Oracle Planning Central Cloud and Supply Planning Cloud: Managing Safety Stock
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Overview

Safety stock is inventory that is carried to prevent stock outs. Stock outs stem from factors, such as fluctuating customer demand, forecast inaccuracy, and variability in lead times for raw materials or manufacturing.

Maintaining safety stock supplies enables you to hedge supplies to meet unexpected demands and improve customer satisfaction. Adequate safety stock levels enable your business operations to proceed according to plan.

The two graphs illustrate the business value of using safety stock levels to avoid stockouts.

Item safety stocks are part of the supply chain planning process. Safety stock is a floor or base level of inventory from which the system performs all planning. In other words, the item is planned as if the safety stock quantity for the period is the zero inventory balance of the item. This process ensures that the safety stock quantity remains in inventory to cover any fluctuations and uncertainties in demand.

Safety Stock Management Methods in Planning Central

There are four methods that planners can use to manage safety stock supply in Oracle Planning Central Cloud:

<table>
<thead>
<tr>
<th>Safety Stock Management Methods</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>User-specified days of cover</td>
<td>Time varying safety stock levels are calculated during planning. Days of cover is based on a moving average demand and a user-specified target for days of cover.</td>
</tr>
<tr>
<td>User-specified time varying safety stock levels</td>
<td>Time varying safety stock levels set externally by item and organization. Use the CSV upload template for safety stock to upload the time varying levels for items by organization.</td>
</tr>
<tr>
<td>User-specified fixed safety stock level</td>
<td>User-specified fixed safety stock quantity as an item attribute.</td>
</tr>
<tr>
<td>Statistical safety stock calculation</td>
<td>Oracle Planning Central Cloud statistical calculation using forecasts, forecast error measures, and service level targets to set a single safety stock quantity as an item attribute.</td>
</tr>
</tbody>
</table>

The four methods use different approaches to determine the safety stock levels that a plan can use. Different items can use different methods, depending on the item setup. For each safety stock method, there are different setup steps.

**User-specified Days of Cover**

Days of cover is based on a moving average demand and a user-specified target for days of cover.

To set up items to use the days of cover method, set the following three item-organization attributes on the Manage Items page in the Product Information Management work area:

- Safety Stock Planning Method = **Days of Cover**
- Demand Period = User-defined value that is used to calculate the average daily demand in days.
- Days of Cover = User-defined value in days. The value can be a fractional value.

Planning Central calculates the actual ‘days of cover’ safety stock level based on the following:

- Average Daily Demand = \( \frac{\text{Sum (Demands for the next Period days)}}{\text{Demand Period days}} \)
  - Demands are sales orders, forecasts, manual demands, and dependent demands
  - Demand Period days is evaluated in working days
- Safety Stock for day \( X \) = Average Daily Demand for day \( X \) * Days of Cover

Planning Central recalculates safety stock levels every day. The safety stock smoothing options are applied to the daily variations in safety stock. Since Planning Central is a day-level planning tool, the safety stock level is a target to be satisfied by the end of the day.

When Planning Central calculates safety stock levels by using the days of cover method, if the item-organization attribute rounding is Yes, the safety stock levels are rounded up to the nearest integer. Setting the rounding attribute to Yes is recommended for items that have safety stock levels.

**Example A:** 5 day work week, Period days = 5, Days of Cover = 1, Plan Horizon = Day 15
<table>
<thead>
<tr>
<th>Days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Requirements</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Average Daily Demand (Period)</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>22</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Safety Stock</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>22</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
</tr>
</tbody>
</table>

Note that when the remaining plan horizon is less than the demand period, the safety stock level is constant for the remaining days in the plan and equal to the last calculated safety stock level.

**Example B:** 5 day work week, Period days = 5, Days of Cover = 3, Plan Horizon = Day 15

<table>
<thead>
<tr>
<th>Days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Requirements</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Average Daily Demand (Period)</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>22</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Safety Stock</td>
<td>48</td>
<td>54</td>
<td>60</td>
<td>66</td>
<td>72</td>
<td>72</td>
<td>72</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>78</td>
</tr>
</tbody>
</table>

Safety stock is not calculated on non-working days. However, it is displayed for nonworking days. It is the value carried over from the last working day.

