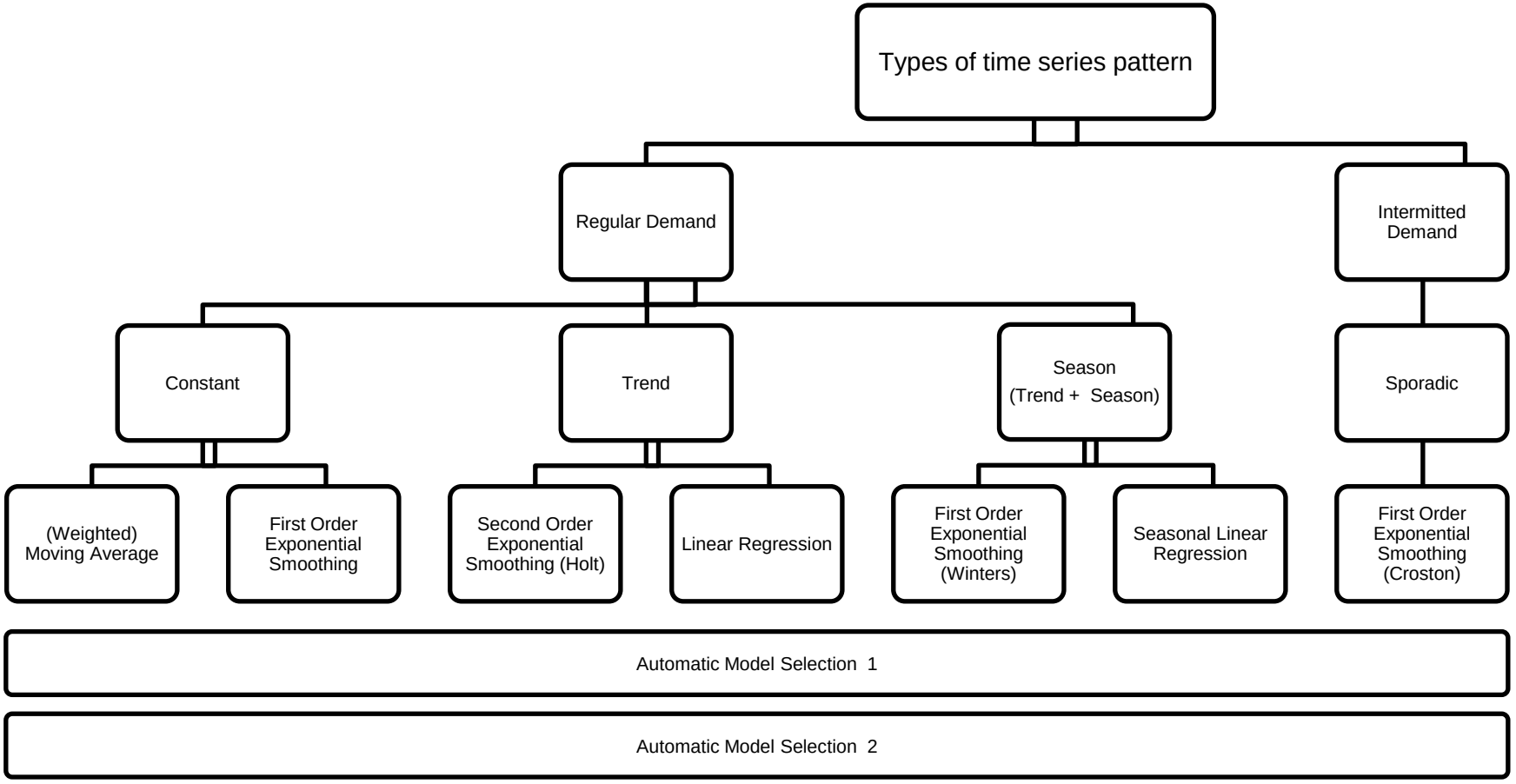
Demand Planning Details:

