Getting the Most out of Statistical Forecasting!

Author: Ryan Rickard, Senior Consultant
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Delivering Strategic, Implementation, Enhancement, Migration/Upgrade and Outsourced Support Services across SAP’s Execution and Supply Chain Planning Suite Including and Not Limited to:

- ERP ECC & S/4 HANA, SCM APO, IBP on HANA, SCIC/Control Tower, SNC, EIS (SmartOps), S&OP Powered by HANA and Ariba
- Delivering Projects and Services Across 20+ Different Countries in North and South America, Europe and Asia Since Our Inception 15+ Years Ago

Founded in 2001, SCMO2 Specializes in High-End Supply Chain Consulting Work Focused on The Implementation and Better Use of SAP Applications, Including ERP ECC & S/4, SCM APO & IBP on HANA, Ariba, Among Others


Company Statistics
Our Services

- SUPPLY CHAIN STRATEGY & ROADMAPPING
- BUSINESS CASE ROI & TECHNOLOGY BLUEPRINTING
- PROCESS DESIGN & ROLL OUT
- IMPLEMENTATION SERVICES
- OPTIMIZATION REDESIGNS & UPGRADES
- MASTER DATA STRATEGY & GOVERNANCE
- ANALYTICS, REPORTING & DASHBOARDS
- TRAINING & EDUCATION
- SUPPLY CHAIN BPO & SUPPORT SERVICES
**SCM APO**
Implement, Redesign, Optimize & Upgrade
- Demand Planning
- Supply Network Planning
- Production Planning & Detailed Scheduling
- Global Available to Promise

**EIS / SNC / Ariba**
Performance Optimization
- Supplier & Customer Collaboration Scenarios in SNC and Ariba
- Inventory Optimization with EIS or SmartOps
- Sense & Respond and Demand Signal Management

**SCIC / BI / Control Tower**
Supply Chain Analytics
- Supply Chain Info Center
- IBP Control Tower
- All BW front end tools (Business Objects Design Studio, BEx, Web Intelligence, Crystal Reports, BOBJ Analysis, Lumira)

**ERP ECC / S/4 HANA**
Focus on Core Process Areas
- Manufacturing Execution
- Logistics Execution
- Order to Cash
- Procure to Pay

**Integrated Business Planning (IBP)**
Process Transition, Design & Implementation
- APO Transition
- IBP for Demand
- IBP for Inventory
- IBP for Sales & Operations
- IBP for Response & Supply
- IBP Control Tower
Forecasting is a Core Competency

We already offer programs specific to Demand Planning and S&OP

STATS PACK FOR DEMAND PLANNING

A shoulder-to-shoulder approach with planners to get better results in forecast accuracy.

- Rapid evaluation and ID of accurate historical demand patterns
- Segmentation of Demand and align with proper Statistical models & settings
- Automate the assignment of each product to lowest error forecast model
- Establish methods and procedures for continuous improvements

SALES & OPERATIONS PLANNING VALUE ASSESSMENT

A process-centric approach to ensuring S&OP that is Powered by SAP to create maximum benefits to that business.

- Comparison on viable options for S&OP platform, Hana vs. APO
- Roadmapping plan for changes needed across People, Process, Technology, and Data
- ROI analysis for investment
Meet Ryan Rickard

Ryan Rickard – Senior Consultant
• 17 years’ Experience in Supply Chain Planning, Including Working as a Planner, IT Resource, and as a Business Process Re-design Lead
• Demand Planning and Statistical Forecasting Specialist in APO-DP and IBP-Demand
• Frequent Speaker at Many Premier Supply Chain Events

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Getting the Most out of Statistical Forecasting!
A multi-series webinar to explain “How to Effectively Analyze & Model your Demand”

- **Session 1**  
  Variability Matters  
  *Calculating Variability & Segmenting to help drive the process*

- **Session 2**  
  How Much is Enough?  
  *How much Historical Data is Enough? How frequent to Run (Stat) & React?*

- **Session 3**  
  Super Model Forecasting  
  *The Optimal Level of Aggregation*  
  *Weeks vs. Months can make a Difference*  
  *Using the Tool to Find the Best Model*

- **Session 4**  
  FVA: The New Frontier  
  *Understanding how Forecast Value Add can enhance your forecasting value*
Series Overview

There are some fundamental data considerations before effectively incorporating Statistical Forecasting into your Demand Planning process.

