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MARKDOWN OPTIMIZATION FOR AN INDIAN APPAREL RETAILER

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Deepak George, Karthik Kuram, Ramalakshmi Subramanian, Sumad Singh and U Dinesh Kumar, Professor of DS&IS, prepared this case for class discussion. This case is not intended to serve as an endorsement, source of primary data, or to show effective or inefficient handling of decision or business processes.

> *The vision of WE SELL STYLE is to provide good quality merchandise at an affordable price to the Indian consumers.*
>
> Siddharth Sinha, Chief Executive Officer

Siddharth Sinha, Chief Executive Officer of "WE SELL STYLE[1]", started a discussion on pricing during end of the season sales with his team of managers. As it was one of the key challenges, he wanted the planning department to address it in the forthcoming season. He said:

> *While some apparel retailers position themselves as 'good quality high price' apparel retailers, we are providers of 'good quality clothing at an affordable price', hence our merchandise is very sharply priced, we need to be very astute in planning our markdowns during End of Season.*

Markdown planning has been an important aspect of the apparel business. It is imperative to understand that the demand for fashion apparel is seasonal – affected by current fashion, variations in the seasons, festivals and hence difficult to estimate. An apparel retailer could go off target – either by overestimating or underestimating the demand, with overestimating being prevalent. The ordering–manufacturing–stocking cycle is easily a 6-month cycle before the selling actually starts; with an expectation to improve sales year on year, the procurement team buys more, making an increase in the variety of colors and styles to offer more to the consumer. However, not all styles sell as expected, leaving higher than expected stocked inventory, which requires an impetus to sell. The impetus in the industry comes in the form of ''end of season markdown''. Sinha summed up the problem as follows:

> *Our goal is to liquidate as much of our unsold inventory as possible, while keeping the markdowns at an optimal level. We don't want to give too less, so as to be left with too much of an inventory, while at the same time being cautious of not offering too high to lose out on margins. At present, we are giving an overall markdown that is more than the industry standard for 'everyday low price players' like us*.

WE SELL STYLE (WSS) sells apparel in the ''Core'' and ''Fashion'' categories. Core apparel is the vanilla, plain simple clothing, always in demand, while fashion apparel is high on design features such as prints, cuts, colors, and exhibit demand variability. The garments sold in core category are on ''planned markdown'' and are always sold in bundles – for example, buy 2 for INR 499 throughout the year **(Exhibit 1)**.

The fashion garments come in a range of styles, often varying with seasons. Fashion garments experience high variability in sales, some styles and colors sell fast while others lag. At the end of a season, the left over fashion merchandise is put on markdown that often exceeds the planned markdown set for them. The focus of WSS is to reduce the unplanned markdowns to the extent possible; a process is in place to markdown styles by looking at their rate of sales and sell-through performance, however, the markdown given at WSS as a percent of sales is still above the industry standard.

[1] Name changed to maintain confidentiality

APPAREL RETAIL INDUSTRY

MARKET OUTLOOK

A rising number of urban and small town consumers purchasing branded fashion led to the growth of organized apparel retail industry in India. Indian apparel industry has been showing a strong growth trend. According to a PricewaterhouseCoopers (PWC) 2015-16 Outlook for Retail and Consumer products sector, the apparel retail industry in India is forecast to have a value of $15 billion in 2018, an increase of 91% since 2014, with the compound annual growth of the industry in 2014-18 predicted to be 17.5%[2] **(Exhibit 2)**.

APPAREL SEGMENTS AND PRODUCT HIERARCHY

The apparel retail industry consists of the following segments – men's wear, women's wear, and kids' wear. Apparel in each segment is further identified by a hierarchy of family, class, and brick (**Exhibits 3** and **4)**. For example: Men's wear is a segment; formal wear is a family under this segment; tops is a class of apparel; and shirts represent a brick. Other than the product hierarchy, apparels also have attributes. Attributes include brand, style, color, and size. For example, Classic Polo is a brand; Polo Shirt with stripes is one of the styles; black is one of the colors; medium being one of the sizes.

