DEMAND PLANNING

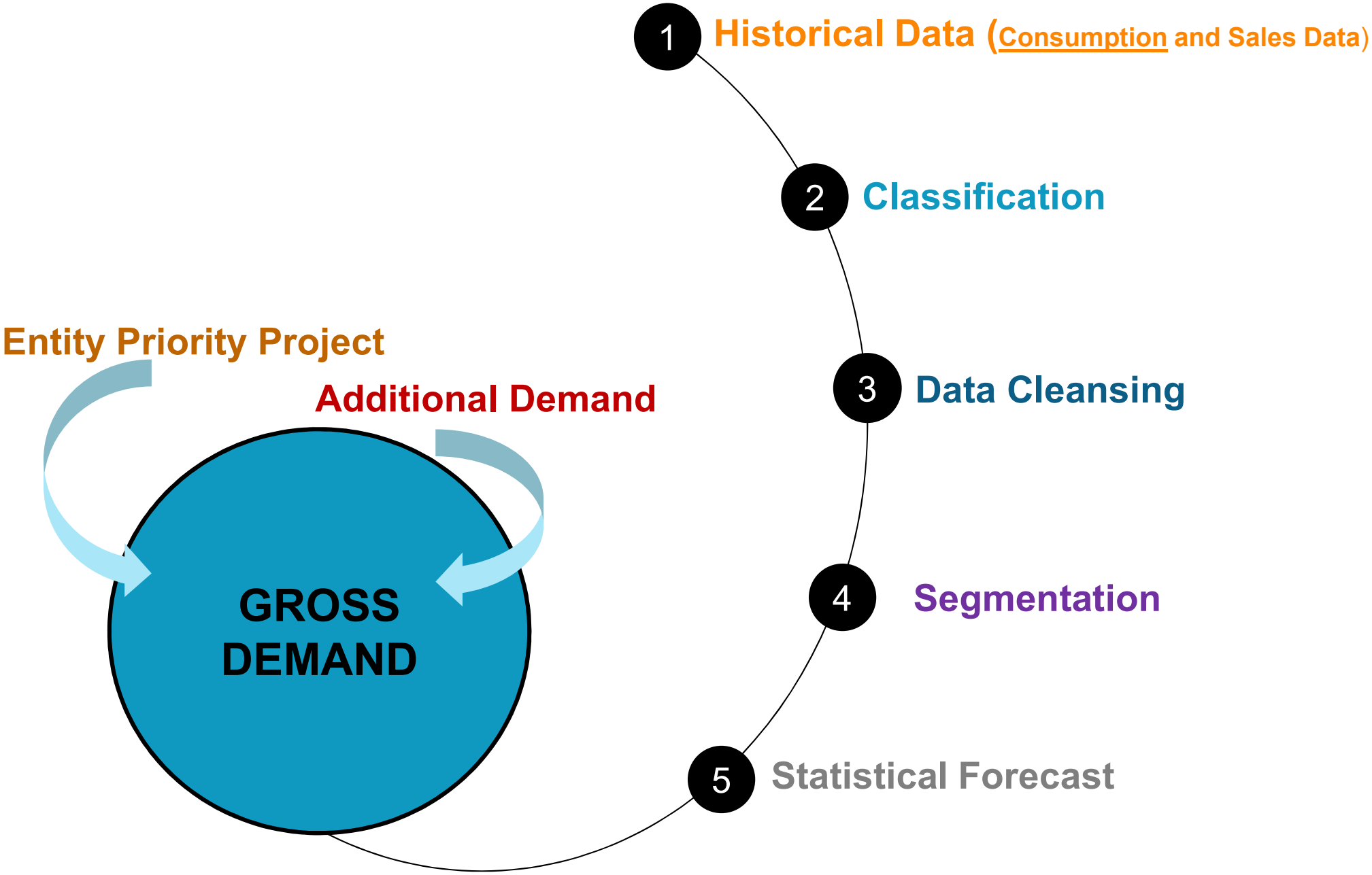
Umoja Demand Planning and Supply Network Planning Solution

