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"XYZ" Inventory Classification & Challenges

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Abstract : *Inventory Management is a buzz word these days. As much as the industry focuses on revenue, profits, top lines and bottom lines there is more focus these days on inventories, working capital and efficiencies. Complexities of managing these supply chains have increased because of various factors like globalization, increased product portfolio, decentralization etc. There are various inventory models and matrices available today to monitor the supply chains which are mentioned in this paper but the main focus is to study the volatility of the supply chain and its impact on Inventory.*
One of the ways to classify items is based on Predictability (XYZ Analysis). Items which have

- *Uniform demand as X,*
- *Varying demand as Y*
- *Abnormal demand as Z*

It is always easier to group items with similar patterns and apply appropriate strategies to each group differently. But we need to understand if there are limitations and common underlying issues before these strategies are employed.
Keywords; *XYZ Analysis, Forecast Optimization, Inventory Planning*

I. INTRODUCTION

In any industry today forecasting and planning is a vital function. Especially when capital is required and unnecessary inventory pile up can become a huge burden. There are un-certainties in both Supply and Demand. Forecasting with these uncertainties does become a big challenge. It is also generally known that forecasts have their own inherent errors [1]. With appropriate use of XYZ analysis these errors can be reduced. The reduction of forecasting error is critical because extrapolation of historical data will amplify the inherent errors also. As periods of planning horizon increases the forecasting errors [2] also increase.

II. BACKGROUND TO THE STUDY

There are so many metrics that indicate the Performance of the Supply Chain [3]. The question is – are there more indicators required to understand the system better. Company's inventories are becoming more dynamic. Not only are their product portfolios increasing, the product life cycles are reducing. This means that companies have to handle more products and new products continuously replace the existing portfolios. This may not seem so complicated for sales but for product design, planning and execution (production and deliveries) they pose a lot of challenges. Is it possible to measure this dynamic characteristic of the Supply Chain?

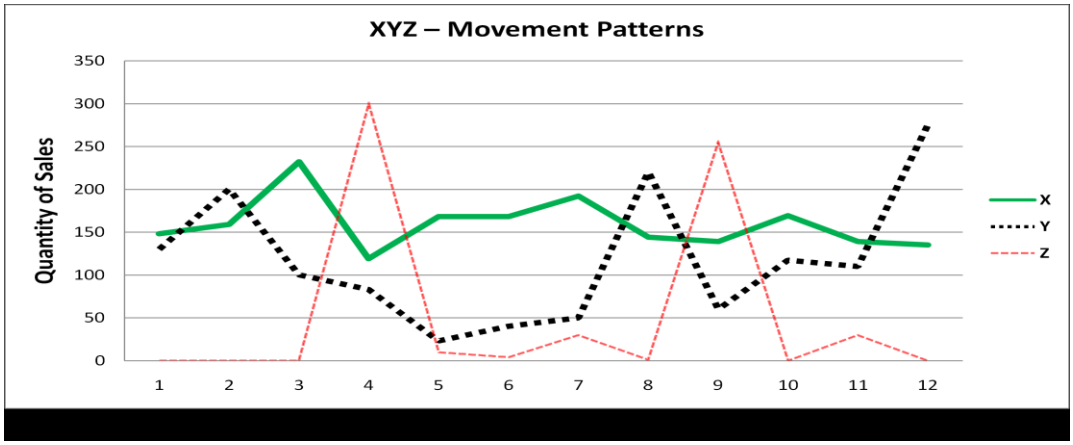

figure 1

The above chart –Figure 1 illustrates the demand patterns of XYZ products. There is another type of XYZ analysis that is based on the percentage of value of inventory in stock. This also follows the Pareto rule

according to which, 20% of the items would contribute to 80% of inventory value. But this XYZ analysis is different from the XYZ considered in this study which is based on predictability or volatility of items.