Calculation of safety stocks also respects the advanced plan option **Safety Stock Bucket Start Offset Days**. For every day, calculate the sum of gross requirements for the safety stock demand window. This use case, to have the start date of the safety stock bucket offset from the current day, is to be able to ignore the impacts of high near-term demand, which is possible due to high backlog demand.

This demand window is arrived at as follows:

- Start date of the window = Today + m days, where m = Safety Stock Bucket Start Offset Days, which is available as an advanced plan option. If not set, m defaults to 0.
- End date of the window = Start Date of the window + n days where n = Demand Period (item attribute).

Note: In both of the above calculations, m and n are working days based on the organization manufacturing calendar.

The following example illustrates the use of this profile option:

- Safety Stock Bucket Start Offset Days = 5
- Demand Period Days = 30
- 24 by 7 manufacturing calendar
<table>
<thead>
<tr>
<th>Day</th>
<th>Bucket Start</th>
<th>Bucket End</th>
<th>Safety Stock Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Day 6</td>
<td>Day 35</td>
<td>Calculate safety stock based on average daily demand in days 6 to 35</td>
</tr>
<tr>
<td>2</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Use day 1 value calculated level</td>
</tr>
<tr>
<td>3</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Use day 1 value calculated level</td>
</tr>
<tr>
<td>4</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Use day 1 value calculated level</td>
</tr>
<tr>
<td>5</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Use day 1 value calculated level</td>
</tr>
<tr>
<td>6</td>
<td>Day 6</td>
<td>Day 35</td>
<td>Use day 1 value calculated level</td>
</tr>
</tbody>
</table>

**User-specified Time-Varying Safety Stock Levels**

You can upload time-varying safety stock levels by item and organization. Use the CSV upload XLSM template for safety stock to upload the time-varying levels for items by organization.

To use these uploaded daily levels, set the following item-organization attribute on the Manage Items page in the Product Information Management work area or in the simulation set attached to the plan:

- Safety Stock Planning Method = *Safety Stock Quantity*

Set the following item-organization attributes in the simulation set attached to the plan:

- **Safety stock quantity override** must be null
- **Safety stock quantity** must be null

Refer to the section Viewing Safety Stock Levels in a Plan to see the uploaded levels.

**User-specified Fixed Safety Stock Levels**

Manually enter fixed safety stock quantity as an item attribute, which is a way for you to manually enter safety stock levels that are fixed for the plan horizon.

To use the user-specified fixed levels, set the following item-organization attribute on the Manage Items page in the Product Information Management work area or in the simulation set that is associated with the plan:

- Safety Stock Planning Method = *Safety Stock Quantity*

The fixed safety stock levels are used by planning when the simulation set attached to the plan meets these two conditions for these item-organization attributes:

- **Safety stock quantity override** contains the manually-entered safety stock level
- **Safety stock quantity** must be null

You can enter the values directly into the simulation set as shown in the following example:
Note that for AS6647331 in Organization 002 the safety stock quantity override is set to 250. This means that the safety stock level is 250 units throughout the plan horizon. Also note that safety stock quantity is null and safety stock planning method is Safety Stock Quantity.

Refer to the section Viewing Safety Stock Levels in a Plan to see the safety stock levels for each item and organization.

**Statistical Calculation of Safety Stock Levels**

Oracle Planning Central Cloud statistical calculation of safety stock levels uses forecasts, forecast error measures, and service level targets to set a single safety stock quantity as an item attribute.

You can configure parameters in which to calculate safety stock quantities as part of plan options. The safety stock calculation process outputs to plan data for the related safety stock fields for each item-organization attribute. The process calculates statistical safety stock levels based on forecasts and forecast error measures. The statistical calculation detail is in the appendix pages.

**Safety Stock Plan Options**

Define or modify plan options for safety stocks on the Plan Options: Safety Stock. The safety stock calculation process also outputs values to the plan simulation set specified on the Plan Options page, Scope tab.

The Edit Plan Options page, Safety Stock tab displays the safety stock calculation plan options.
*Example of the safety stock options page with Safety Stock Planning Method “Statistical for end items, user-specified for all others.”

The Safety Stock Planning Method selection determines the available fields for the rest of the page.

Note that User-specified values are derived from Days of Cover, Time-varying levels or fixed safety stock levels. The actual method depends on the specified item attributes.

