RETAIL SUPPLY MANAGEMENT

Problem Statement

1. The problem of properly allocating several different products in the stores network is one of the crucial processes in the Retail Industry. This means trying to meet market demand and at the same time reducing logistics costs.

2. Second, the products can experience large unexplained drops or spikes in demand for one period. If the calculations do not have a way to filter those periods, they can cause a large swing in the overall average. A large change in the average would lead to a dramatic change in the future order quantity.

3. The lead time variance indicates the amount of deviation buyers experience with order delivery. This number represents the reliability of the lead time forecast.

4. The order cycle refers to the amount of time expected between receipt. Large inventory needs to be maintained to keep track of the order cycle.

5. How much customer demand should be supported by replenishment inventory and safety stock.

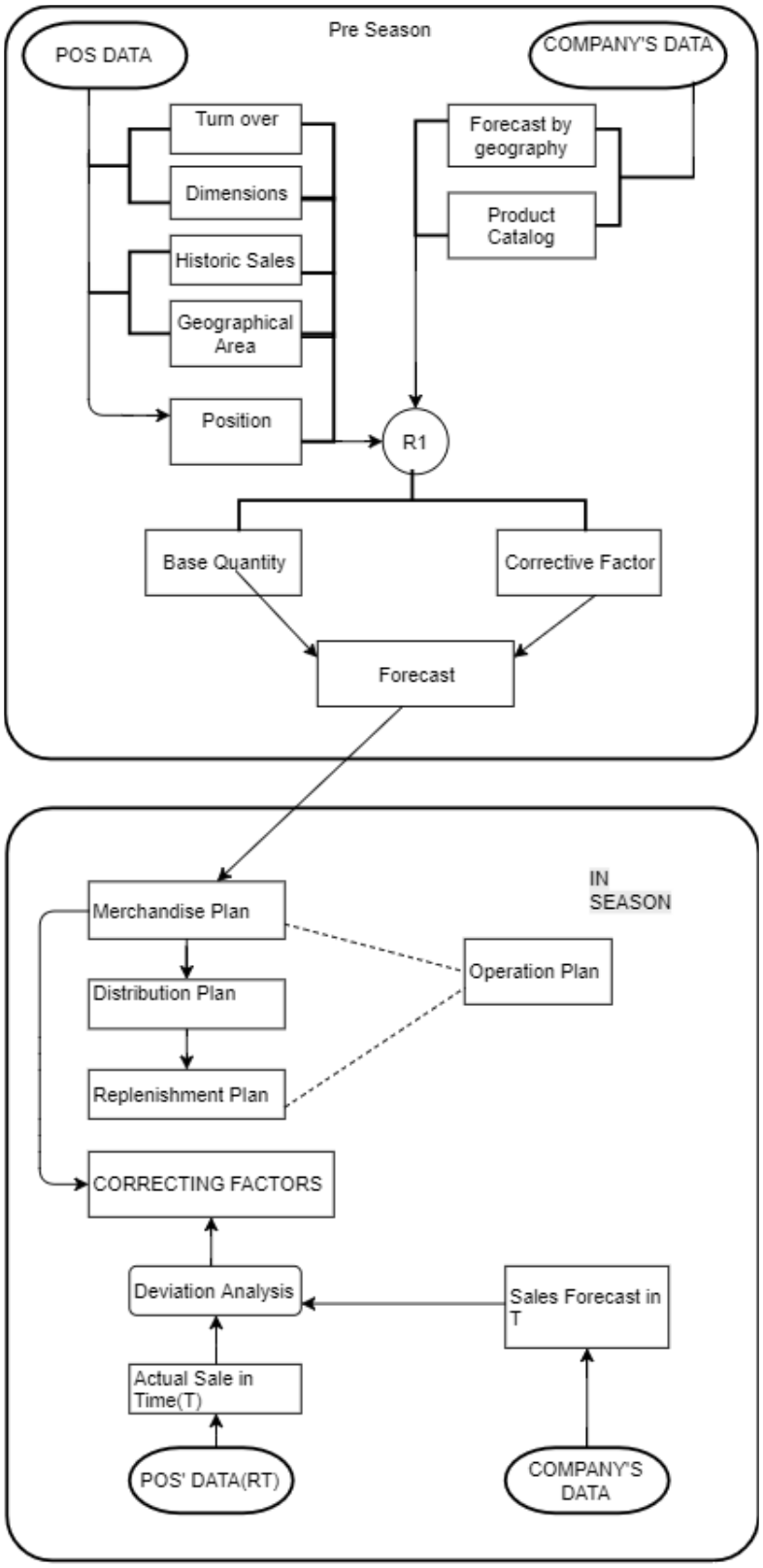
Assumed Algorithm:

Work flow is divided into:

Merchandise planning: Pre-Season forecasting process, of medium-long term, aimed at the definition of commercial plans of purchasing and distribution of items to POS.

Replenishment planning: In Season process, of short term, aimed at the definition of item's net requirements in stores, to replenish by sending consignment lots from logistic warehouses to the network.