Segmentation and Statistical Forecast

UCS Training Team

DEPARTMENT OF OPERATIONAL SUPPORT

Process of planning the Gross Demand



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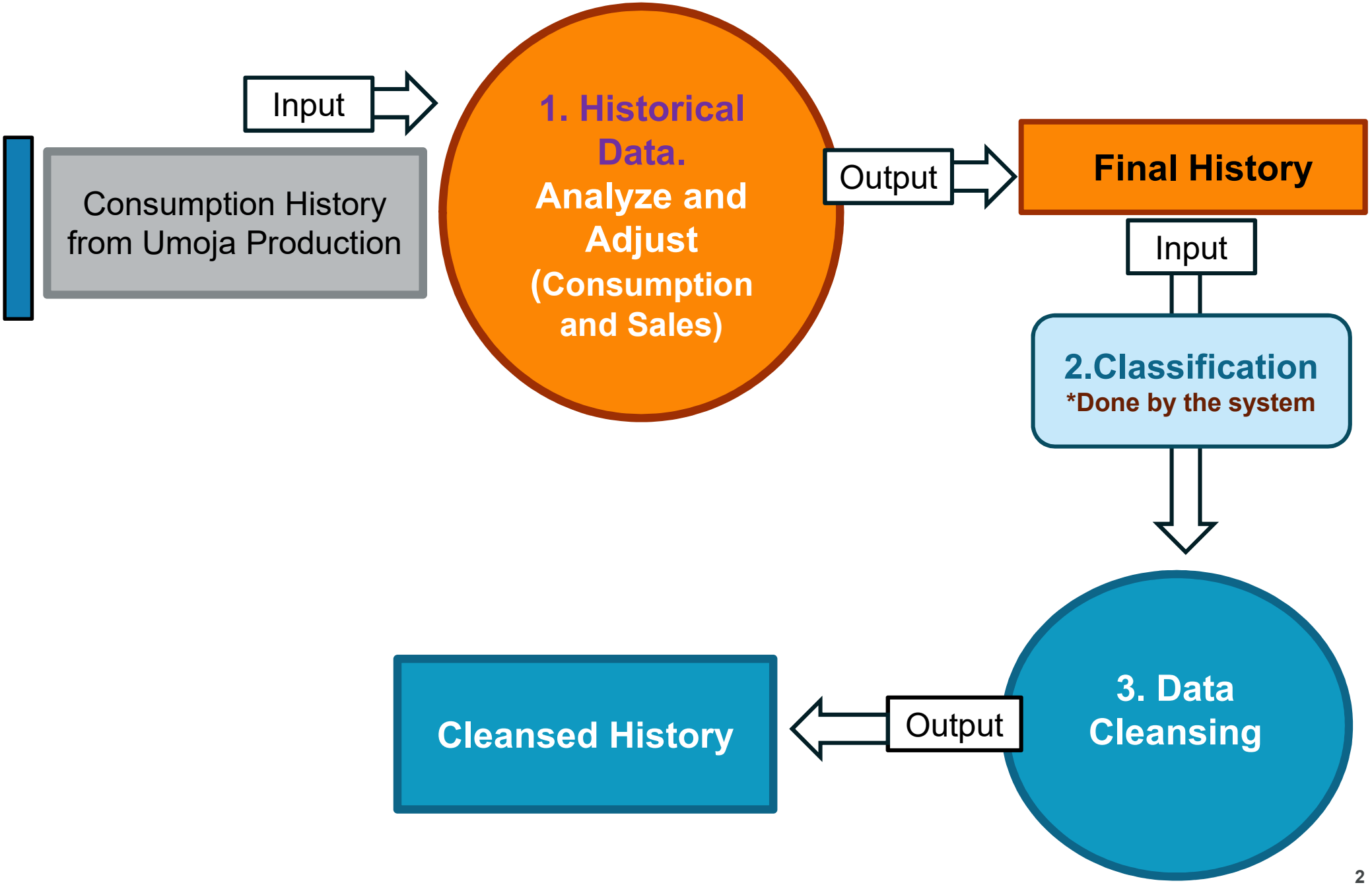
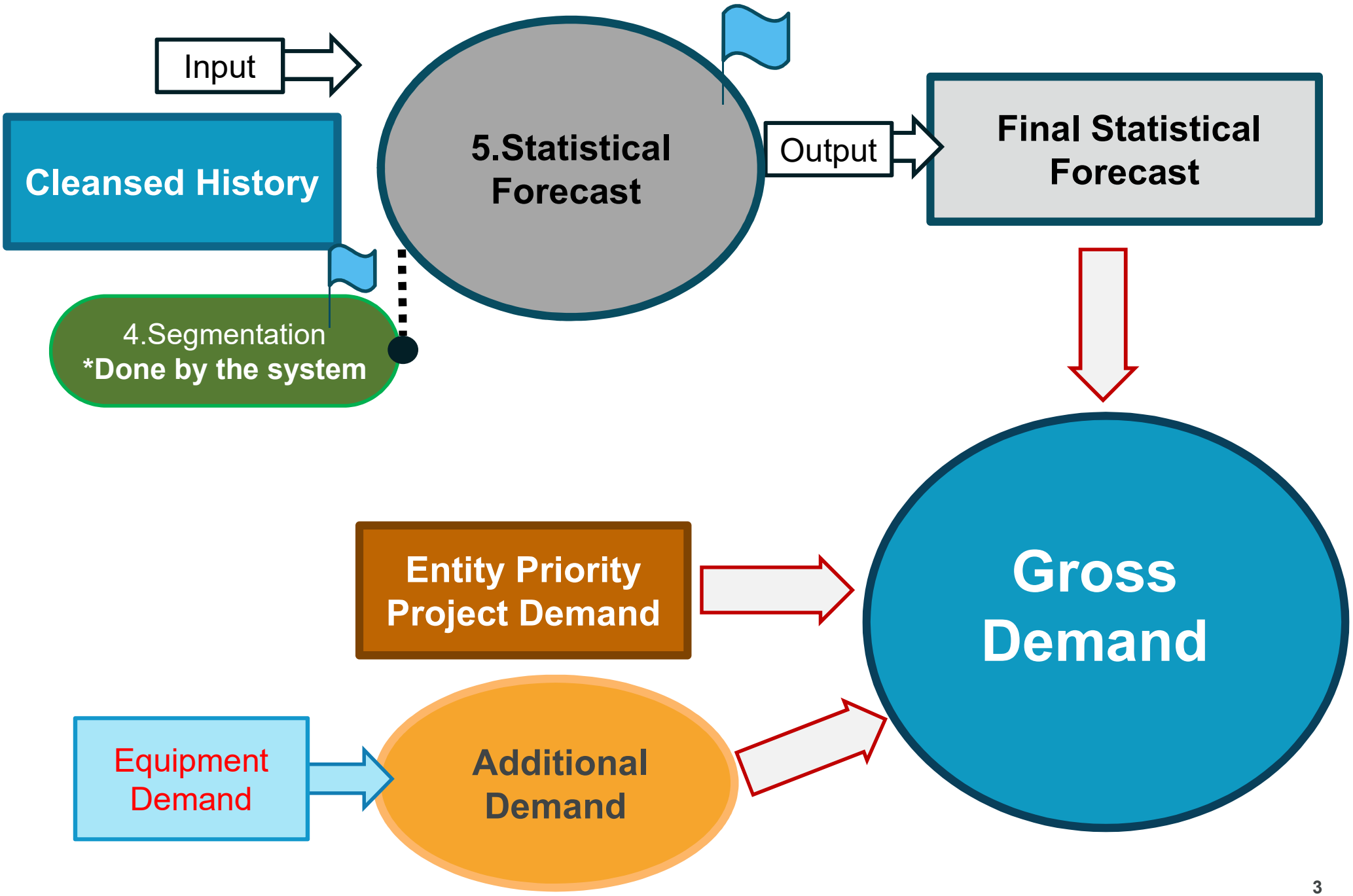
Planning the Gross Demand 1of 2



Planning the Gross Demand 2 of 2



Product Segmentation

4.Segmentation
***Done by the system**

Considering that:	Therefore:
❖All goods and services have their own demand particularity or characteristic.	❖Demand for some products ***should be forecasted in priority;*** several factors matter.

The goal of Product Segmentation is:

Prioritize products based on their relative importance within a plant

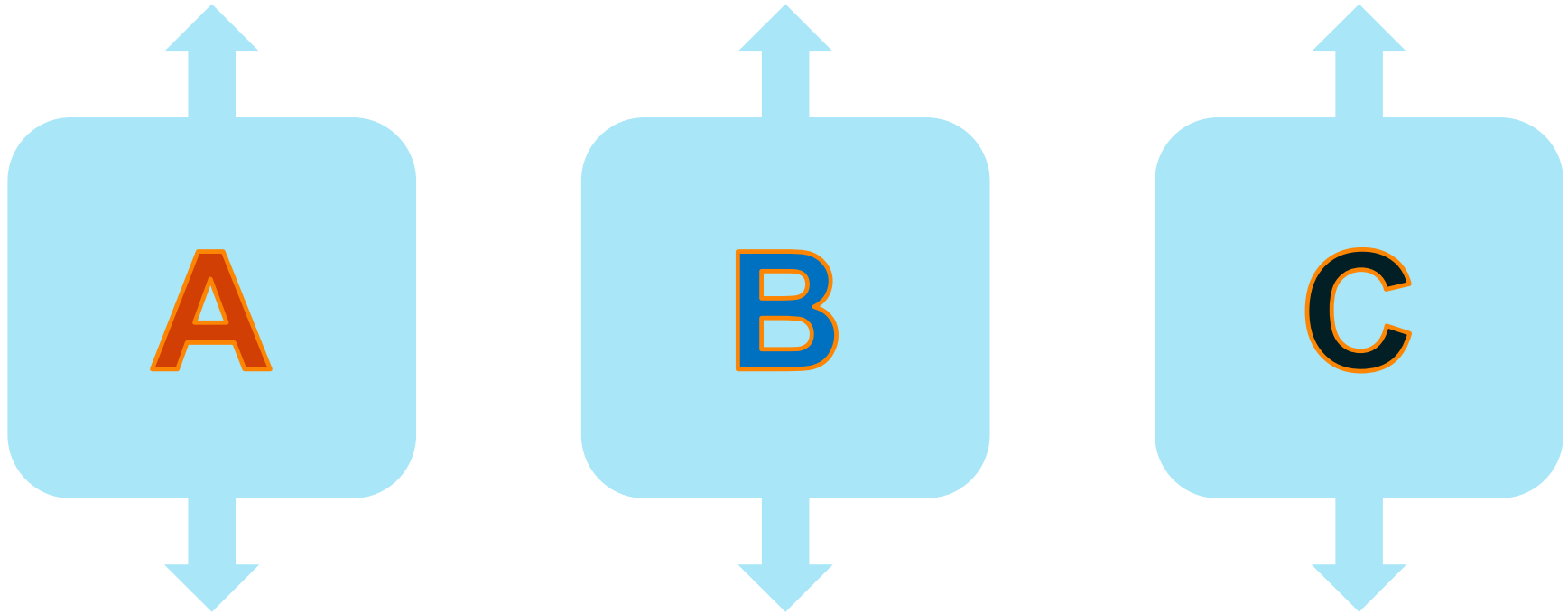
Product Segmentation: ABC

- The concept states that a small percentage of a group accounts for the largest fraction of the impact, value, etc.
- Applying the concept to inventory items we could say that 20% of the inventory items may constitute 80% of the inventory value.
- The ABC principle states that effort and money can be saved through applying looser controls to the low-dollar-volume class items and focus mainly on high-dollar-volume class items.
- <u>Other factors to consider to segment products:</u>