III. IMPORTANCE AND NEED

All the Inventory Control Methods have their limitation in terms of the usage and applicability. The VED analysis [4] is most commonly used in spare parts management and not so popularly used in general inventory management. FSN analysis [4] fails when used in manufacturing environment where raw materials may be issued for production and eventually the produced items may remain in inventory giving a wrong picture of consumption. SDE analysis mostly depends on how the vendors are managed. Strategic purchasing plays a vital role and inaccurate information can distort the analysis. HML analysis cannot be used unless they really have a major impact on the total inventory, in the sense that some high value items may have very low transactions and in most cases are found in MTO and PTO situations [5]. XYZ analysis is done on inventory in the stores which can vary dramatically every month for which the analysis is done. Various external factors like lost/delayed sales orders and supplies can influence the analysis. The most effectively used analysis in the industry today is ABC analysis and they have the following limitations

- Highly critical parts low in consumption value may be over looked
- Periodic updation and review becomes critical
- Cannot precisely consider all problems of Inventory control like thousands of low value items

Money-based measures of inventory are not always best suited for operations. Also considering only costs and compromising on other factors like service levels, efficiencies etc can impact business. Ofcourse at the micro level customers demand at item level must be planned and controlled to match supply and demand. The days of supply and quantities on hand may become unambiguous and does not reveal if this inventory is appropriate.

Aggregate dollars and a historical view aren't very useful to operations, which needs to match supply and demand of specific items in future.

Various MRP tools and techniques address both of these shortcomings by coordinating the quantities and timing of the deliveries from known target requirements to minimize cost or achieve desired service levels [6]. With realistic lead times and realistic forecasts, the resulting inventories would be optimal for the circumstances. Lack of realism in these areas, however, undermined the operation of MRP systems, yielding less-than-desired service and more-than-desired inventory.

IV. CHALLENGES IN XYZ CLASSIFICATION:

IV.1. FORMULAE AND STEPS

For XYZ analysis the following calculations have to be done.

1. Sum of Squares,
2. Variances and
3. Standard Deviation (SD).
4. Co-efficient of Variation (CV):

Compilation of all these data can be tedious and prone to errors.

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \overline{x})^2}$$

"equation 1"

- σ is Standard Deviation
- Xi are individual values,
- $\overline{X}$ is the average Value
- N is the total number of observations

The above formula (1) may look simple for calculating SD. But if you consider data of large organization with 3000-15000 SKUs spread over a large time frame. Calculating SD can be a very tedious task. Once SD is CV is easily calculated.

- $CV = \sigma / \overline{X}$ (σ is S.D. and $\overline{X}$ is Mean)

"equation 2"

The first big challenge for calculating SD.

You first need to define what your average should be?

SD needs to be calculated for weekly data or monthly data or any other data set?

Technically it is possible to estimate SD for the following periods.

1. Yearly
2. Quarterly
3. Monthly
4. Fortnightly
5. Weekly
6. Daily
7. Hourly etc

Let's say you want to calculate Variance, SD and CV for monthly data i.e. data consolidated monthly and their monthly patterns are studied. In the example given below the table shows data consolidated for the months Feb, Mar and Apr 2013 along with their ranks. Products against S No. 3 to 17 have the same ranks (60). The standard deviation and the average of these 15 items are different but their CVs are the same. There is already lot of literature that can show that both Averages and SD are not good statistics as compared to CV especially when it comes to Inventory Management and related subjects. But in cases as shown in "Table 1" below, CV can also become a huge task to handle. If 300 products have to be classified as X, Y and Z, the first 20% (X products) will have 74 products instead of 60 because of the clash in ranks

