batch processes based on product classes
Overview of Replenishment Problem

**Situation**
- Business was struggling to determine the best inventory policy for slow moving products. Demand for slow moving products are often difficult to forecast and as a result, the business was not sure if they should even use forecasting as a method to drive replenishment or simply to use reorder replenishment and thereby further reduce forecasting/batch process overhead.

**Complication**
- Inventory replenishment decisions need to consider many operational and financial variables—each of which could impact the final decision.

**Desired outcome**
- A simple and transparent analysis that:
  - Recommends the right policy to follow for each replenishment scenario
  - Estimates the $ value of the benefit that can be realized by following the recommended policy.
Solution Approach

**Operations Metrics**
- Demand Pattern
- Initial Inventory and inventory position
- Lead Time
- Order Cost
- Inventory Holding Cost
- Inventory Handling Cost
- Mean Forecast Error

**Financial/Business Metrics**
- Weighted Average Cost of Capital (WACC)
- Price of SKU
- Contribution Margin per SKU
- Cost of lost sale/SKU

**Simulation**
1. Identify the optimum operating variables for each inventory policy
2. Create table for week-by-week calculation of inventory position
3. Run simulation to predict the cost and contribution resulting from following each inventory policy
4. Compare costs or contribution to select best inventory strategy
As a first step towards the solution, we identify the operating variables for each inventory strategy.

<table>
<thead>
<tr>
<th>Reorder Strategy Assumptions</th>
<th>Forecast Strategy Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reorder Point (Safety Stock)</td>
<td>Safety Stock</td>
</tr>
<tr>
<td>Reorder Quantity</td>
<td>Initial Inventory</td>
</tr>
<tr>
<td>Initial Inventory</td>
<td>Initial Inventory Position</td>
</tr>
<tr>
<td>Initial Inventory Position</td>
<td></td>
</tr>
<tr>
<td>Lead Time (weeks)</td>
<td>Lead Time (weeks)</td>
</tr>
<tr>
<td>Order Cost (per order)</td>
<td>Order Cost (per order)</td>
</tr>
<tr>
<td>Holding Cost (for each SKU per week)</td>
<td>Holding Cost (for each SKU per week)</td>
</tr>
<tr>
<td>Inventory Handling Cost (per SKU)</td>
<td>Inventory Handling Cost (per SKU)</td>
</tr>
<tr>
<td>Lost Sales Cost (per SKU)</td>
<td>Lost Sales Cost (per SKU)</td>
</tr>
<tr>
<td>Weighted Average Cost of capital (WACC)</td>
<td>Weighted Average Cost of capital (WACC)</td>
</tr>
<tr>
<td>Contribution Margin</td>
<td>Contribution Margin</td>
</tr>
<tr>
<td>Price of SKU</td>
<td>Price of SKU</td>
</tr>
<tr>
<td>Demand Probability Distribution</td>
<td>Demand Probability Distribution</td>
</tr>
<tr>
<td>Mean (Demand Probability Distribution)</td>
<td>Mean (Demand Probability Distribution)</td>
</tr>
<tr>
<td>SD (Demand Probability Distribution)</td>
<td>SD (Demand Probability Distribution)</td>
</tr>
<tr>
<td>Forecast Error Probability Distribution</td>
<td>Forecast Error Probability Distribution</td>
</tr>
<tr>
<td>Forecast Error Mean</td>
<td>Forecast Error Mean</td>
</tr>
<tr>
<td>Forecast Error SD</td>
<td>Forecast Error SD</td>
</tr>
</tbody>
</table>
The next step is to create and populate a week-by-week inventory table.

The table would comprise inventory levels, position, and demand. It would be used to calculate all the costs that are driven by the inventory strategy.
Solution Approach – Simulation

The simulation

- Identify the optimum operating variables for each inventory policy
- Create table for week-by-week calculation of inventory position
- Run simulation to predict the cost and contribution resulting from following each inventory policy
- Compare costs or contribution to select best inventory strategy
Inventory strategies can then be compared on the basis of costs or profits (contribution).

- Identify the optimum operating variables for each inventory policy
- Create table for week-by-week calculation of inventory position
- Run simulation to predict the cost and contribution resulting from following each inventory policy
- Compare costs or contribution to select best inventory strategy

The forecast scenario cost is likely to be above the re-order scenario cost 84.57% of the times.

The forecast scenario contribution is likely to be above the reorder scenario contribution 82.24% of the times.
Comparison of Strategies

Value by which forecast cost exceeds reorder cost changes with the forecast error. Ordering every week.

Recommendation
Use the forecasting strategy if the forecast error is less than 57%.
To switch, or not to switch to a new forecasting solution?

• **Situation**: Organizations may often wonder whether they should replace their existing forecast solutions with a new one.

• **Complication (need for change)**: Organizations may find it difficult to quantify the benefits that would accrue from a more accurate forecasting solution.

• **Key Question**: Is it possible to develop a method that quantifies the cost or profit expected from moving from one forecast solution to another?

• **Desired outcome**: Simplify the decision to move from one forecast solution to another (or to select between two forecast solutions) based on a quantification of associated costs or profits.
Question: How much do we gain if we improve forecast error from 75% (present) to 50% (new forecast solution)?

Answer: $25,000 in total costs for this particular inventory part.

Reason: The solution estimates that the total costs for replenishment are $40,000 / year with a forecast error of 75% vs. $15,000 for a forecast error of 50%.
Identifying the key value levers for an inventory replenishment operation

**Situation:** Organizations may often want to analyze their inventory replenishment operations to identify the most important variables that impact cost or profit.

**Complication (need for change):** It is difficult to estimate impact of each operating variable on cost or profit- given the demand uncertainty and the various operating / financial variables involved.

**Key Question:** Is it possible to develop a method that estimates the sensitivity of each operating and financial variable in a replenishment scenario?

**Desired outcome:** Management is able to identify the few variables it needs to focus on for improving its costs or profits in an inventory replenishment scenario.
Question: If operations managers were to cut total costs related to their inventory replenishment operation, which variables should they focus on?

**Answer:** Inventory Holding cost and WACC.

**Reason:** The solution estimates the maximum variation in cost is driven by inventory holding costs and WACC (Weighted Average cost of capital).

**Potential Beneficiaries:** Any organization that needs to identify the key value drivers in an inventory replenishment scenario.
Several areas of analysis and recommendations are possible

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<td>• Answers the question: Which controllable variables impact cost/contribution/service</td>
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Questions