1. Demand characteristics (Consumption Volume, Volatility, etc.)
2. Supply characteristics (Cost, Availability, Location, Reliability, etc.)
3. Internal Organizational Characteristics (Strategic, Critical)

Product Segmentation: ABC

- Determining the Item priority



Product Segmentation: XYZ

- XYZ analyses group of items according to the **volatility** of their demand.
- It focuses on how difficult is a product/service to forecast, **being X the easiest** and **Z the most difficult.**

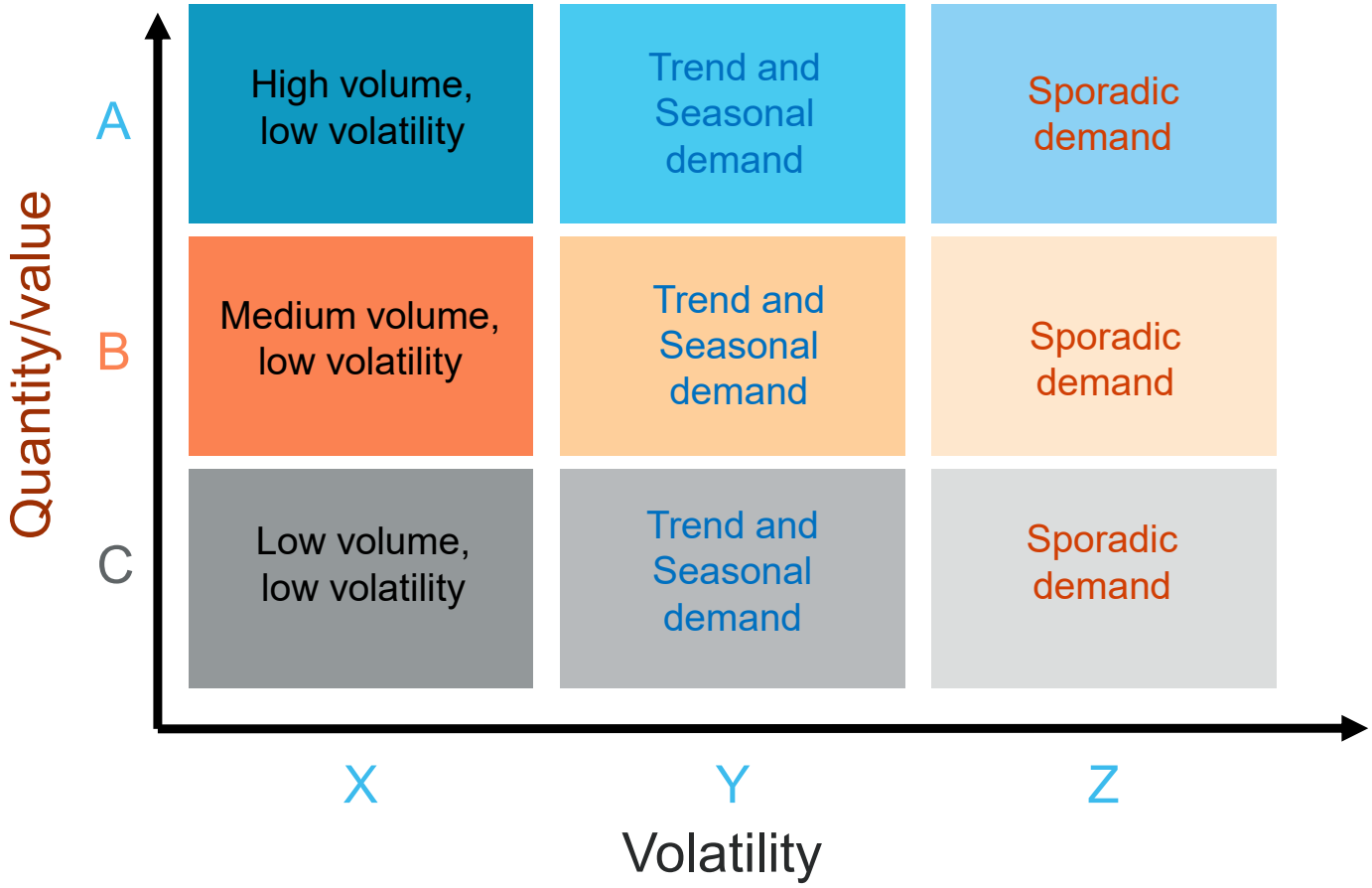
Formula explained:

- *First we calculate the **Average Demand** across a period.*
- *Then we calculate the **Standard Deviation** from the **Average Demand**.*
- *Lastly we calculate the **Coefficient of Variation (CV)***

$$\textit{Coefficient of Variation} = \frac{\textit{Standard Deviation of Average Period Demand}}{\text{Average Period Demand}} \textit{ x 100}$$

ABC/XYZ: Analysis

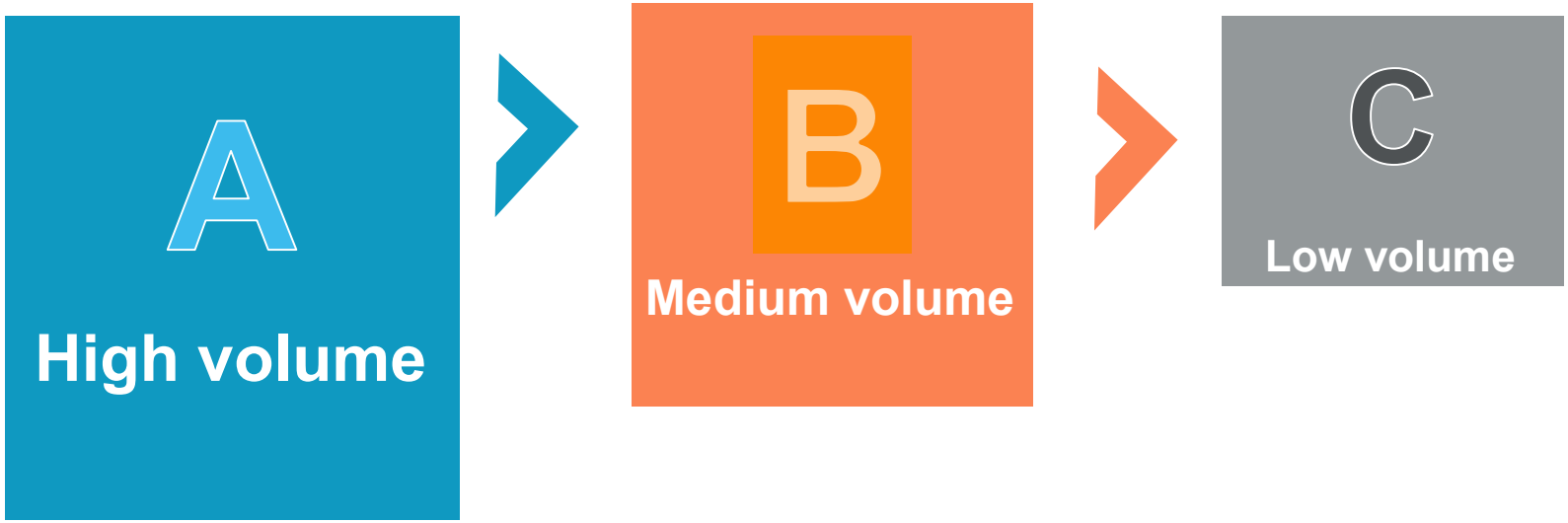
- Combine the ABC Segmentation: Items are categorized by importance of their quantities\values (High/Medium/Low), with XYZ Segmentation: items are categorized by the volatility of their historical demand (Constant/Trend or Seasonal/Random or Sporadic)