- It is important to recognize which items drive the most volume and/or value to your business to properly focus attention.
- It is also essential to find the pattern, or DNA, of your historical data and then match the forecast strategy and model to the data.
- And it is important to understand the variability and forecastability of your portfolio.

Together, understanding the volume or value, patterns and variability will allow you to focus effective attention on Statistical Modeling for your business.
Session 1

Variability Matters
“There are many different strategies that you can choose from. And the best strategy would depend on the particular variability.”

On Solving a braille Rubix Cube by T.V. Raman in 24 seconds “…is only possible with good design. And good design is only possible when we understand variability.

“We need to understand variability, and understand how to design for it.”

Cyberlearning Summit 2012

https://youtu.be/8WClnVjCEVM
Not all of your Items have the same patterns and variabilities

Therefore, the strategy and approach to forecasting them needs a “good design”

Example

9800 Total Products
Based on Unit Volume (36M Historical Actuals)

A’s
1200 Items
Top 80%

B’s
2100 Items
Next 15%

C’s
6500 Items
Bottom 5%

Forecastability
Understanding Data Variability is Important

- Low variability items are easier to forecast and require less attention
- High variability items are harder to forecast and typically require more attention or collaborative input

In some cases it makes sense to run Stat on highly variable items to recognize that the Stat output is just as good as any manual forecast.

It may make sense to not forecast highly variable items at all and plan them via min/max or covering via safety stock.
Determining Variability can be easily calculated using the Coefficient of Variation (CoV) formula. CoV is defined as the ratio of the Standard Deviation ($\sigma$) to the Mean ($\mu$) of a dataset:

$$CV = \frac{\text{Standard Deviation}}{\text{Mean}}$$

Measures the dispersion of the data points around the mean and helps show how much volatility (or uncertainty) your historical demand has. Also referred to as Coefficient of Variance, CoV, or $C_v$. 

[Image of the Coefficient of Variation formula]
Variability Example

CoV Results closer to zero mean lower variability
We often use the term “Forecastability” when referring to CoV.

How easy or hard is it to predict the future demand based on the variation of your history?

Variation Correlates to Forecastability

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<th>How Accurate Can the Forecast Be?</th>
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Maximum Achievable Forecastability

Is it truly logical to expect 100% FA when you know the variability is 32%?

Judgment

Stat

Naïve
Methods of Calculating Variability

- Manually via Excel type tools
  - Access to historical data for analysis in Excel
  - Knowledge of the Excel formulas to calculate

- Via a Planning System like SAP IBP or APO
  - Configuration within the tool, including parameters and thresholds (ABC/XYZ)
  - Access to the historical data in the tool
  - Access to run the Segmentation Job, or access to the ABC/XYZ results
Calculating Variability Manually

- Collect several years of historical data into Excel
- Calculate the Standard Deviation across the historical data horizon
- Calculate the Mean (Average) across the historical data horizon
- Calculate the CoV for each record
- Sort or rank according to desired thresholds

Before you Collect and Analyze your data, it’s important to consider:
- What Planning Level you want to analyze your data (Product, Product/Customer)
- What Time Bucket level you want to analyze your data (Months, Weeks)

The results will be different, and the analysis should correlate to the levels that you plan to Statistically Forecast
Calculating Variability Manually

- In our Demo which have collected 36 months of data at the Product level to analyze (9800+ products)

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For all 36 months, calculate Standard Deviation and Mean using Excel formulas

- Standard Deviation =STDEV.P(range)
- Mean =AVERAGE(range)

Calculate the CoV in Excel

- CoV = Standard Deviation/Average
### Calculating Variability Manually

- Copy the 3 formulas down for each Product in Excel

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<th>36M STDEV</th>
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Calculating Variability Manually