As shown above the Safety Stock Planning Method has the following options

- Do not plan safety stock (default): There will be no safety stock levels calculated or planned for any item in the plan
- User-specified values for all items: planning will plan safety stock levels and supplies for all items based on each item’s safety stock method.
  - If the Apply Safety Stock Quantity Override is checked and if a planned item has its Safety Stock Override item attribute NOT NULL then the Safety Stock Override is used and the engine will not calculate any values for such items.
  - With this option safety stock is planned calculated in one or more of the following ways:
- The user can upload safety stock quantities via FBDI files for items with the "Safety Stock Planning Method" item attribute set to Safety Stock Quantity. Safety stock is not planned for items with statistical safety stock parameters.
- Planning will calculate safety stock levels and supplies based on user specified days of cover for items with the "Safety Stock Planning Method" item attribute set to Days of Cover. Safety stock is not planned for items with statistical safety stock parameters.
- Safety stock levels and supplies aren’t planned if the "Safety Stock Planning Method" item attribute is set to NULL.

**Statistical safety stock** for end items, none for all others: planning will plan safety stock levels and supplies only for those END items that have statistical safety stock parameters defined for them. Safety stock levels and supplies for items that do not have forecasts defined are not planned.

  o If the Apply Safety Stock Quantity Override is checked and if a planned item has its Safety Stock Override item attribute NOT NULL then the Safety Stock Override is used and the engine will not calculate any values for such items.

**Statistical for end items, user-specified for all others:** calculate and plan statistical safety stock levels and supplies for end items and user specified safety stock for all other items.

  o If the Apply Safety Stock Quantity Override is Checked and if a planned item has its Safety Stock Override item attribute NOT NULL then the Safety Stock Override is used and the engine will not calculate any values for such items.

The flowchart below describes the logic used by supply planning to determine the safety stock method for the item.
The additional parameters for calculating safety stock discussed in the following table:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use item-specific values</td>
<td>Select to specify whether the supply plan run uses item-specific values in</td>
</tr>
<tr>
<td></td>
<td>safety stock calculations. The item-specific values are found in the</td>
</tr>
<tr>
<td></td>
<td>simulation set.</td>
</tr>
<tr>
<td>Service Level Percentage</td>
<td>Enter a value between 0 and 100 to set the level of customer service that</td>
</tr>
<tr>
<td></td>
<td>you want in satisfying the product demand immediately out of inventory.</td>
</tr>
<tr>
<td>Forecast Error Type</td>
<td>Determines whether the quality of a forecast is measured by using MAD,</td>
</tr>
<tr>
<td></td>
<td>MAPE, or Intermittent.</td>
</tr>
<tr>
<td>Overwrite</td>
<td>Select a value to use to overwrite the previously generated or entered</td>
</tr>
<tr>
<td></td>
<td>safety stock levels.</td>
</tr>
<tr>
<td>Save to collected data</td>
<td>If selected, then the collected data is updated with the safety stock</td>
</tr>
<tr>
<td></td>
<td>quantities that are calculated and with safety stock quantity overrides.</td>
</tr>
</tbody>
</table>

You must use a simulation set for statistical safety stock planning. The simulation set is used as input to the safety stock calculation and where the output of the safety stock quantities is written. This is applicable to supply plan, and demand and supply plan types.

If you select **Use item-specific values**, then the system data snapshot provides the item-specific values from the simulation set, such as MAD, MAPE, or intermittent demand and also gets the overrides from the simulation set.
If you select **Use item-specific values**, the first time that you run the plan, the safety stock levels in the simulation set will be populated by the statistical safety stock calculation. However, during this first run, the safety stock levels are not used by supply planning because the simulation set values are null at the start of the first run. The second time that you run the plan, the populated values are used by supply planning for planning supply to meet safety stock levels.

To use the statistical calculated levels in supply planning, set the following item-organization attribute on the Manage Items page in the Product Information Management work area or in the simulation set that is associated with the plan:

- **Safety Stock Planning Method = Safety Stock Quantity**

The statistical safety stock levels are used by planning when the simulation set attached to the plan meets these two conditions for these item-organization attributes:

- **Safety stock quantity override** is null
- **Safety stock quantity** is populated from a prior run of the plan with **Calculate New Safety Stock Quantities for End Items** selected

**Demand Schedules**

To calculate safety stock, planning considers the demand schedules attached in the Organizations and Schedules tab. If the same item-organization combination is present in multiple demand schedules, planning engine calculates a separate safety stock value for each demand schedule and then sets the safety stock for the item as the sum of the safety stock values calculated from each demand schedule.