Applying the ABC/XYZ Analysis

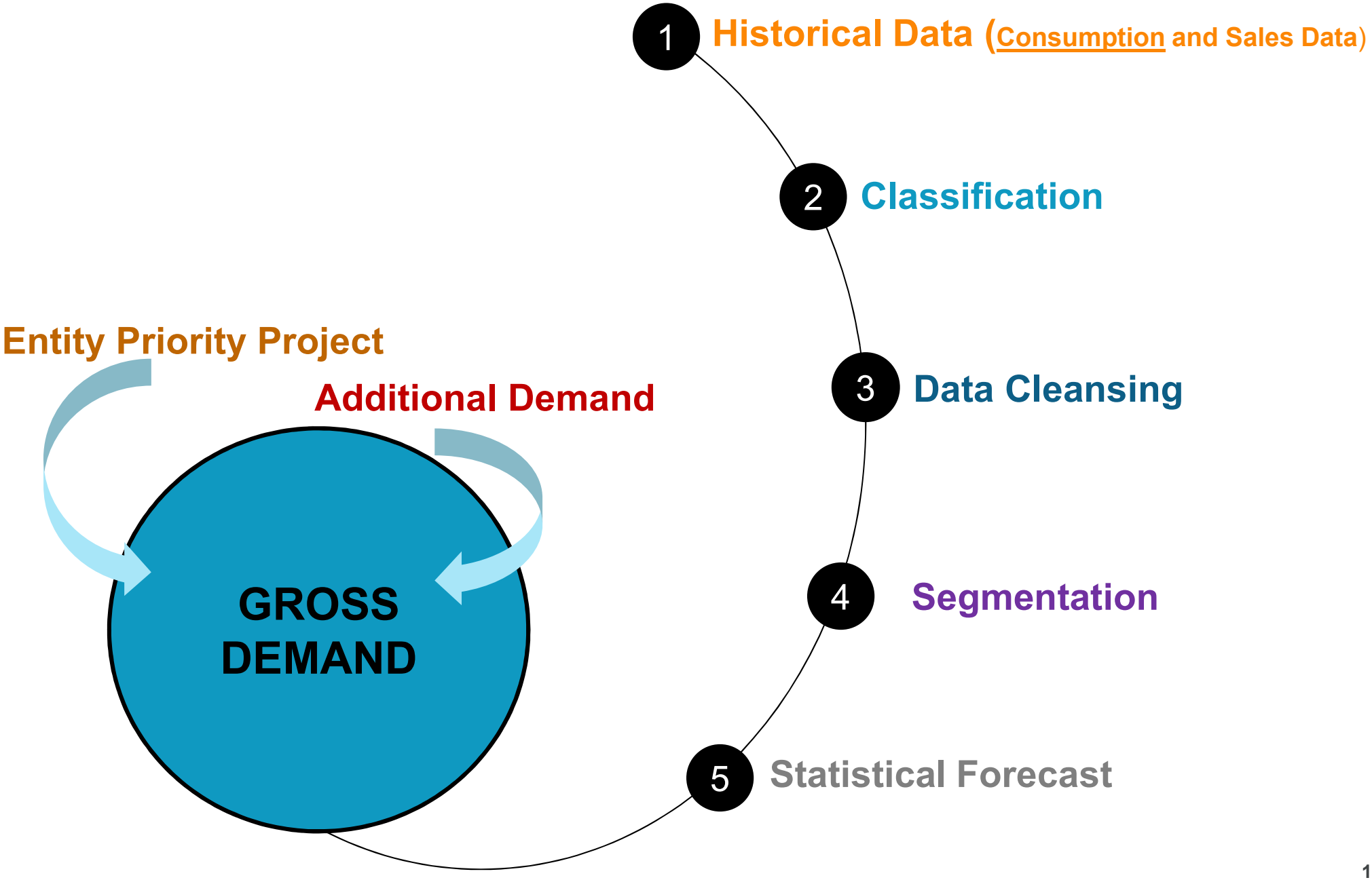
- Planning should be primarily focused on the demand of class A product. Due to its high consumption volume, these products hold a high quantity/value of the total spending.

- Demand planning of products of class B and C should be subsequentially addressed



STATISTICAL FORECAST

Process of planning the Gross Demand



Statistical Forecast Template

- It organizes, interprets, and analyzes historical data to predict the future demand for a product or product group.

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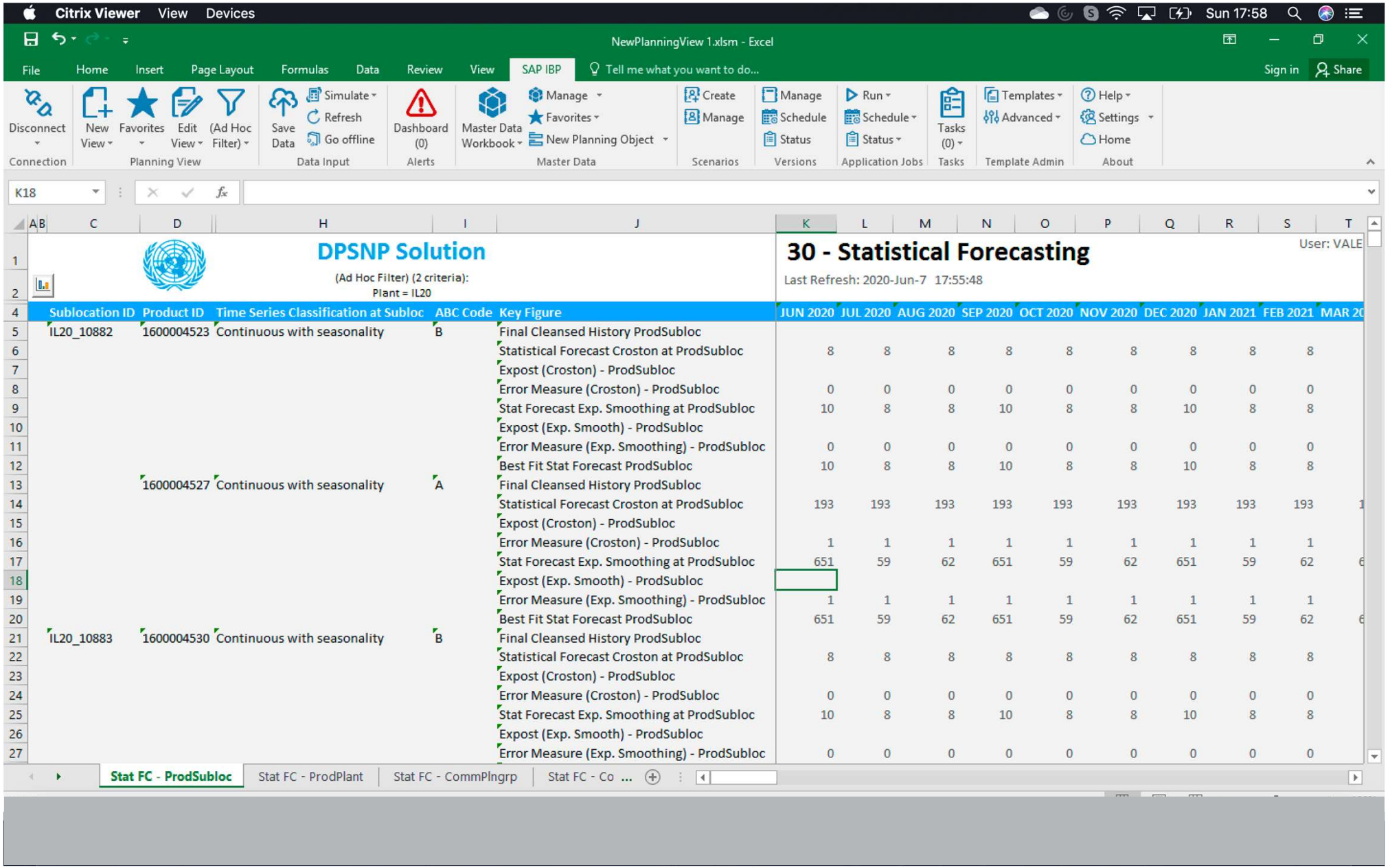
Statistical Forecast Template