- Sort to Analyze and Assign XYZ values based on determined thresholds

In our demo dataset we used the following XYZ thresholds:

- X = < .30
- Y = .30 to <.70
- Z = .70 +

Remember a CoV of .30 correlates to a potential Forecastability of 70%
### Calculating Variability Manually

- Calculate again using 24 months of historical data
  - Calculate Standard Deviation for 24 Months
  - Calculate Mean for 24 Months
  - Calculate CoV using 24 Month Standard Deviation and 24 Month Mean
  - Sort, Rank and Assign Values

<table>
<thead>
<tr>
<th>Product ID</th>
<th>Key Figure</th>
<th>24M STDEV</th>
<th>24M AVG</th>
<th>24 CoV</th>
<th>24M Manual XYZ</th>
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</table>
Calculating Variability Manually

- Calculate again using 12 months of historical data
  - Calculate Standard Deviation for 12 Months
  - Calculate Mean for 12 Months
  - Calculate CoV using 12 Month Standard Deviation and 12 Month Mean
  - Sort, Rank and Assign Values

<table>
<thead>
<tr>
<th>Product ID</th>
<th>Key Figure</th>
<th>12M STDEV</th>
<th>12M AVG</th>
<th>12 CoV</th>
<th>12M Manual XYZ</th>
</tr>
</thead>
<tbody>
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<tr>
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<td>1002.0000000</td>
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</tr>
</tbody>
</table>
High level comparison across multiple years indicates that using 2 or less years of data provides less variability than considering all 3 years of data.

Some items appear less variable using 1 year of data.

**Compare CoV Results**

- **36 Months**
  - X: 1856 Items (19%)
  - Y: 3902 Items (40%)
  - Z: 4100 Items (41%)

- **24 Months**
  - X: 2434 Items (25%)
  - Y: 3903 Items (40%)
  - Z: 3521 Items (35%)

- **12 Months**
  - X: 2789 Items (28%)
  - Y: 3272 Items (33%)
  - Z: 3797 Items (39%)
By reviewing and filtering in Excel, we can identify items where the Variability differs significantly between years.

Filtering on 12 month X’s and 36 month Z’s highlight items where using 12 months is potentially more stable.
- Reviewing examples graphically may tell a story

Examples where variability 3 years ago is higher than the last 12 and 24 months.
Comparing big changes in CoV between 36 months and 12 months will also help highlight where using more or less history reduces the overall variability.
Reviewing big changes in CoV in both Excel and graphically may highlight when the volume or pattern has changed.

**100001122 Actuals Qty**

- Mar-14
- Apr-14
- May-14
- Jun-14
- Jul-14
- Aug-14
- Sep-14
- Oct-14
- Nov-14
- Dec-14
- Jan-15
- Feb-15
- Mar-15
- Apr-15
- May-15
- Jun-15
- Jul-15
- Aug-15
- Sep-15
- Oct-15
- Nov-15
- Dec-15
- Jan-16
- Feb-16
- Mar-16
- Apr-16
- May-16
- Jun-16
- Jul-16
- Aug-16
- Sep-16
- Oct-16
- Nov-16
- Dec-16
- Jan-17
- Feb-17
Calculating Variability within SAP IBP

- Steps
  - Create XYZ Segmentation Rules
  - Run the (Segmentation) Application Job
  - Review the Segmentation Results

- Via the Web User Interface of SAP IBP we can view or create Segmentation Rules
  - Under the General Planner section on the Home page locate the “Manage ABC/XYZ Segmentation Rules” Fiori App
Segmentation Profiles in SAP IBP

- We’ve setup 3 Segmentation Profiles in IBP using different periods of Historical data

<table>
<thead>
<tr>
<th>Segmentation Profiles (4)</th>
<th>Search</th>
</tr>
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<tbody>
<tr>
<td>Name</td>
<td>Description</td>
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<tr>
<td>AIT Inv Opt and Demand - Weekly (AIT)</td>
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</tr>
<tr>
<td>ABC_XYZ_Volume_Variability_12_MO</td>
<td>ABC based on Volume, XYZ based on Variability - 12 Months</td>
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<td>ABC_XYZ_Volume_Variability_24_MO</td>
<td>ABC based on Volume, XYZ based on Variability - 24 Months</td>
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<tr>
<td>ABC_XYZ_Volume_Variability_36_MO</td>
<td>ABC based on Volume, XYZ based on Variability - 36 Months</td>
</tr>
</tbody>
</table>