The model consists of two macro blocks: the first, called Pre-Season, accepts input of all historic data about sales of the closest ended time bucket and business data about products and forecasts for the period under review. This step provides as output the "Merchandise Plan" (MP) which contains all sales data expected to be achieved in the coming period (disaggregated by point of sale and product code). Each input factor, through well-defined computation rules, will have a different weight on the quantities defined by the MP. The second step of the model, called In Season, has the purpose of monitoring, in real time, actual sales results, to allow the "Replenishment Plan" (RP) elaboration, which are periodic supply plans recalibrated, work in progress, compared to initial estimates, to evaluate possible overestimation and underestimation resulting from the MP.



T: Time in range

Continuous Replenishment Program:

Requirements:
1. Inventory management
2. Economic order quantity management
3. Safety tock level management
4. ROP (Reorder Point) identification
5. Lead Time Demand (Forecast)
6. Monthly sells data requirement
7. Supplier data includes Delivery time for a consignment and reorder time

Calculation of Lead Time demand:
LD = Lead Time * Avg daily usage of product (in units)

Constraints for Lead Time demand
Average monthly sales of product are needed
Based on Average monthly sale of product the Average daily sales can be predicted

Safety Stock Level calculations:
As safety stock level is the access inventory beyond the excess demand.
The calculation for this can be done by forecasting the lead time deviation, expected service level and the demand of the product.

$$SSL = Z * sqrt [LT *(\sigma D)2 + (D_{avg} * \sigma LT)2]$$

Z = Service Level
LT = Lead Time
σ LT = Standard deviation of Lead Time
D_{avg} = Average Demand
σ D = Standard Deviation of Demand

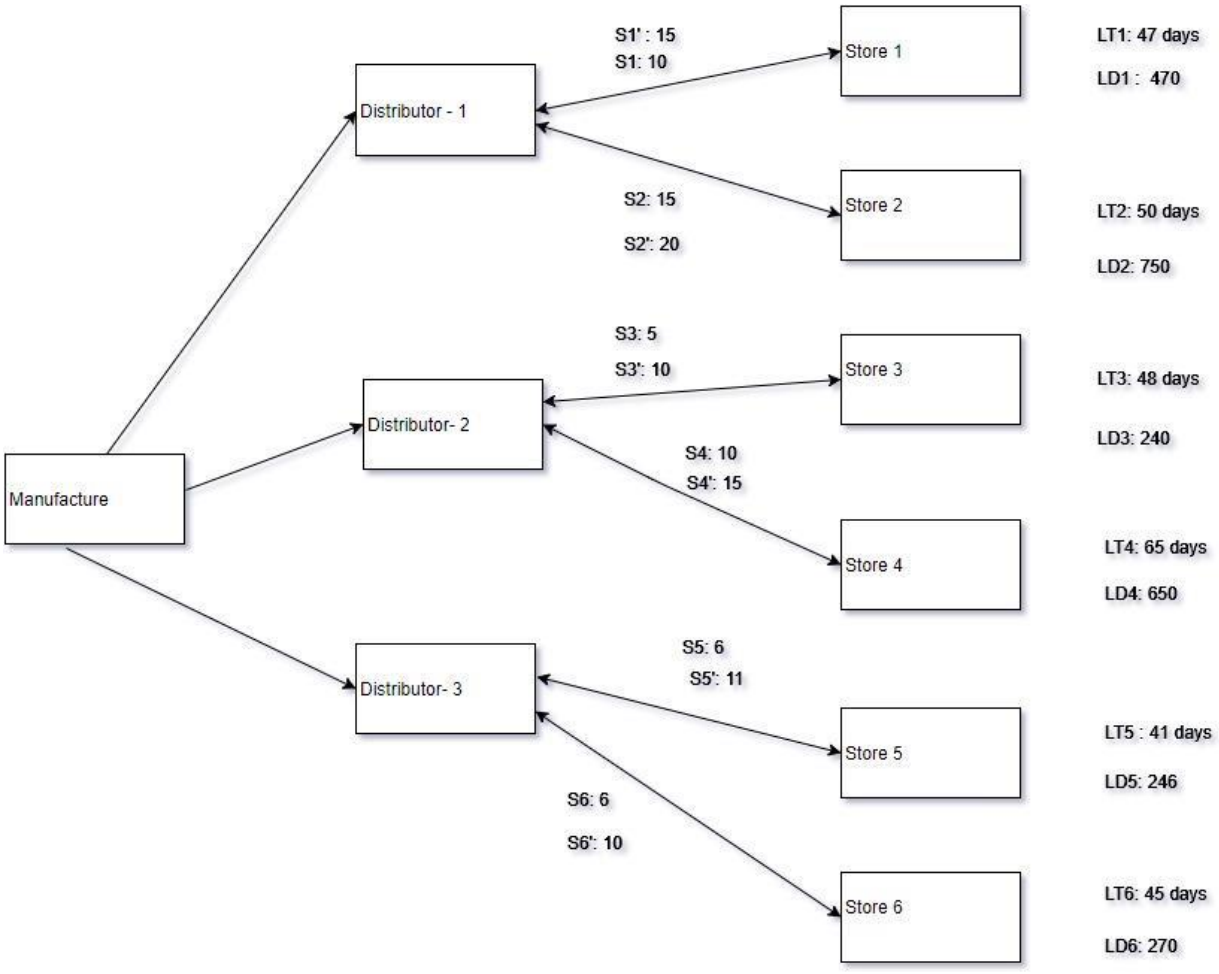
Constraints:
For calculation of Max Lead time and average lead need to predict the supply pattern. Takes into consideration the supply delay and reordering delay.
For Max daily sales and Avg daily sales need to forecast the sales of the product and the sales pattern.