Table 1

S No	Product	Feb13	Mar13	Apr13	Std Dev	Average	CV	Rank	
1	Prod 41	40	40	39	0.47140452	39.66666667	0.01188415	58	
2	Prod 21	30	30	22	3.77123617	27.33333333	0.13797205	59	
3	Prod 24	7	7	0	3.29983165	4.66666667	0.70710678	60	
4	Prod 2	0	1	1	0.47140452	0.66666667	0.70710678	60	
5	Prod 4	0	40	40	18.85618083	26.66666667	0.70710678	60	E
6	Prod 6	0	10	10	4.71404521	6.66666667	0.70710678	60	Q
7	Prod 9	0	1	1	0.47140452	0.66666667	0.70710678	60	U
8	Prod 15	0	2	2	0.94280904	1.33333333	0.70710678	60	A
9	Prod 20	0	6	6	2.82842712	4.00000000	0.70710678	60	L
10	Prod 25	0	2	2	0.94280904	1.33333333	0.70710678	60	
11	Prod 3	1	1	0	0.47140452	0.66666667	0.70710678	60	Coeff.
12	Prod 21	1	0	1	0.47140452	0.66666667	0.70710678	60	Of
13	Prod 1	2	2	0	0.94280904	1.33333333	0.70710678	60	
14	Prod 7	2	0	2	0.94280904	1.33333333	0.70710678	60	Variance
15	Prod 10	2	2	0	0.94280904	1.33333333	0.70710678	60	
16	Prod 5	5	5	0	2.35702260	3.33333333	0.70710678	60	
17	Prod 23	10	10	0	4.71404521	6.66666667	0.70710678	60	
18	Prod 64	10	0	7	4.18993503	5.66666667	0.73940030	75	

Quarterly and Yearly data would be very long periods of analysis and will have seldom usage because product life cycles are getting shorter and shorter. Also will it be really possible to compute XYZ classification based on Hourly, Weekly and fortnightly consolidations.

IV.2. Periods for Data Analysis

The next big challenge with XYZ classification is the total period for which the Analysis should be done. Let's say you decide to consolidate daily data for one month. For that particular month you may have only 69 active items. If you consider longer durations the number of active items would proportionally increase as shown in the "Table 2" below.

Table 2

Periods	Active	% Diff	X	% Diff	Y	% Diff	Z	% Diff
1Month	69		13		23		33	
2Months	102	48%	19	46%	30	30%	53	61%
3Months	133	30%	25	32%	42	40%	66	25%
4Months	143	8%	27	8%	49	17%	67	2%
5Months	164	15%	31	15%	52	6%	81	21%
6Months	177	8%	34	10%	61	17%	82	1%
7Months	182	3%	35	3%	64	5%	83	1%
8Months	195	7%	38	9%	67	5%	90	8%
9Months	203	4%	39	3%	71	6%	93	3%
12Months	217	7%	42	8%	65	-8%	110	18%

As the number of active items increase for increasing periods, proportionally the no of items classified as Xs, Ys and Zs also increase. Now if we were to extrapolate 'X' items for planning and budgeting purposes, what would be the most appropriate number of Xs that we should consider. Between the two extremes 13 and 42 – 'X' Class items for 1 Month and 12 Months data analysis as shown in table above, the entire planning can go for a toss. TO be on the safer side, instead of choosing the data on the extremes, you may settle for 5-7 Months for data analysis for XYZ classification.

V. DRAWBACKS FOR XYZ CLASSIFICATIONS

The most important drawback of XYZ analysis is categorization of new products. They are most often classified as 'Z' class items because their demand patterns are not established. The easier way is to exclude all new items in the XYZ analysis. But if their contribution to inventory costs and sales percentages are significant, there must be ways of quantifying this volatility created by the new items.

Another important drawback of the XYZ analysis is that the XYZ defines the predictability of the demand among the items. There are no benchmarks or industry standards. There are no standards that say that items which have specific variability should only be planned. Irrespective of type of industry, if 'X' category has significant variation in demand, it can affect overall inventory.

XYZ analysis can also overlook seasonal items. Therefore it becomes mandatory to remove these seasonal items from this analysis. To simplify inventory management, timeframes must be defined for seasonal products. During the season these items by default are classified as fast-moving items and after the season they must be classified as Non-moving irrespective of the sales impact during the season.

VI. CONCLUSION

Different Inventory Classification methods may be employed for different purposes. But we must carefully understand their limitations and implications before major decisions are put in place based on these classifications It would be better if some kind of automations and procedures with checks are designed for such Analysis like XYZ where entire process may be very tedious. There may be some negative and exceptional transactions in the database which can some impact on your XYZ – data analysis. Some of the limitations of this analysis can also be handled by introducing additional dimensions in reporting. ABC along with XYZ, a 2-dimensional approach to inventory classifications can be used more effectively.

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