The use case for the same item-organization combination appearing in multiple demand schedules is if the demand is split by demand class or demand type, for example Promotional versus Baseline or Retail versus Wholesale. In such cases, since each demand type tends to have different variability measures. It does make sense to add the calculated safety stock values together.

**Safety Stock Planning in a Plan**

To have Planning Central generate supplies for safety stock levels, you must enable safety stock planning. On the Supply Plan: Safety Stock page, in the Safety Stock Parameters section, do not select the option **Do Not Plan Safety Stock**.

When planning supplies for safety stock levels, supplies are planned to meet safety stock levels at the end of the day. The daily calculation for a new planned order to meet a safety stock level is:

\[
\text{New Planned Order (Today) =} \\
+ \text{Demands (Today)} \\
- \text{Supplies (Today)} \\
- \text{Projected Available Balance (Yesterday)} \\
+ \text{Safety Stock Level (Today)}
\]

Standard supply and demand netting considers the daily safety stock level. A typical daily supply and demand netting approach will create planned orders whenever Projected Available Balance (PAB) is
negative. If there is a safety stock level specified for today, then the planned orders are created whenever the projected available balance is less than safety stock level.

Note that the New Planned Order (Today) quantity must also consider order modifiers.

**Safety Stock Pegging in a Plan**

Pegging does not show supply pegged to safety stock demand because Planning Central does not have a measure for safety stock demand. Supplies may come in early compared to other demands, which is caused by safety stock levels. In the example above, each week ends with a positive projected available balance and some of the supplies that arrive in a week are pegged to future demands.

The pegging from supplies scheduled for safety stock levels always lean to the right to peg to a future demand. Additional supplies in the future are scheduled to keep the projected available balance at safety stock level and then peg further to the right. The blue lines in the example below represent pegging from supply to some demand in the future:

<table>
<thead>
<tr>
<th>DAY</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Quantity</td>
<td></td>
<td></td>
<td>50</td>
<td></td>
<td>25</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>On-Hand Work Order</td>
<td></td>
<td>50</td>
<td></td>
<td>25</td>
<td></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Planned Order</td>
<td></td>
<td></td>
<td>25</td>
<td></td>
<td>25</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>PAB</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Safety Stock Level</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

In the supply demand window, we do show a row marked Not Pegged in the pegging display. The Not Pegged row only populates the organization and the item-organization attributes in the supply demand window. The dates, order number, and any demand or supply specific attributes are not populated.

The purpose is to indicate to the planner that some supply quantity was simply not pegged to any demand. In the example above, if there are no other demands after day 7, then the 100 unit supply on day 7 will show as not pegged in the pegging details.

**Viewing Safety Stock Levels in a Plan**

To view the safety stock levels in a plan, either define a new table or copy the material plan. Include the measure Safety Stock in the table. Typically, place the Safety Stock measure below the Projected Available Balance measure so it is easy to compare the two measures, as shown in the following screenshot:
Safety Stock Smoothing

Typically, planners want to reduce fluctuations in safety stock. Safety stock levels that change every day are awkward to manage. Small changes in safety stock levels can cause large projected available balance changes due to order modifiers.

Safety stock smoothing advanced plan options enable you to control the day to day and week to week variations. To access the safety stock smoothing parameters for a plan, navigate to the Plan Options: Safety Stock page. There are five parameters to control safety stock smoothing:

### Parameters for Safety Stock Smoothing

- **Apply safety stock change interval to all items**
- **Smoothing Method to Calculate Safety Stock Within Change Interval**
  - Minimum
- **Safety Stock Change Interval in Days**
- **Safety Stock Bucket Start Offset Days**
- **Maximum Percentage Variation in Safety Stock Values**
- **Minimum Percentage Variation in Safety Stock Values**

*Apply Safety Stock Change Interval to All Items*

If you select **Apply safety stock change interval to all items**, the planning process applies safety stock change interval to all items, including items with Safety Stock Quantity safety stock method. If you do
not select this option, then the safety stock change interval applies only to items with Days of Cover safety stock method. Safety stock change interval is the time interval used for the smoothing within time interval functionality. If you specify an interval of 20 days, then starting from the application date, the planning process groups the safety stock calculation in 20-day buckets. The planning process then uses the smoothing method to calculate the safety stock within change interval to determine the safety stock level for the bucket.