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				Statistical Forecast Croston at ProdSubloc	8	8	8	8	8	8	8	8	8	
				Expost (Croston) - ProdSubloc										
				Error Measure (Croston) - ProdSubloc	0	0	0	0	0	0	0	0	0	
				Stat Forecast Exp. Smoothing at ProdSubloc	10	8	8	10	8	8	10	8	8	
				Expost (Exp. Smooth) - ProdSubloc										
				Error Measure (Exp. Smoothing) - ProdSubloc	0	0	0	0	0	0	0	0	0	
				Best Fit Stat Forecast ProdSubloc	10	8	8	10	8	8	10	8	8	
	1600004527	Continuous with seasonality	A	Final Cleansed History ProdSubloc										
				Statistical Forecast Croston at ProdSubloc	193	193	193	193	193	193	193	193	193	1
				Expost (Croston) - ProdSubloc										
				Error Measure (Croston) - ProdSubloc	1	1	1	1	1	1	1	1	1	
				Stat Forecast Exp. Smoothing at ProdSubloc	651	59	62	651	59	62	651	59	62	6
				Expost (Exp. Smooth) - ProdSubloc										
				Error Measure (Exp. Smoothing) - ProdSubloc	1	1	1	1	1	1	1	1	1	
				Best Fit Stat Forecast ProdSubloc	651	59	62	651	59	62	651	59	62	6
IL20_10883	1600004530	Continuous with seasonality	B	Final Cleansed History ProdSubloc										
				Statistical Forecast Croston at ProdSubloc	8	8	8	8	8	8	8	8	8	
				Expost (Croston) - ProdSubloc										
				Error Measure (Croston) - ProdSubloc	0	0	0	0	0	0	0	0	0	
				Stat Forecast Exp. Smoothing at ProdSubloc	10	8	8	10	8	8	10	8	8	
				Expost (Exp. Smooth) - ProdSubloc										
				Error Measure (Exp. Smoothing) - ProdSubloc	0	0	0	0	0	0	0	0	0	

Statistical Forecast

- Statistical Forecast is the process of making predictions of the future based on past data and most commonly **by the analysis of trends.**

- By collecting, organizing, interpreting, presenting and analyzing Historical Data (time series), the Statistical Forecast allows you to predict the future demand for a product or product group.

Time series analysis:

- Looking at a collection of values observed sequentially over time, it performs time-based predictions.
- It assumes that **past data** patterns such as level, trend, and seasonality repeat themselves in the future.

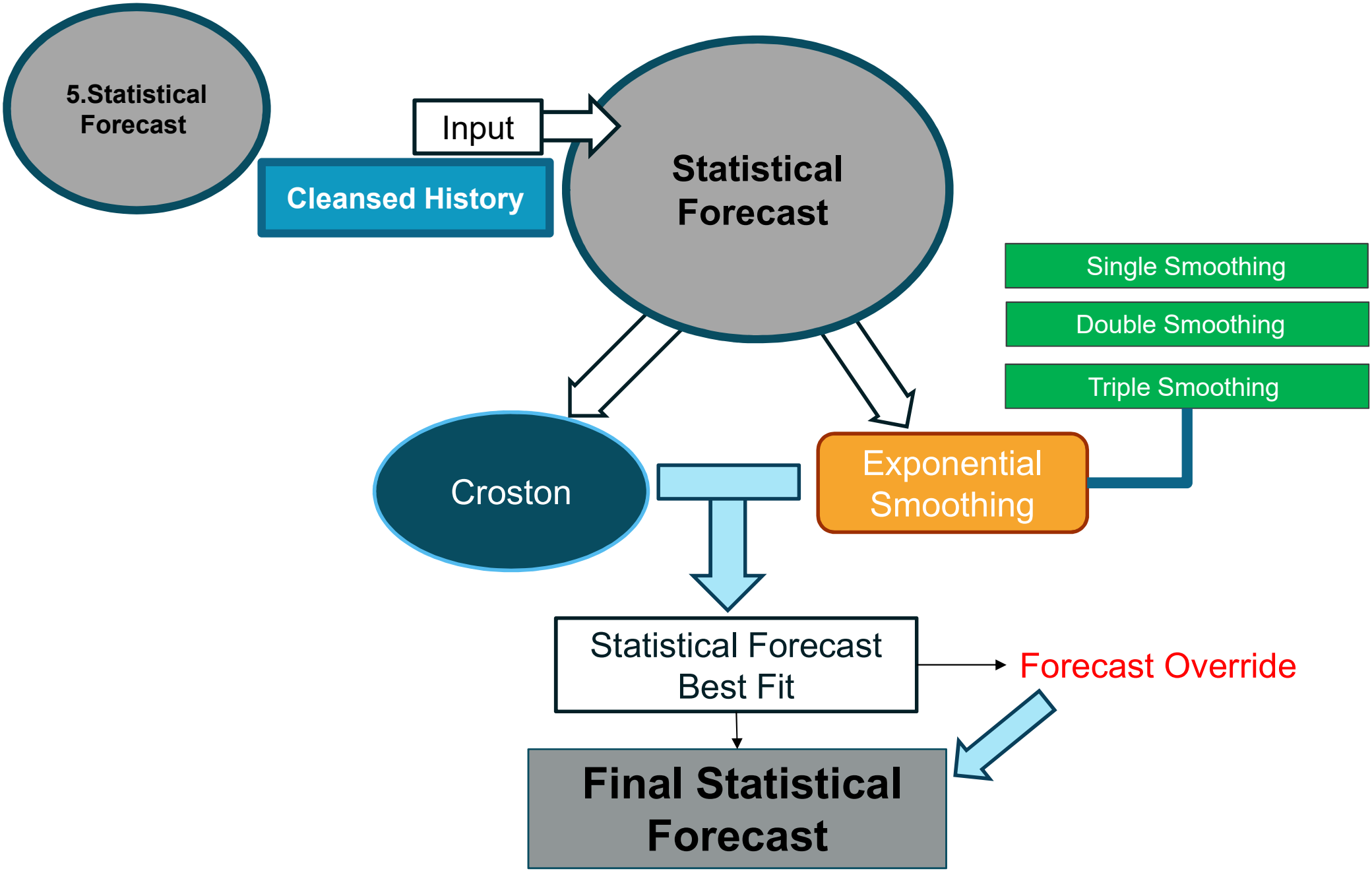
Forecast after Time Series Analysis

- Forecast is calculated using **Forecasting Algorithms** (mathematical formulas).
- Different formulas could be used depending on the type of Data we are analyzing:

DPSNP Solution selected below best forecast models:

Constant model	Trend model	Seasonal model	Intermittent model
Single Exponential Smoothing	Double Exponential Smoothing	Triple Exponential Smoothing	Croston Method

Statistical Forecast

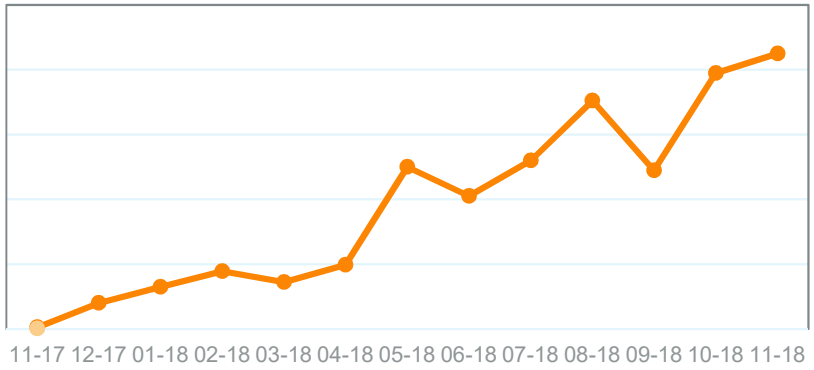


3 Exponential Smoothing Algorithms

- The **Single Exponential Smoothing** is used to calculate the Forecast when Data are classified as Continuous.