- The IBP Segmentation Profiles allow you to setup both ABC and XYZ profiles to model both Volume/Value and Variability
  - Variability is profiled as XYZ
  - Volume/Value is profiled as ABC
**XYZ Segmentation Settings**

- **Target Attribute for Segmentation Results**: Attribute 1
- **Segmentation Level**: Product ID
- **Segmentation Measure**: Actuals Quantity (ACTUALSQTY)
- **Base Planning Level**: Customer ID - Location ID - Product ID
- **Periodicity**: Month
- **Time Scope**: Past
- **Calculation Horizon**: 36 Months
- **Offset for Calculation Horizon**: 0 Months
- **Measure for Variance Calculation**: Coefficient of Variation (CV)
- **Segmentation Method**: By Thresholds
- **XYZ Segments (3)**
  - X: 0.36
  - Y: 0.70
  - Z: No Maximum Value

**Source Key Figure to Read Historical Data From**

**Periodicity (Weeks or Months) and # of Periods to Read**

**Target Attribute to Write the XYZ output to**

*For this demo we’ve leveraged another attribute to not overwrite the previous values*

**User defined Names for each Segment**

Can be different than XYZ if desired

**CoV Thresholds by Segment**

*You can have 1 or many based on the segmentation needs*
Running the ABC/XYZ Application Job

- Under the General Planner section of the SAP IBP Web UI, locate the Application Jobs Fiori App.

- Create a Job by clicking the New icon inside the Application Job app.
  - Or Copy a Previously Execute Job and Reschedule it by clicking the Copy icon.
Running the ABC/XYZ Application Job

- Complete the required fields to create the new Job

*General Information*

- **Job Template:** ABC/XYZ Segmentation
- **Job Name:** ABC/XYZ Segmentation 36 Months

*Scheduling Options*

- **Start Immediately:** Yes
- **Start Date**
- **Time Zone:** UTC+0

*Parameter Section*

- **Planning Operator Type:** SEGMENTATION
- **Planning Area:** Demo Planning Area
- **Version:** __BASELINE
- **Segmentation Profile Id:** 100151

*Sharing Information*

- **Comment:** New 36 Month ABC XYZ Run
- **Reason Code:**
- **Group:**

*Pl. Op. Id | PPO Name*
--- | ---
100153 | ABC_XYZ_Volume_Variability_12_MO
100152 | ABC_XYZ_Volume_Variability_24_MO
100151 | ABC_XYZ_Volume_Variability_36_MO

Select ABC/XYZ Segmentation job template from the dropdown
Select Planning Area and Version
Select desired Segmentation Profile ID from the Dropdown
In IBP Excel we can review the Segmentation results in 1 of 2 ways

- Master Data view
- Planning View

Master Data View

- After logging into IBP Excel, locate the Manage icon for Master Data in the IBP Ribbon
- Using the dropdown under Manage, select Mass
- Select Master Data Type “Product”, then View

*If you assigned the ABC/XYZ output do a different attribute, then you would select that Master Data Type*
Viewing the IBP Segmentation Results

- In the Master Data View of IBP Excel we see the output of the ABC/XYZ job results

<table>
<thead>
<tr>
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<th>Attribute 1</th>
<th>Attribute 2</th>
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<tbody>
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</table>
Planning View

- Using a new or pre-defined template you can include the attributes showing the ABC/XYZ results in a Planning View.
- Within the Planning View now you can utilize filters or selections based on the Products associated with ABC or XYZ.

### Viewing the IBP Segmentation Results

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<th>M1-2016</th>
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<th>M4-2016</th>
<th>M5-2016</th>
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<td>12</td>
<td>12</td>
<td>4</td>
</tr>
</tbody>
</table>
It is important to know that nulls and zeros have different affects on data analysis and Statistical Forecasting algorithms.