Apparel stock keeping unit (SKU) is identified by brand, family, class, brick, style, color, and size.

SEASONS

The apparel sale in India follows two seasons – Spring Summer and Festive Winter. The approximate periods of the seasons, interspersed with two end of season markdown periods are shown in **Table 1**.

APPAREL LIFECYCLE

Typical apparel lifecycle is shown in **Figure 1**. Four to five months before the launch of the season, an apparel retailer starts the lifecycle with the process of finalizing the styles to be launched in the next season. Once the styles are decided, merchandising, the most critical activity starts. The retailer comes up with an assortment plan, that is, which styles should be introduced in which stores; the color sets and size sets are also finalized. The assortment plan is used to create a buy plan, that is, what number to buy for each store considering the period of sales, store capacity, and expected rate of sales. The overall goal for a retailer operating in value merchandise is to sell more quantity and hence maximize profit in the season despite small margins; this requires an understanding of what merchandise is expected to sell in the period. The retailer must factor in the open inventory from the last season and then based on these data determine the budget to be made available for procurement for the upcoming season, and hence determine the quantity to be procured.

[2] Source: 2015-16 outlook for retail and consumer products sector in Asia.
http://www.pwchk.com/webmedia/doc/635593364676310538_rc_outlook_201516.pdf

After the planning process, the apparel is produced or ordered for production. Subsequently, floor plans and three-dimensional displays are charted out as a part of the visual merchandising process, to gear up for displaying the merchandise with launch of the season.

Retailer communicates the launch of the season with promotional and marketing activities. Once the selling/retailing starts, retailer monitors the sales vis-á-vis the planned forecast for every week of the season. If the sales underperform to the forecast, the retailer's planning and buying team decide to offer the merchandise at a price lower than the MRP. This is defined as markdown. Markdown done during the season is called in-season sale (referred to as ISS). Markdown offered at the end of a season is end-of-season sale (referred to as EOSS).

ABOUT THE RETAILER

The WSS apparel retail chain [3] was set up in 2008, housing more than 100 brands. In 2015, they operated over 200 stores in all four regions of the country. They primarily focused on providing good quality fashion at a remarkably low price.

MARKDOWN

Decision on the percentage of markdown for EOSS is one of the most critical tasks for an apparel retailer. This activity starts months ahead of the EOSS. The product team and the planning team come up with an EOSS plan at the style level. In the decision process, procurement and planning team use their domain expertise and judge the performance of style using metrics such as rate of sales, full price sell-through, inventory left, and more. The key decision is to quantify the degree of non-performance of styles that did not sell as forecasted and by how much to markdown for the EOSS.

Often the procurement team does not favor heavy markdowns. Procurement teams are often criticized that they fall in love with what they buy, and continue believing that styles need to be on the shelves longer before their rate of sales picks up, and that they will make up to the planned margins by the end of season. In contrast, the planners want to mark them down deep enough to recover costs and liquidate inventory, while settling for lower margins. So, this activity heavily depends on the teams involved, and consequently might not be the most optimal and objective. Another aspect that makes it sub-optimal is having same markdown plan across all the stores. These unplanned markdowns provide impetus to sales, but also result in depletion of margins **(Exhibit 5)**.

SCOPE OF CHANGES

The management team started efforts to make improvements in having:

a. Markdowns based on groups of similar stores.

[3] This project used real client data for the analysis but owing to client confidentiality agreement, we have not mentioned actual client name.

b. Markdown at brick level. In 2015, the EOSS planning was at the style level. With thousands of styles across different segments, the number of discount points became too high. Customer surveys showed that the high number of discount signage in the store led to clutter and confusion in the minds of the consumer. Management wanted to bring down the number by offering markdowns at a brick level.

MARKDOWN OPTIMIZATION FOR WOMEN'S ETHNIC WEAR

Ramesh, the head of planning had been trying to get over the ''one size fits all'' approach of markdown planning for all stores. IT systems were capturing the sales data at 185 stores for all brands and bricks, along with promotions, and end of season markdown on apparel. He started looking at the data for the last festive winter EOSS period for women's ethnic wear. The data dictionary is provided in **Exhibit 6**.