Univariate Forecasting Models

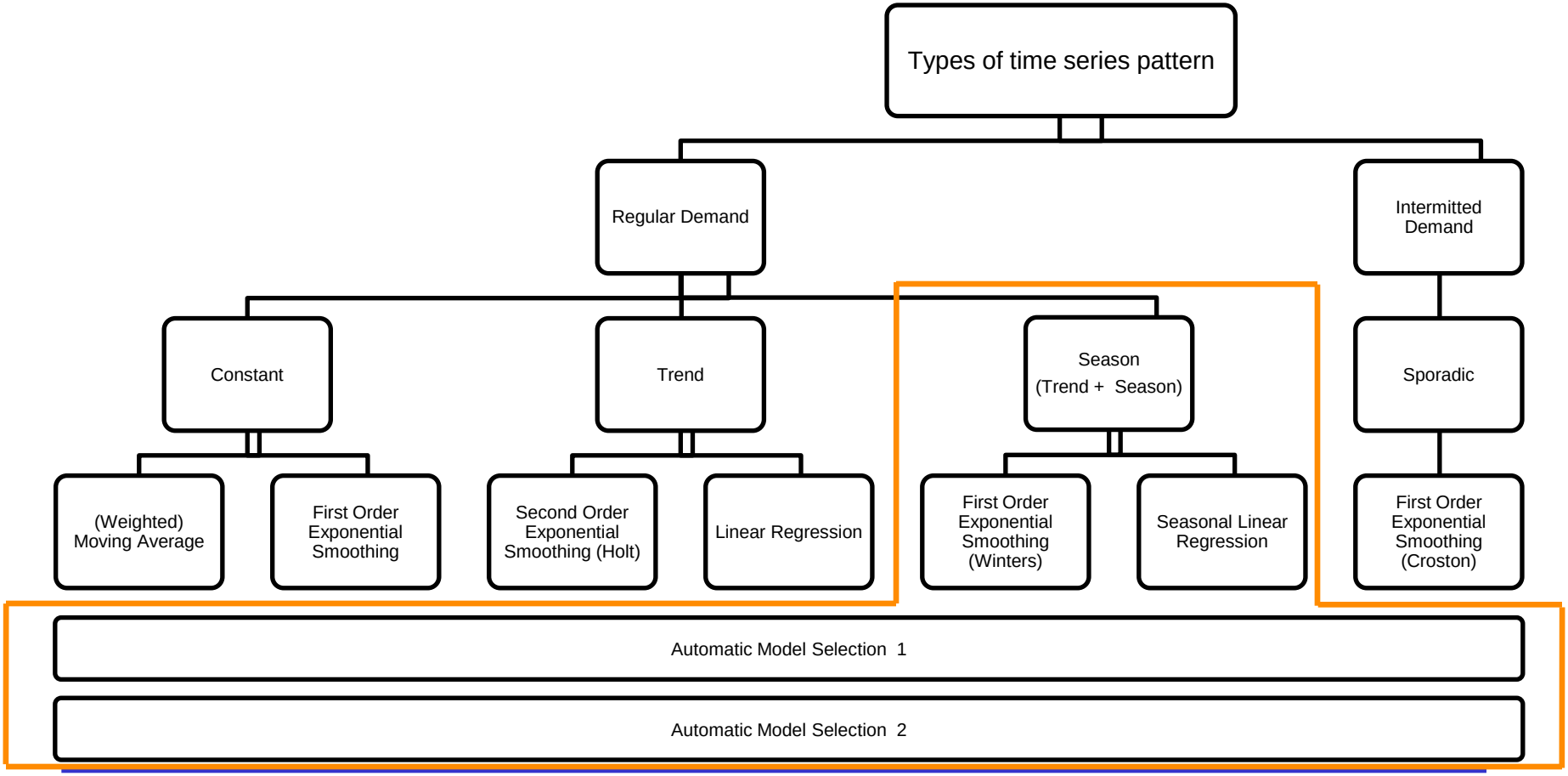
Overview

In SAP APO DP different forecasting methods can be assigned based on regular and intermitted demand patterns. In regular demand patterns you can distinguish between constant, trend and seasonal pattern. You can also choose Automatic Model Selection if there is no knowledge of the pattern in the historical data.