- For example, when calculating a Mean across a time series which has several null values will only average the periods with data. If there are zeros in the data the zeros will be included in the average.

Based on your APO or IBP configuration and key figure settings you may or may not calculate and store zeros for historical sales. NO sales is ZERO sales and statistical algorithm do consider blanks as zeros.

- When exporting your data for analysis, make sure that you consider the implications of nulls versus zeros.
### Example with Null Values

- Note the 12 month Standard Deviation, Mean and CoV

<table>
<thead>
<tr>
<th>Product ID</th>
<th>Key Figure</th>
<th>Mar-16</th>
<th>Apr-16</th>
<th>May-16</th>
<th>Jun-16</th>
<th>Jul-16</th>
<th>Aug-16</th>
<th>Sep-16</th>
<th>Oct-16</th>
<th>Nov-16</th>
<th>Dec-16</th>
<th>Jan-17</th>
<th>Feb-17</th>
<th>12M STDEV</th>
<th>12M AVG</th>
<th>12 CoV</th>
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<tbody>
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<td>8</td>
<td>54</td>
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</table>

### Replacing Null values with Zeros

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<th>May-16</th>
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We recommend filling in any null values, after the first data point, with zeros before doing analysis in Excel for Coefficient of Variation.

We will discuss this further in Session 2 when we consider how many periods of history to incorporate.
What Does this all Mean?

- Understanding the Variability of your business and products will help you “design” the best forecasting process and organization.
  - It’s also important to understand that the lower or more detailed you get with both your analysis and planning, the more variability you will have.
  - In our examples thus far, we have analyzed at the Product level. Going to Product/Customer or Product/Customer/Location will add variability and complexity in planning accuracy.

- Understanding the Variability of your data will help you apply the best algorithms and periods of history to optimize the Statistical Forecast output.
Two Most Common Forecasting Questions

- How many SKUs can a Demand Planner forecast?
- Is my Planning Organization the right size?

- 300?
- 3,000?
- 30,000?
- 10,000?

What should my Forecast Accuracy be?

We should ask and understand...

- How Accurate can it be? What’s the Forecastability?

How do you forecast more efficiently and accurately using the resources that you do have.
Potential Process Considering Variability & Volume

- AX: High Volume, Low Variability
  - System/Stat Driven Process
  - Product Level
  - Less Intervention
  - Weekly

- AY: High Volume, High Variability
  - System & People Input Likely
  - High Attention/Collaboration
  - More Intervention
  - Weekly

- AZ: Low Volume, Low Variability
  - System/Stat Driven Process
  - Very Little Intervention
  - Weekly or Monthly

- BX: Low Volume, High Variability
  - Chose System or High Intervention
  - Attempting to plan the Variability could take a lot of time and not add value
  - Weekly to react to variability for Inv. Planning, or Monthly to deal with MOQ’s/EOQ’s

- CY: Variability
  - Stat Models
  - Constant
  - Seasonal
  - Seasonal Trend

- CZ: Variability
  - Constant
  - Crostons
  - Seasonal
  - Seasonal Trend
How Can We Help You?

We already offer programs specific to Demand Planning

**STATS PACK FOR DEMAND PLANNING**

A shoulder-to-shoulder approach with planners to get better results in forecast accuracy.

- Rapid evaluation and ID of accurate historical demand patterns
- Segmentation of Demand and align with proper Statistical models & settings
- Automate the assignment of each product to lowest error forecast model
- Establish methods and procedures for continuous improvements
All products are not the same. Their DNA and patterns are different.

A good *(process, approach and models)* design is only possible when we understand variability.

Calculating Variability can be done using the Coefficient of Variation methodology – in Excel or APO/IBP.

Using different time ranges of data can change the Variability output and Stat modeling approach.

Zeros matter in the CoV calculation.

Variability correlates to Forecastability.

Summary of Key Points – Variability Matters
Questions?

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Getting the Most out of Statistical Forecasting!

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