Grouping stores that behave similarly during markdown period could enable the planning team to devise custom markdown plans for them. This idea of clustering was in contrast to the store categorization that was already being done using criteria such as sales per square feet, footfalls, sales conversion, catchment area, sell through, etc., to group stores for assortment planning, that is, which brand and styles should be stocked in what quantity and sold in which stores.

CLUSTERING

Sunil, VP of supply chain who had heard about clustering to segment similar stores together said:

> *I want to examine if the data we have on sales, markdown, cost of goods sold and store demographics can be used to cluster the stores, the immediate benefit could be for us in devising different promotion plans during EOSS for stores based on their cluster profiling.*

Sunil shared his idea with Ramesh.

> *I think we need a measure of how well the stores do in sales vis-à-vis the markdown given in EOSS period. Some stores may do exceedingly well in increasing sales when markdown is offered, while others may show no significant jump in sales, or possibly even a total slump in sales. For lack of a more comprehensive term, let us call it 'markdown sensitivity', where Markdown Sensitivity = Total Sales in EOSS (INR)/Total markdown given in EOSS (INR).*

Ramesh was quick to formulate Analysis of Variance (ANOVA) to test the hypothesis that markdown sensitivity was not the same across stores during EOSS.

Confident with the results of hypothesis testing, Ramesh added:

We must also include a measure of profitability of store, normalized by the store area to have stores that are similar in profitability grouped closely and otherwise. Profit per Sq. Ft = Total Profit made during EOSS (in INR)/Total Area (in sq. feet).

Sunil before leaving, happy that he paved a way forward for clustering stores, commented:

I would prefer including location as a measure in clustering also, to prefer closely located stores to be possibly clustered together.

DEMAND MODEL ESTIMATION

Sanjay, Head of Merchandizing and Shama, strategic advisor in the company were contemplating on the discussion from the morning in a separate meeting with their team. Shama opined:

Optimizing the markdown percentages requires determining the relationship between demand and markdown percentages. The relationship would mirror the typical demand – price curve.

Sanjay commented:

The relationship does mirror the demand curve, we saw that when we ran a scatter plot between the two variables for women's ethnic wear category ***(Exhibit 7)****. However, if we try running a regression with units sold as dependent variable and percent discount given (markdown) during our last EOSS period, the fit statistics show a poor fit, and we know why that happened, don't we Ramya*?

Ramya, the Category Head, Women's Wear commented:

Yes, we have a problem of specification bias. We are definitely missing out on other pertinent variables that explain the variation in demand.

We often see that there is a lag between the time we send out the marketing communication about EOSS and the surge in sales it causes, I can say that markdown we offered last week has a bearing on not only the sales of last week , but also on that of current week.

We see apparel demand also exhibits seasonality and trend, so we could model demand as a function of demand of previous weeks. Other factors like age of the merchandise, and the week being a markdown or non-markdown week need to be considered when we construct a mathematical model for demand estimation.

OPTIMIZATION

Ramya started off by getting the data in place to build a demand prediction model, while Shama's thoughts were trained on how this would fit into the objective of optimizing the markdown percentage during EOSS. In the EOSS season, a retailer wants to sell as much as possible while keeping as low markdowns as possible. The retailer came with a strategy of moving most of the apparel inventory to the other marts and stores under the same brand. With that, the pressure of keeping a low inventory at the end of season was somewhat relieved. The objective therefore, was to earn as much revenue during the EOSS as possible.

The numbers from the last season's EOSS show that the retailer was able to dispose the merchandise that remained after EOSS in the partner stores at an approximate price of 40% of the original MRP.