*Smoothing Method to Calculate Safety Stock within Change Interval*

Use this option for smoothing raw safety stock quantities in every interval, starting from the plan horizon. You can select Minimum, Maximum, or Average from the drop-down list. The result is always rounded up to nearest integer.

There are the two types of safety stock smoothing:

- Within a time interval
- Across time intervals

You can instruct the planning process to keep safety stock levels relatively constant within a time interval by specifying values for the following:

- **Smoothing Method to Calculate Safety Stock Within Change Interval**. Select a method that planning should use to calculate the constant value: Minimum, Maximum, or Average.
- **Safety Stock Change Interval in Days**. Enter the number of days in the time interval. If null, then safety stock smoothing is not performed.

Planning Central begins at the plan start date and performs the following:

1. Groups the days into the time interval based on the number of days that you specify.
2. Finds the value among the days that corresponds to the selected method (minimum, maximum, or average).
3. Sets the safety stock level for all the days in the time interval to that value.

*Safety Stock Change Interval in Days*

Safety stock change interval is the number of working days used for smoothing safety stock within the time interval. If you specify an interval of 20 days, then starting from the application date, the planning process groups the safety stock calculation in 20-day buckets. The planning process then uses the smoothing method to calculate the safety stock within the change interval to determine the safety stock level for the bucket. Enter a value greater than zero (0).

**Example:**

On the Supply: Advanced Options page, in the Safety Stock Parameters section, set the following smoothing parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoothing Method to Calculate Safety Stock Within Change Interval</td>
<td>Minimum</td>
</tr>
<tr>
<td>Safety Stock change Interval in Days</td>
<td>5</td>
</tr>
</tbody>
</table>
After setting the smoothing parameters, the following illustrates that in the second interval, safety stock after smoothing within the interval using the minimum option equals 10. Safety stock after smoothing across intervals using the maximum percentage of 25 percent equals 12.

<table>
<thead>
<tr>
<th>Safety Stock Bucket Start Offset Days</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Percentage Variation in Safety Stock Values</td>
<td></td>
</tr>
<tr>
<td>Maximum Percentage Variation in Safety Stock Values</td>
<td>25</td>
</tr>
</tbody>
</table>

Maximum Percentage Variation in Safety Stock Values:

When you use this option, the planning process does not allow the safety stock to deviate by more than the specified value in the next the time interval. Enter a value greater than zero (0). For example, if you specify 25 percent, the planning process sets 25 percent as the maximum percentage of change in safety stock quantity between buckets.

Specify values for the **Minimum Percentage Variation in Safety Stock Values**. Enter a percentage for the minimum change in safety stock values that you consider significant enough to trigger a change in the safety stock level from one bucket to the next.

Minimum Percentage Variation in Safety Stock Values:

When you use this option, the planning process keeps the safety stock constant across time intervals if the deviation is within the specified percentage. Enter a value greater than zero (0).

Specify values for the **Maximum Percentage Variation in Safety Stock Values**. Enter a percentage for the maximum change in safety stock values that you will allow between time intervals.

Note: If you set the maximum percentage variation to less than the minimum percentage variation, you will get unpredictable results. If the maximum percentage is less than the minimum percentage, Planning Central will use the minimum percentage variation as the maximum percentage variation.
Planning Using Minimum and Maximum Percentage Variations in Safety Stock Values:

Planning Central finds the highest safety stock level within the planning horizon and begins the smoothing process from that time interval. Planning proceeds backwards to the plan start date and smooths each time interval. Next, planning proceeds forward to the end of the planning horizon and smooths each time interval.

The planning process calculates the change between time intervals as \(\frac{100 \times (\text{Safety stock level in the next interval} - \text{Safety stock level in this interval})}{\text{Safety stock level in this interval}}\).