- The **Double Exponential Smoothing** is used for the Forecast when Data are classified as Continuous and Continuous with Trend; while the **Triple Exponential Smoothing** is used for the Forecast when Data are classified as Continuous, Continuous with Seasonality and Continuous with Trend.

Example: Continuous with Trend Demand



The Exponential Smoothing Algorithm

- The Forecasting Algorithm Exponential Smoothing calculates the Forecast assigning an exponentially decreasing weights from newest to oldest Data, hence the name “exponential smoothing”.
- The weight is given by a parameter, α (Alpha), the smoothing factor, which is set to a vale between 0 and 1.
- More recent data will be associated with value closer to 1, as to say that more importance is given to the most recent data, which will therefore influence the Forecast more.
- Alpha value will exponentially decrease as older data are included in the calculation of the Forecast.

The Single Exponential Smoothing Algorithm: the Formula

$$F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$$

F_t new Forecast

F_{t-1} Previous period Forecast

A_{t-1} Previous period actual demand

α smoothing parameter

- Starting from the Forecast of the previous period F_{t-1}, apply a smoothing parameter (α), adjustable between 0 and 1, to the difference between the Actual Demand of the previous period (A_{t-1}) and its forecast (F_{t-1}).

- The difference $(A_{t-1} - F_{t-1})$ is the Error in the forecast of previous period. (t-1).

The Double and Trible Smoothing Algorithm

- Both are an exstension of the Simple Esponential Smoothing.

In addition to the smoothing parameter Alpha:

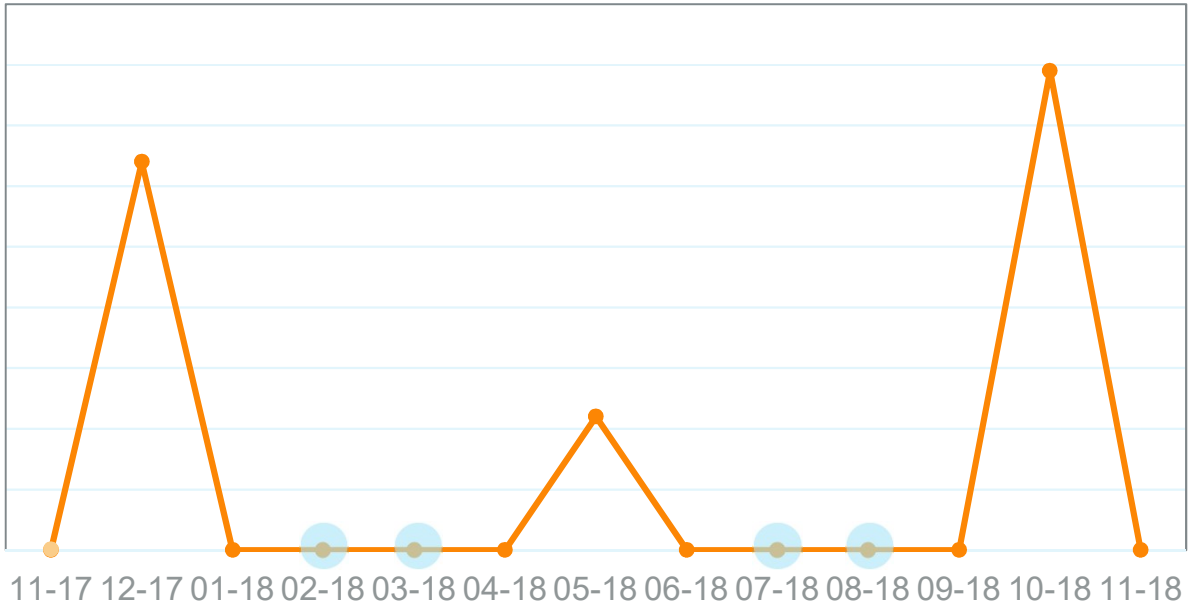
- Double Smoothing introduces smoothing parameter to control the influence of the Trend in data. The increasing or decreasing pattern will be represented by a Line or Curve.

- Triple Smoothing introduces the smoothing parameter to control te influence of Seasonality in data. In this case a regular and predictable changes recurs every given period.

Croston Algorithm

- The Time Series are classified as **Intermittent** when a product experiences several periods of **zero demand,** also referred to as Sporadic Demand. In this case, the best algorithm to use is **Croston.**

Example: Sporadic Demand



The Croston Algorithm: the Formula

- This algorithm determining how frequently a good is requested and the typical amount requested, assumes that a constant Demand of size Y, occurs every P periods.

- It calculates the Average Demand level when there is a demand occurrence simply utilizing **the size of non-zero demands** and **the time interval** of those demands occurred.

$$\overline{Y}_t = F_t / P_t$$

$\overline{Y}_t$ = Average demand per period

A_t = Actual Demand period

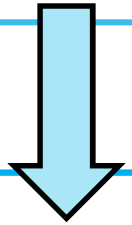
$\overline{P}_t$ = Forecast Demands Interval

The Croston Algorithm in 4 steps

1. Evaluate when Demand is zero o non-zero.
2. Calculate the average size of demand and apply **simple exponential smoothing**.
3. Calculate the average time interval between two demands occurrences and apply **simple exponential smoothing**.
4. Use the form of the constant model to predict the future demand: Forecast the demand as the demand level (when there is an occurrence) multiplied by the probability to have an occurrence.

Calculating the Statistical Forecast Best Fit

- At this time, the system will produce **two Forecast Values**, one as result of applying Exponential Smoothing and the other as result of applying Croston.



- The **Best Fit** will be the value between the 2 with the **lowest** Mean Absolute Percentage Error **(MAPE)**. The calculation of the Error is based on past data.

Adjustment of the Best Fit

- How the planner knows if a Forecast is a good one? An error factor between 0,3-0,4 could be quite reasonable.

- The planner can adjust the Final statistical forecast manually if he/she thinks it does not represent the right sublocation requirement.