Shama and Sunil in the meanwhile discussed the topic again over evening tea. Shama said:

> *From what Ramya described, I see that the demand estimation model would definitely be a non-linear model. So, we are surely looking at a non-linear optimization model to solve the optimal discount percentages for the weeks of next EOSS.*

Sunil responded:

> *Indeed, but that should not be much of a challenge, we have non-linear solvers available aplenty to solve non-linear models. One needs to specify solving for a global optima and utilize 'multi-start' options available in the solver.*

THE WAY FORWARD

Shama, Sunil, Sanjay, Ramya, and Ramesh came together and summed up the overall idea of the solution **(Exhibit 8)**. The team agreed that the markdown optimization can be broken into three sub-problems: (1) Segment stores so that appropriate pricing strategy can be devised for each of the store clusters, (2) Develop a multivariate time series forecasting model to forecast demand, and (3) Develop non-linear optimization model to identify optimal discounts that maximize revenue.

Exhibit 1

‘‘Core’’ and ‘‘Fashion’’ Merchandise

Core Merchandise – Plain men’s shirts for everyday use, often sold in bundles of 2 or 3

Fashion Merchandise – salwars, tops, churidars, skirts, and denims with prints and cuts. The prints and cuts are inspired by what is expected to be liked in the season.

Source: WE SELL STYLE

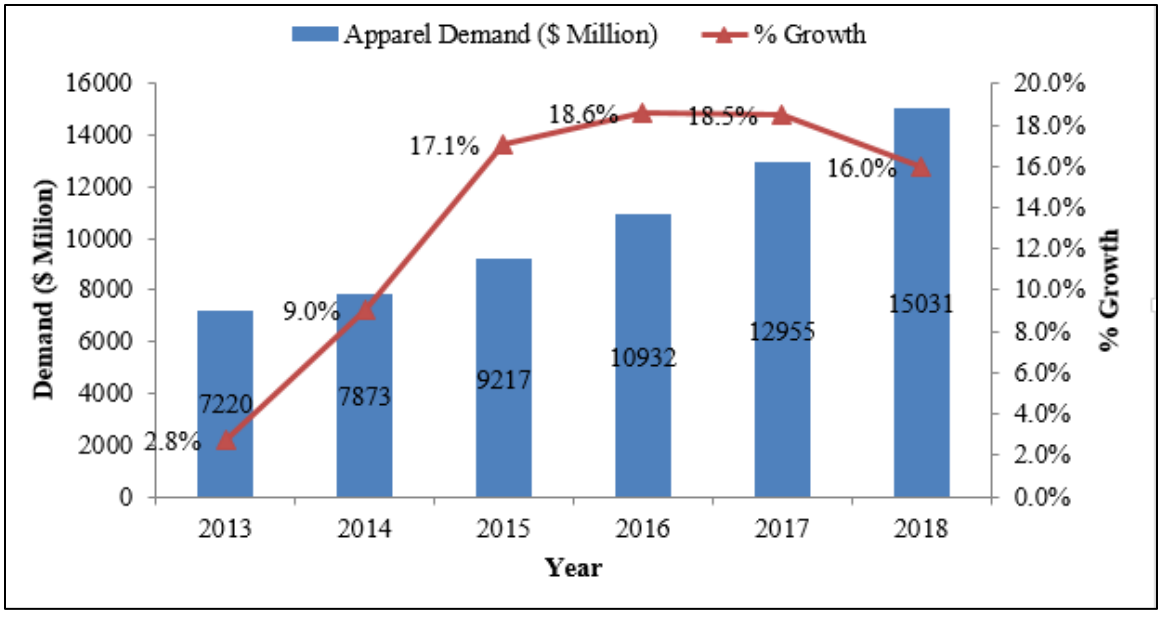
Exhibit 2

Forecasted Growth of Indian Apparel Retail Business

Year	INR (billion)	% Growth
2013	916.7	15.9
2014	1058.7	15.5
2015	1229.3	16.1
2016	1352.7	10
2017	1496.6	10.6
2018	1695.5	13.3