If the deviation between the two time intervals is:

- Between the minimum and maximum changes in safety stock levels that you will allow, planning leaves the original safety stock level for the interval.
- Higher than the maximum changes in safety stock levels that you will allow, planning adjusts the original safety stock level to be at the maximum percent.
- Lower than the minimum changes in safety stock levels that you consider significant, planning retains the safety stock level for the two buckets.
Appendix A: Statistical Safety Stock based on MAD

Safety Stock based on Mean Absolute Deviation (MAD) is calculated in the following ways:

1) At the Plan Level by unchecking the "Use Item Specific Values" checkbox in the Safety Stock tab of the Plan Options: In this case the user will enter the plan level values on the Safety Stock tab of Plan Options.

2) For one more specific Item-org combinations by checking the "Use Item Specific Values" checkbox in the Safety Stock tab of the Plan Options. Users will have two options a) Upload flat file values (for the relevant item-org combinations) with MAD and Service Level Percentage. The "Forecast Error Type" item attribute will be set to MAD. b) Update the MAD override and Service Level values and set the "Forecast Error Type" item attribute to MAD. Include these changes in Simulation Set and include the Simulation Set in Plan Options.

The content below explains the method used by SP to calculate SS based on MAD.

In this method, the safety stock quantity is calculated based on the Mean Absolute Deviation (MAD) as the forecast error and a user specified service level with respect to a normal distribution. MAD is the mean absolute deviation of the historic forecasts from the actual demand:

\[
\text{MAD} = \frac{\sum_{t=1}^{n} |A_t - F_t|}{n}
\]

A\(_t\): Actual demand for time bucket “\(t\)"

F\(_t\): Forecast value for time bucket “\(t\)"

n: Number of time buckets

The safety stock based on MAD is calculated by the following equation:

\[
\text{SS} = Z \times (1.25 \times \text{MAD} \times \sqrt{\text{LT}_b})
\]

SS: Safety Stock Quantity

Z: Number from the normal distribution probabilities corresponding to the service level specified by the user

LT\(_b\) is the Replenishment Lead Time and is equal to the Pre-processing + Processing + Post-Processing lead times for an item-org combination.

Note: The calculated statistical safety stock (MAD) is flushed to both items and safety stock table. The calculated safety stock is displayed in the Safety Stock column for an item-organization combination and
the Safety Stock measure on the material plan. The material plan will show a constant statistically calculated SS value (MAD in this case) throughout the horizon.

Appendix B: Statistical Safety Stock Based on MAPE

Safety Stock based on Mean Absolute Percentage Error (MAPE) is calculated by planning in the following ways.

1) At the plan level by unchecking the "Use Item Specific Values" checkbox in the safety stock tab of the plan options. In this case, the user will enter the plan level values on the safety stock tab of plan options
2) For more specific item-org combinations by checking the "Use Item Specific Values" checkbox in the safety stock tab of the plan options. Users will have two options:
   a. Upload flat file values (for the relevant item-org combinations) with MAPE and Service Level Percentage. The "Forecast Error Type" item attribute will be set to MAPE.
   b. Update the MAPE override and Service Level values and set the "Forecast Error Type" item attribute to MAPE. Include these changes in Simulation Set and include the Simulation Set in Plan Options

In this method, the safety stock quantity is calculated based on the Mean Absolute Percentage Error (MAPE) as the forecast error and a user specified service level assuming with respect to a normal distribution. MAPE expresses forecast accuracy as a percentage, and is defined by the formula:

\[
MAPE = \left[\frac{\sum |(A_t - F_t) / A_t|}{n}\right] / n
\]

\[t = 1\]

\(A_t\): Actual demand for time bucket “t”

\(F_t\): Forecast value for time bucket “t”

\(n\): Represents the number of time buckets

The safety stock based on MAPE is calculated by the following equation:

\[
SS = Z \times (1.25 \times \text{MAPE} \times \text{AF} \times \sqrt{\text{LT}_b})
\]

\(SS\): Safety Stock Quantity

\(Z\): Number from the normal distribution probabilities corresponding to the service level specified by the user

\(\text{LT}_b\) is the Replenishment Lead Time and is equal to the Pre-processing + Processing+Post-Processing lead times for an item-org combination.
AF: Average forecast, which is the sum of the Gross Forecasts between Plan Start and the Plan Start Date + the Horizon For Average Daily Demand specified in the Advanced Plan Options. The gross forecast should be from the same demand schedule as provided by Snapshot.

Note – MAPE is an input from the VCM forecasting system. User can also specify a value for MAPE and override the system calculated one.