Min/max Planning
Constraints:
When no reorder needs to be made then the reorder quantity is set to zero.
When a reorder of X quantity is needed to be made and assume stock level is S then both min and max values are set to X-S.

Reorder point (ROP):
ROP = Lead time Demand (LD) + Safety stock level (SSL)

Reorder point (ROP)	Safety Stock level(SSL) for each store
For Store 1: 810 For Store 2: 1110 For Store 3: 500 For Store 4: 1050 For Store 5: 550 For Store 6: 500	Store 1: 340 Store 2: 350 Store 3: 260 Store 4: 400 Store 5: 304 Store 6: 30

As soon as the stock level reaches the reorder point (810 for Store 1) the store needs to place a reorder for that product (470 as Lead time).



S': Max Daily Usage of product (in units)

S : Average Daily usage of product (in units)

LD : Lead Time Demand

LT: Lead Time

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Lead time standard deviation (σ LT)

Expected Time	Actual Time
6	11
6	8
6	11
6	5
6	4

Mean = 8

Variance = 6 (i.e., sample portion)

Standard Deviation = 2.45

Lead Demand

Require calculating the standard deviation of lead demand

Require calculating the Avg demand

Let us assume average demand to be = 20

Standard deviation = 11

Assume Z-score for 75% accuracy as 0.67

SSL = 0.67 + sqrt [8 * 121 + $(2.45 * 20)^2$] = 39 (rounded-off)

Lokad Dataset Details:

Lokad_Items.csv file:

The file contains the list of products sold by the retailer.

ID: the SKU (Stock keeping Unit) identifier (value: 10014552/Chicago)

Loc: the identifier of the geographical location (value: Chicago)

Ref: the identifier of the product (value: 10014552)

Name: name of the product (value: Belkin 8 Outlet SurgeMaster II Gold Surge Protector with Phone Protection)

Category: the main hierarchy to organize the product in a group (value: Office supplies)

SubCategory: the sub category to organize the product (value: Appliance)

Brand: name of the brand (value = Belkin)

Supplier: primary supplier from whom the product is being purchased (value = FHL)

StockOnHand: No of units readily available (value = 6 in soma case values is zero)

StockOnOrder: No of units already ordered from the supplier but are yet to be receive (value = 3, in some case the value is zero to)

BackOrder: no of units ordered by the customer (value = 0)

BuyPrice: per unit purchase price (value = 7.37)

SellPrice: per unit sell price (value = 17.18)

MOQ: Minimal ordering quantity per product (value = 0 for all)

LotMultiplier: the lot multilplier constraints when ordering from the supplier (value = 20)

Volume: the volume per unit (value = 0.045028)

Lokad_Orders.csv:

This file contains the historical sales data

ID: the SKU (Stock keeping Unit) identifier (value: 10014552/Chicago)

Loc: the identifier of the geographical location (value: Chicago)

Ref: the identifier of the product (value: 10014552)

Date: ordering date (value: 4/4/2013 for some cases the values are missing)

Quantity: quantity ordered in units (value: 1)

NetAmount: amount paid for order (value: 135.8)

OrderId: unique identifier for the customer order (value: 1.98E+08)

Currency: code for the currency(value : USD)

Clinet: a client indentifier (value: 17538)

Lokad_PurchaseOrders.csv:

The file describes about the historical purchase data for every transactional shipment.

ID: the SKU (Stock keeping Unit) identifier (value: 10014552/Chicago)

Loc: the identifier of the geographical location (value: Chicago)

Ref: the identifier of the product (value: 10014552)

DeliveryDate: date when the good were delivered, missing values for some which I guess represent the order for which goods are not delivered (value: 22-06-16)

Quantity: order quantity in units (value: 50)

Received: received quantity in units (value: 50)

NetAmount: amount paid for the purchase order (value: 165)

Supplier: identifies the supplier who received the purchase order (value: FHL)

PoNumber: unique identifier for purchase order (value: PONumber)

Date: date when the purchase order was placed (value: 20-04-16)

Currency: code for the currency (value: USD)

Lokad_Suppliers.csv:

The file contains the list of suppliers

Supplier: the index of table (value: Drecom)

MOV: the minimal order volume (value: 25000)

ContainerM3: the target size of the container (value: ContainerM3)

Bundle: identifier that identifies the product bundle (value: 133336895)

Part: product that identifies on element of bundle (value: 13452029)

Quantity: the number of units for the part contained in the bundles (value: 1)