***Source:** Marketline Industry profile of Apparel Retail in India, August 2014

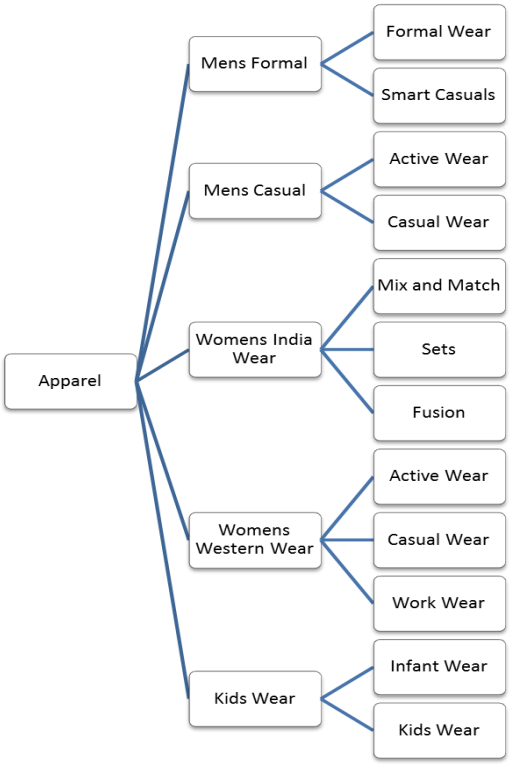
Exhibit 2 (Contd.)



***Source:** 2015-16 Outlook for Retail and Consumer Products Sector in Asia
http://www.pwchk.com/webmedia/doc/635593364676310538_rc_outlook_201516.pdf

Exhibit 3

Apparel Segments and Family

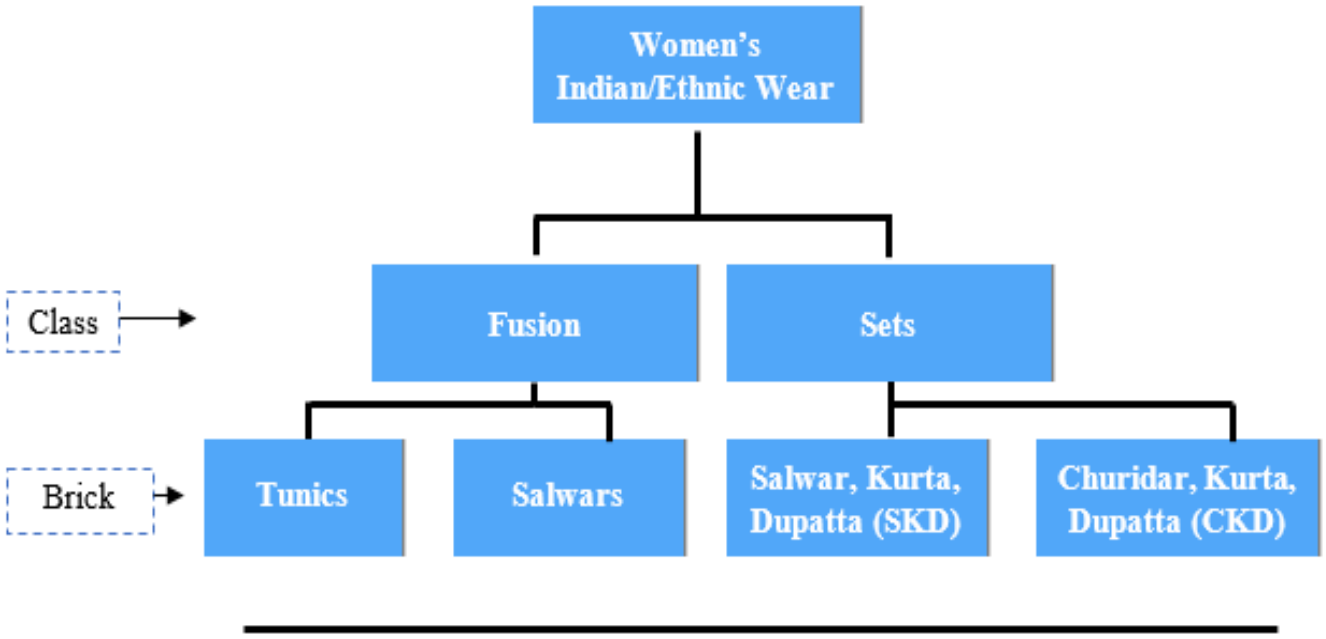


Source: Primary data collected from WE SELL STYLE

Exhibit 4

Example of Apparel product Hierarchy for Women's Ethnic Wear [4]

For Brands – Brand-1 & Brand-2



Source: We Sell Style

[4] Brand-1 and Brand-2 are two examples of brands sold by the retailer.