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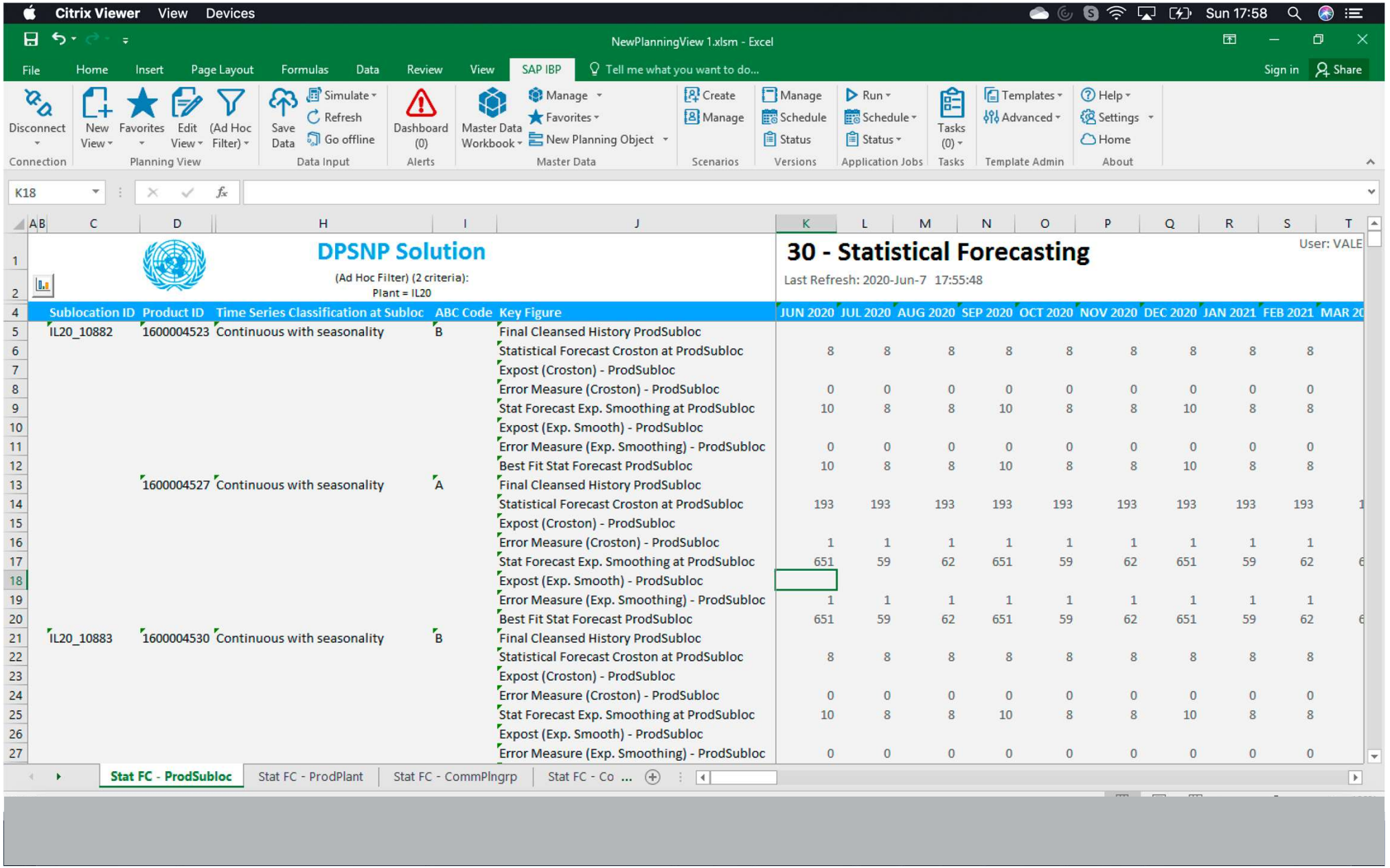
Statistical Forecast Template



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				Error Measure (Croston) - ProdSubloc	0	0	0	0	0	0	0	0	0	
				Stat Forecast Exp. Smoothing at ProdSubloc	10	8	8	10	8	8	10	8	8	
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				Error Measure (Exp. Smoothing) - ProdSubloc	0	0	0	0	0	0	0	0	0	
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	1600004527	Continuous with seasonality	A	Final Cleansed History ProdSubloc										
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				Error Measure (Croston) - ProdSubloc	1	1	1	1	1	1	1	1	1	
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				Error Measure (Croston) - ProdSubloc	0	0	0	0	0	0	0	0	0	
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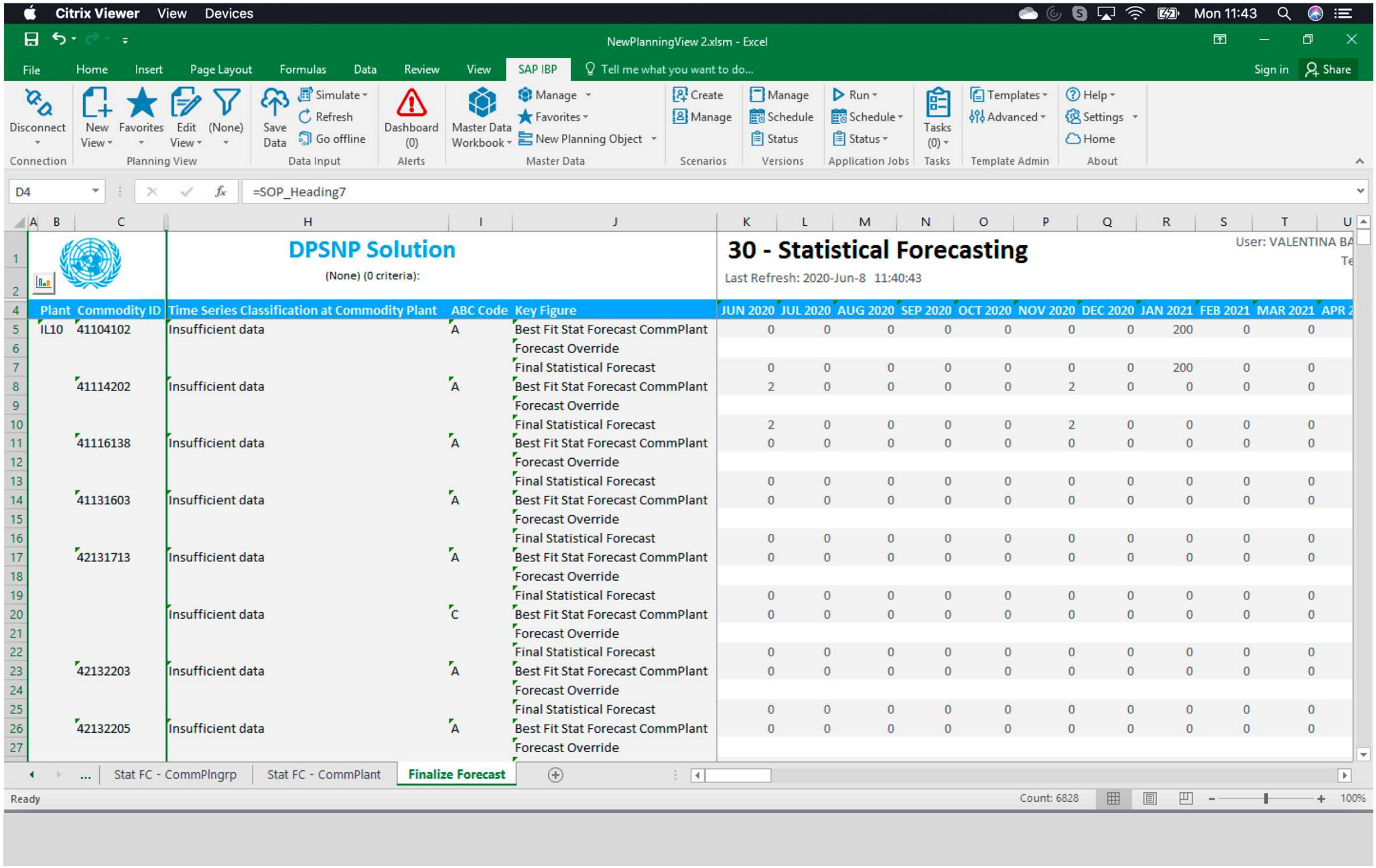
Adjustment of the Best Fit Statistical Forecast