Note: The calculated statistical safety stock (MAPE) is flushed to both items and safety stock table. The calculated safety stock is displayed in the Safety Stock column for an item-organization combination and the Safety Stock measure on the material plan. The material plan will show a constant statistically calculated SS value (MAPE in this case) throughout the horizon.

Example of Prorating Forecast Demand in Weekly Bucket to Calculate Average Forecast:

Plan PL1 has weekly buckets in the following pattern

Day 1-Day5, Day 8-Day 12, Day 15-Day 19...

PL1 runs on Day 1.

The horizon for average daily demand (HADD) is 8 days, in other words demands for SS based on statistical forecasts are from Day 1 to Day 8.

There is only one forecast (quantity 100) on Day 10.

The forecast will be bucketed at the end of the week, Day 12. However, for the purpose of calculating the Average Forecast needed to calculate SS based on MAPE, engine will prorate the forecast through the week as 100/5, or 20 per day in the week (day 8 through day 12).

The UI will display the forecast as 100 on Day 12.

The Average forecast over the HADD is (0+0+0+0+0+0+0+20)/8=2.5, rounded up to 3.

Appendix C: Safety Stock Based on Intermittent Demand

As with MAD and MAPE Safety Stock based on Intermittent Demand is calculated in the following ways:

1) At the Plan Level by unchecking the "Use Item Specific Values" checkbox in the Safety Stock tab of the Plan Options: In this case the user will set the "Intermittent Demand" value to Yes and specify the "Average Inter arrival Time".

2) For a specific Item-org combination by checking the "Use Item Specific Values" checkbox in the safety stock tab of the plan options. Users will have two options:
   a. Upload flat file values (for the relevant item-org combinations)
b. If the user wants the demand pattern to be treated as intermittent they can set the
"Intermittent Demand Override" value in item attributes to "Yes" and also specify the
"Average Inter arrival Time Override"(item attribute). These edits are then saved to a
simulation set, which is then included in the plan options.

In this method, the user can manually specify whether the demand for an item-org combination is
intermittent by selecting Yes or No in the "Intermittent demand" column (item attribute). If the user
selects "Yes" then the Average Inter arrival Lead Time column becomes editable.

The content below is from the SS FDD
“SCM_VCP_SafetyStockCalculation_FDD_Fusion_Release_11.doc”. It explains the calculation of SS based
on intermittent demand.

The safety stock quantity is calculated based on a Pois
son distribution and its corresponding arrival rate:

\[
SS = \left\{ 1 + \min \left\{ \sum_{k=0}^{\infty} \left[ \left( \frac{\lambda^k}{k!} \times e^{-\lambda} \right) / \lambda \right] \right\} \geq SL \right\} - \lambda
\]

SS: Safety Stock Quantity
SL: Service Level Percent

\(\lambda\): represents a positive real number, equal to the expected number of occurrences during a given
interval

For the case of product demand, \(\lambda\) represents number of demands during Replenishment Lead Time.

Example:

Replenishment Lead Time = 21 days
Average Interarrival Time = 3 days (Time interval between 2 demands)

Average Number of Demands per Day = 1 / 3

\(\lambda = (1 / 3) \times 21 = 7\)

\(\lambda = (1 / AIT) \times \text{Replenishment Lead Time}\)

\(AIT: \text{Average Interarrival Time}\)

\textbf{Note} – When \(\left[ \left( \frac{\lambda^k \times e^{-\lambda}}{k!} \right) \geq SL \right] \text{for } k = 0\), then SS = 0.
**Note** – The Average Interarrival Time is determined by the system. The intermittency of demand pattern is also determined by the system. In case of an intermittent demand, a flag called Intermittent Demand flag is set to “Yes”.

**Note** – The system uses this method if the value of Intermittent Demand flag determined by the forecasting system is equal to “Yes”. User can also specify a “Yes” or “No” value for this flag in the Items page. If the value of this flag is set to “Yes”, then user should also enter a value for the Average Interarrival Time field.

**Note** – User can also specify the Average Interarrival Time in the Items page.

**Note**: The calculated statistical safety stock (intermittent) is flushed to both items and safety stock table. The calculated safety stock is displayed in the Safety Stock column for an item-organization combination and the Safety Stock measure on the material plan. The material plan will show a constant statistically calculated SS value (intermittent in this case) throughout the horizon.