Models for seasonal demand pattern

The example for the In-depth stream is the Aggregated Product Group FRU_SEAS1_DP, which shows a seasonal demand pattern. Therefore this introduction is focused on the four main models to forecast seasonal demand (Winters, Seasonal Linear Regression, Automatic Model Selection 1/2).



Seasonal Linear Regression 1/2

Before the system calculates the forecast it carries out a seasonal test to check if the historical data shows any seasonal patterns. The system calculates the autocorrelation coefficient for all periods.

Auto correlation coefficient: $$R_p = \frac{\frac{1}{n-p}\sum[(V_i - \bar{V}) \cdot (V_{i+p} - \bar{V})]}{\frac{1}{n}\sum(V_i - \bar{V})^2} \quad ,$$

where
- V_i = Historical Value in period i
- V_{i+p} = Historical Value in period i+p
- $\bar{V}$ = Mean Historical Value
- n = Number of Historical Values
- p = Number of Periods per season

If $R_p \geq 0{,}3$ the system recognized seasonal patterns. It applies seasonal linear regression.

If $R_p < 0{,}3$ the system applies linear regression.

Seasonal Linear Regression 2/2

The system calculates the seasonal linear regression line as follows:

1. The seasonal indices are calculated

Step 1 is the most important and the most difficult step.
The system first determines the starting seasonal index for each historical period t. The starting seasonal index is the historical value of the period t divided by the average value of the season.
After the system calculated a starting seasonal index for each period t, it determines the average seasonal index. Then it smoothes the average seasonal indices.

2. The actual data is corrected on the basis of the seasonal indices calculated in step 1.

3. Linear regression is performed on the non-seasonal actual values.

Linear regression considers all the historical data at once and calculates a straight line through the data that results in the smallest error (sum of squares)

4. The seasonal indices are applied to the results of the linear regression calculation, which produces the forecast results.

First Order Exponential Smoothing (Winters) 1/2

First order exponential smoothing is an advancement of the weighted moving average method. The basic approach of first order exponential smoothing is, that the more recent periods have a greater impact on the forecast results. The weights for the older periods will decrease at an exponential rate.

$$F_{t+1} = G_t = (1-\alpha)G_{t-1} + \alpha V_t$$

α = the smoothing parameter, $0 < \alpha < 1$
t = current period
F_{t+1} = forecast for period t+1 (made at the end of period t)
V_t = actual demand in period t
G_t = smoothed demand in period t
G_{t-1} = smoothed demand in period t-1 (forecast for period t)

As the original first order exponential smoothing is not suitable to season-like patterns, Winters Model is.
Winters uses two parameters to smooth the constant and the seasonal factor.
Winters assumes seasonal pattern of the demand.

Automatic Model Selection 1

The system checks whether the historical data show seasonal or trend-like patterns.
In Automatic Model Selection 1 the parameters (alpha, beta, gamma) are constant. There is no consideration of error measure.

1. The system check, if there is regular or intermitted demand. If it detects a intermitted demand, it automatically chooses the Croston Model to forecast.

2. The system conducts initialization for the specified model and the test model. The system needs a sufficient number of historical data for initialization (i.e. 2 for seasons for seasonal test or 3 periods for trend test). If there is not enough data, the system will carry out the forecast with the constant model. If enough relevant data is present in the system, Automatic Model Selection will choose first order exponential smoothing and takes the relevant pattern into account.

Automatic Model Selection 2 1/2

The procedure uses the constant model, the trend model, the seasonal model and the seasonal trend model. It varies the parameters of these models in incremental steps. It selects the model with the parameter combination, that delivers the lowest measure of a chosen error (you can choose i.e. parameter optimization with MAPE)

1. The system tests for immediate demand (see Automatic Model Selection 2). If the test is positive, Croston Model is chosen.
2. The system checks for white noise. If there is white noise constant method is chosen.
3. If both tests are negative, the procedure descripted above is used to determine the best fitting model.

Automatic Model Selection 2 2/2