Exhibit 5

An example of unplanned markdowns depleting margins while giving impetus to units sold.

Order size of a style = 1000 units; MRP = INR 699,[5] average cost price = INR 400
Planned full price sell-through in the season = 75%, that is, 750 units planned to be sold at INR 699/unit
Merchandizing drew a plan for a planned sell-through of 25% at average discount of 30%, that is, 250 units planned to be sold at INR 489.3/unit
Target margin = INR 2,46,575
The plan of sale and margin realization, drawn at the beginning of selling period is as follows; last 4 weeks are EOSS weeks.

Week	Planned/Forecasted Sale (Units)	Selling Price	Margin Realization-Planned (INR)	Margin Realization-Planned (%age)	Cumulative Margin Realization-Planned (%age)
1	90	699	26910	11%	11%
2	120	699	35880	15%	25%
3	125	699	37375	15%	41%
4	135	699	40365	16%	57%
5	100	699	29900	12%	69%
6	70	699	20930	8%	78%
7	60	699	17940	7%	85%
8	50	699	14950	6%	91%
9	70	489.3	6251	3%	93%
10	60	489.3	5358	2%	96%
11	60	489.3	5358	2%	98%
12	60	489.3	5358	2%	100%
Total	**1000**		**2,46,575**		

The actual sales turn out to be less than the planned/forecasted sale owing to seasonal variations, and hence margin realization is different from what is planned at the end of 8 weeks of regular selling. Using criteria such as rate of sale, inventory left, and full price sell-through, retailer decides to increase the markdown to 40% from the planned 30% for EOSS period, the actual sales and margin realization are shown in the following table.

[5] 1 USD = INR 65.8 in 2016

Exhibit 5 (Contd.)

Week	Actual Sale (Units)	Margin Realization-Actual (INR)	Margin Realization-Actual (%age)	Cumulative Margin Realization-Actual (%age)	% Discount Offered
1	40	11960	4.85%	4.85%	0%
2	50	14950	6.06%	10.91%	0%
3	60	17940	7.28%	18.19%	0%
4	80	23920	9.70%	27.89%	0%
5	60	17940	7.28%	35.17%	0%
6	60	17940	7.28%	42.44%	0%
7	50	14950	6.06%	48.50%	0%
8	40	11960	4.85%	53.35%	0%
9	90	1746	0.71%	54.06%	40%
10	80	1552	0.63%	54.69%	40%
11	70	1358	0.55%	55.24%	40%
12	60	1164	0.47%	55.72%	40%
Total	**740**	**1,37,380**			

At the end of markdown period, the realized margin was 55.72% (INR1, 37,380) of the planned 100% (INR 2,46,575). It can be noted that:

- EOSS period experienced sales of 300 units, that is, 40% of sales (units) was achieved in last 4 weeks vs. 60% in first 8 weeks – see the actual sales increasing in the last 4 weeks in **Exhibit 5**. The ending inventory as a result was at 260 units, which could have been far worse with 30% markdown.
- Margin realized, however, rose only by 2.36% in EOSS period.