Plant	Commodity ID	Time Series Classification at Commodity Plant	ABC Code	Key Figure	JUN 2020	JUL 2020	AUG 2020	SEP 2020	OCT 2020	NOV 2020	DEC 2020	JAN 2021	FEB 2021	MAR 2021	APR 2
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				Final Statistical Forecast	0	0	0	0	0	0	0	0	0	0	
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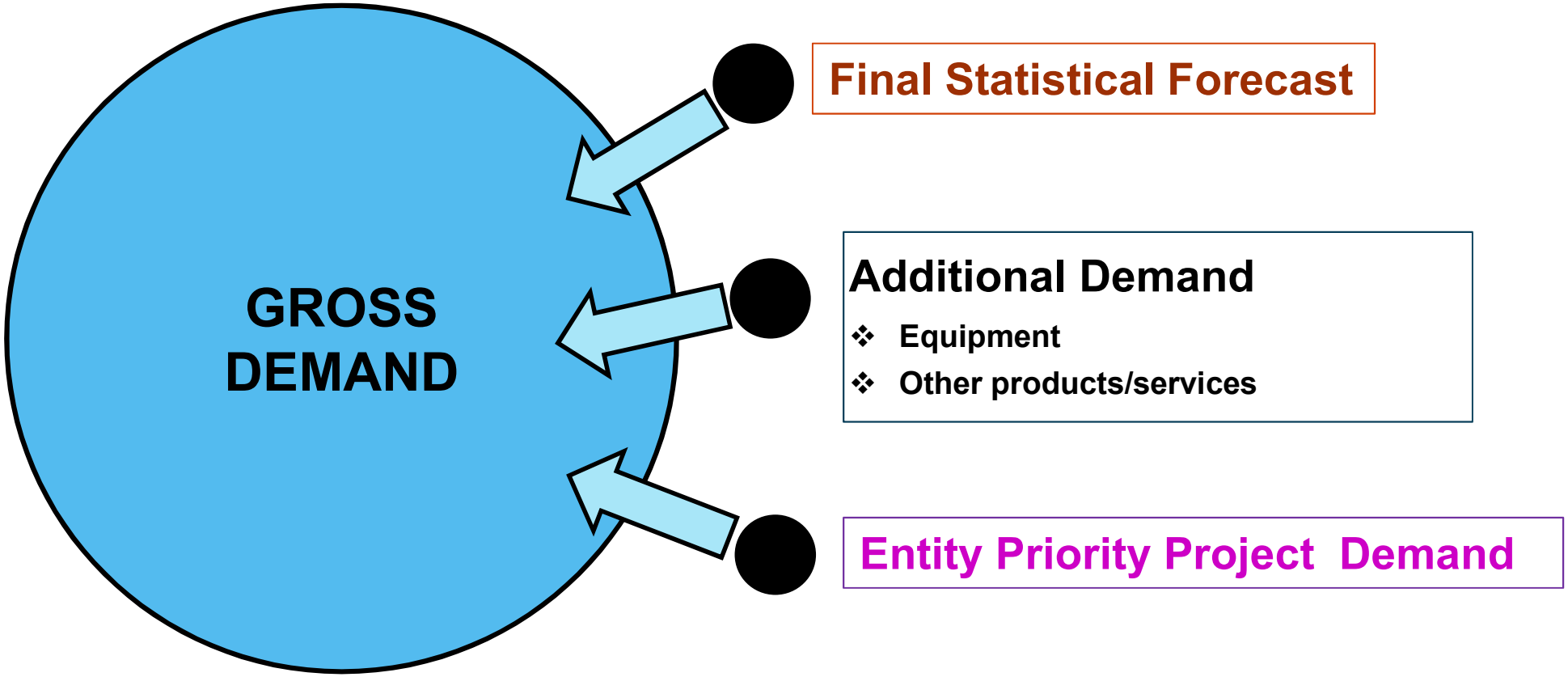
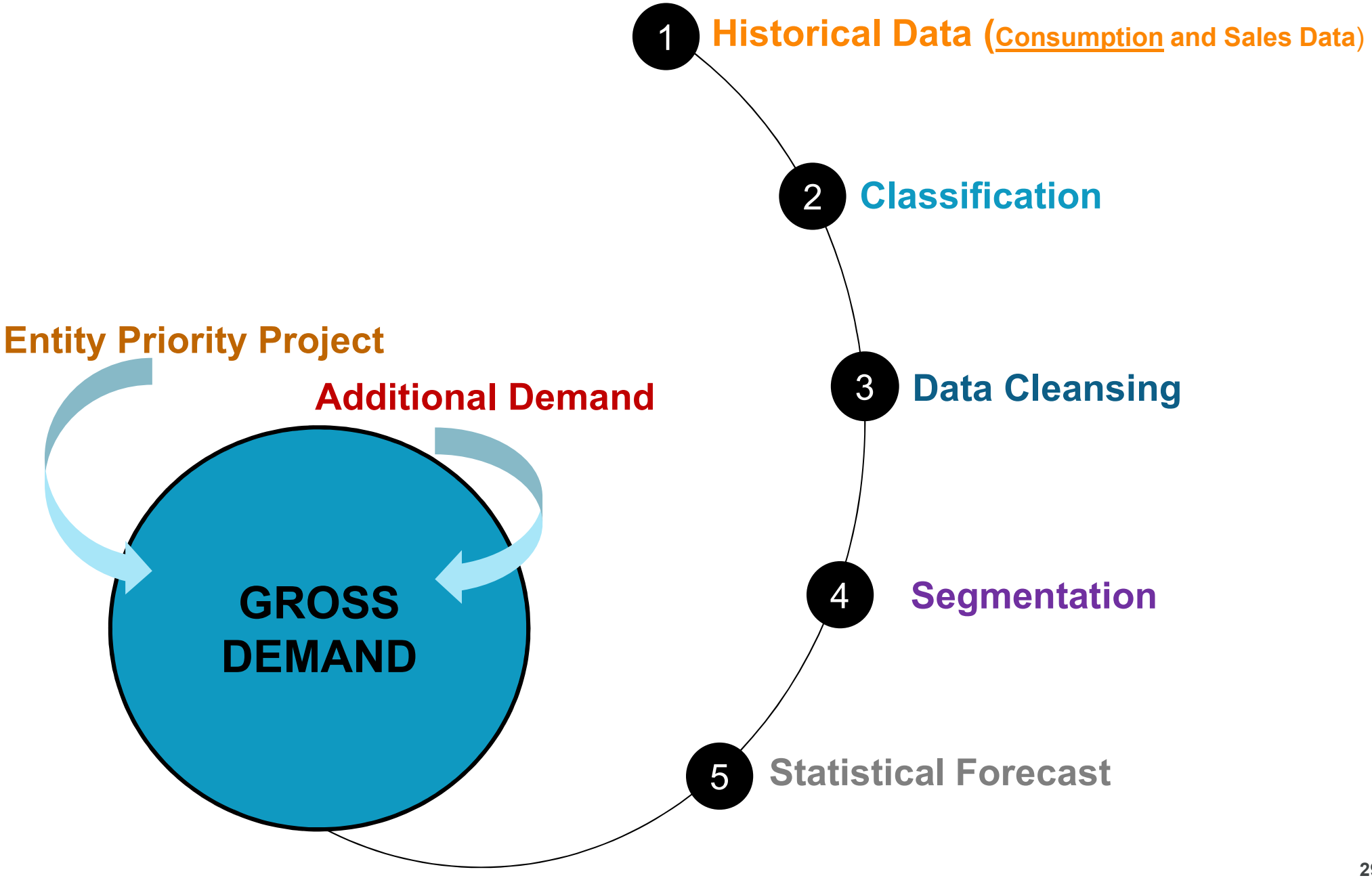
Process of planning the Gross Demand



Next Step: Entity Priority Project Demand



Thank you!