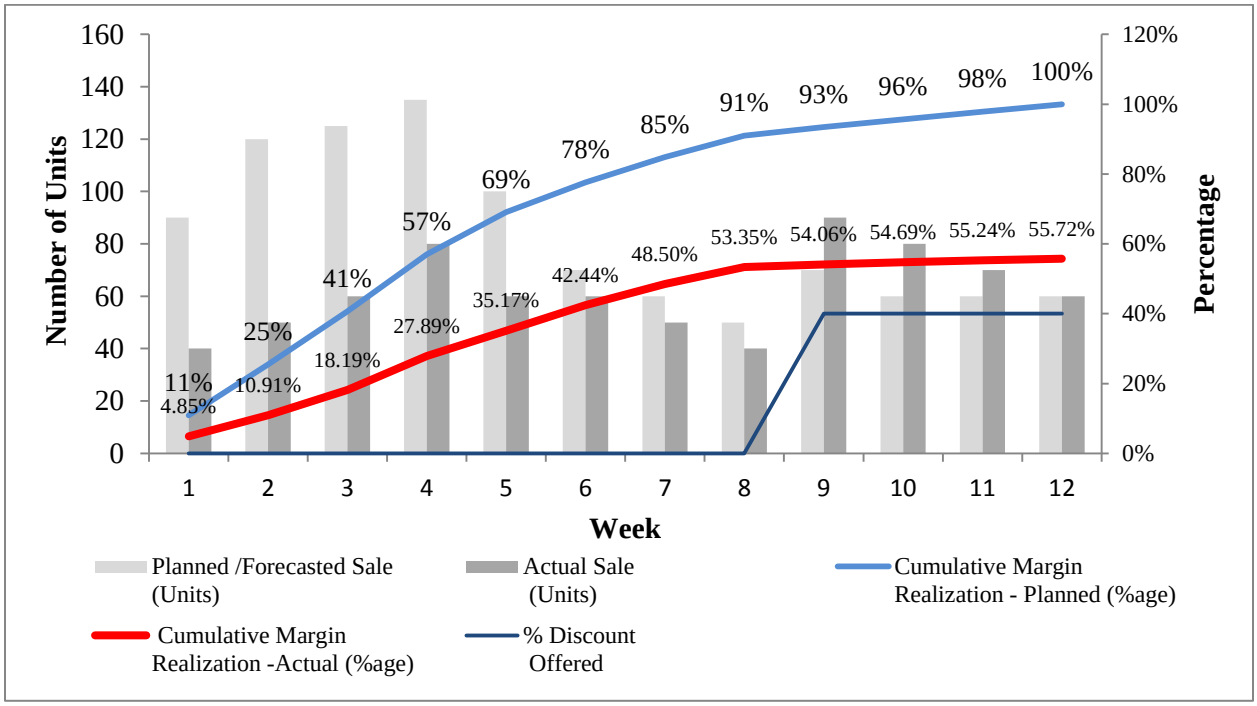


Exhibit 6

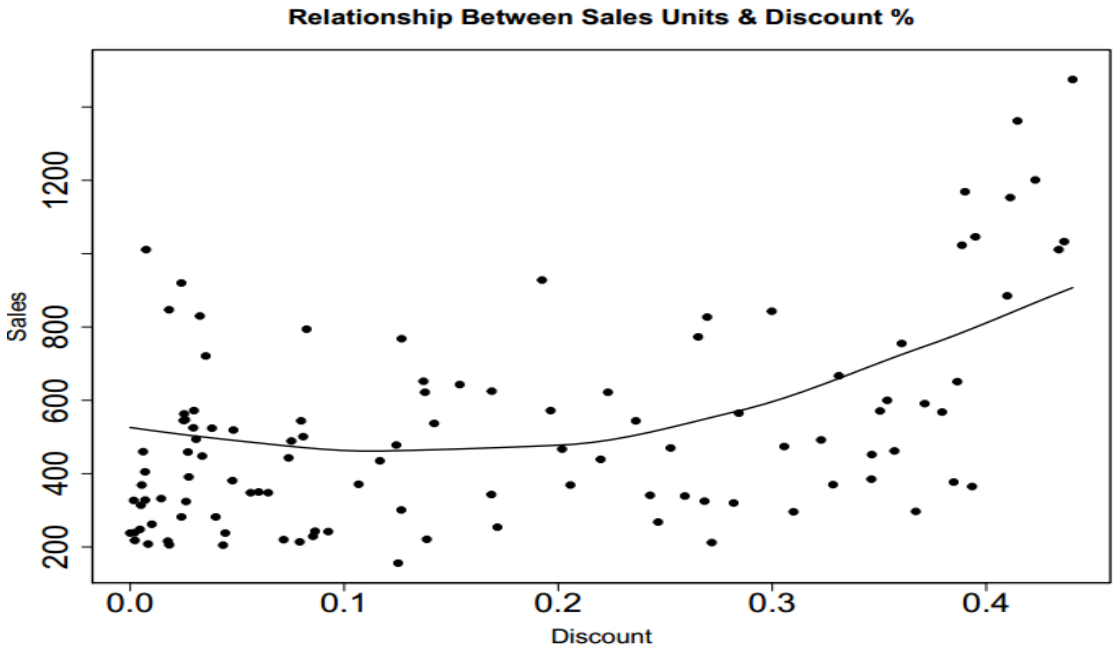
Data dictionary of sales and markdown for women's ethnic wear across stores during last Festive Winter EOSS

a. Store ID – Identifier for store
b. Store area – Area of store in square feet
c. Zone – East, west, north, and south zones based on location of store
d. Net sales in INR – Sales broken down by different brands under women's ethnic wear
e. Total discount in INR – Markdown broken down by different brands under women's ethnic wear
f. Total cost of goods sold in INR – Cost of goods sold broken by different brands under women's ethnic wear

Source: WE SELL STYLE

Exhibit 7

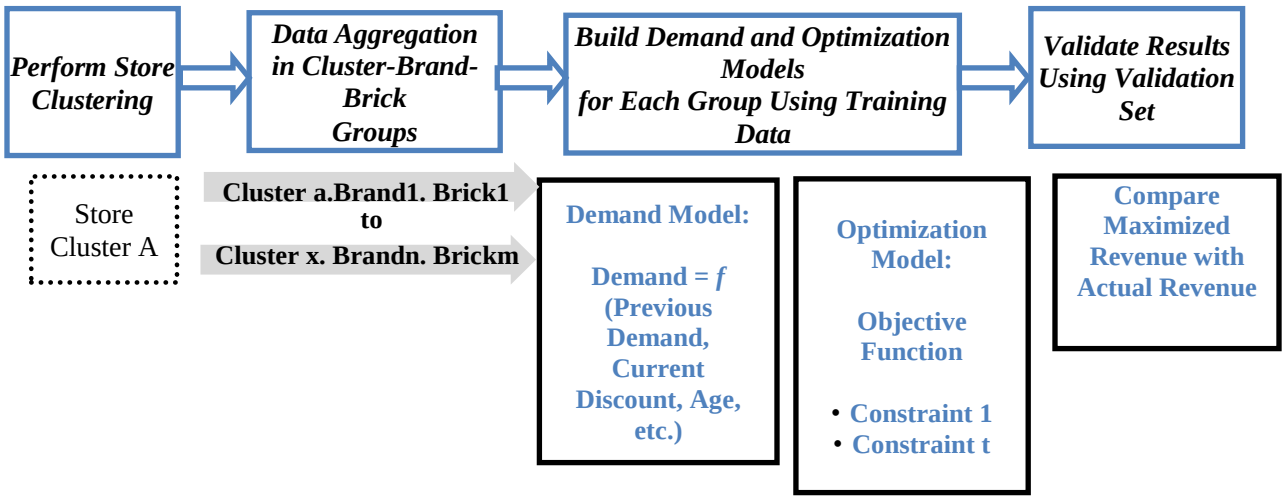
Relationship between Sales Units & Discount%



Source: Based on data from WE SELL STYLE

Exhibit 8

Solution Approach



Source: WE SELL STYLE

Table 1

Apparel Season in India

Season	Period	Weeks
Spring	Mid-January to Mid-April	16
Summer	Mid-April to June	10
Spring Summer EOSS	July to Mid-August	6
Festive	Mid-August to Mid-October	8
Winter	Mid-October to Mid-December	8
Festive Winter EOSS	Mid-December to Mid-January	4

Source: WE SELL STYLE

Figure 1

Apparel Lifecycle

Source: WE SELL STYLE