



Advanced Analytics Solutions

Merchandising Science, Not Art: New-School SKU Management

Historically, merchants used their instincts, experiences and other intangibles to determine which products consumers would buy. Today, however, the most successful merchants leverage big data and advanced analytics in order to manage their SKUs, arming themselves with data and data-mining tools that enable them to make decisions based more on statistics than on hunches, and more on science than on art.

Organizations that leverage this information and these new-school merchandising tools have an edge over those organizations that rely on a gut feeling: The adoption of tools — such as product associations, algorithms and L.E.K. Consulting's merchandising process — all enable merchants to make more informed and efficient assortment decisions, thereby driving top-line sales, maintaining more efficient inventory allocations and reducing product development costs.

Product associations

Any marketer or planogrammer knows how important product association — the tendency for people to purchase certain products together or separately — is to promotions and store planning. A common example is the peanut butter and jelly sandwich: In practically all grocery stores, the probability that a basket containing bread and peanut butter will also contain jelly is far greater than the probability that any given basket will contain jelly. This product association is obvious, but sophisticated algorithms can not only quantify this and other intuitive relationships, but also expose nonintuitive associations. Product association rules are immensely valuable and, in the right hands, have an immediate impact in retail. Marketers can create more effective promotions through appropriate bundling, and planogrammers can strategically adjust store layouts to drive higher-value baskets.

Although retailers often overlook product associations as a metric for SKU management, these associations are critical to a company's understanding of the true value of each item in its portfolio. The easiest way for a retailer to evaluate an item's nominal profit is to subtract the price it paid distributors or

wholesalers for that item from the total revenue of that item over some interval. Many companies layer in allocated costs related to storage, shipping and handling, etc., to determine a more sophisticated but still nominal profit value for each product. Though product-level value is crucial when a company undertakes a SKU rationalization exercise to determine which SKUs to keep, delete or reprice, it views each product in a vacuum, independent of its associations with other products. With the added information that product associations provide, merchants can build assortments, price products and manage portfolios to capitalize on inter-product attraction and repulsion.

Association algorithms

The Apriori algorithm, proposed by Agrawal and Srikant in 1994,¹ finds and measures "rules" that determine how probable it is that a certain item set (one or more products) will be found in a basket containing some other item set. The algorithm produces a robust and illuminating output for small inventories, but its results are not trustworthy for large inventories due to combinatorial explosion. For even a relatively small SKU portfolio, the Apriori algorithm can generate an astronomical number of possible items. For any portfolio of n items, there are $2^n - 1$ possible (nonempty) item sets. So if a company has 10,000 SKUs, the number of possible candidate item sets is $2^{10,000} - 1$, or $1.9 \times 10^{3,010}$. That number is unfathomable: too great for any supercomputer to handle, let alone merchants that typically use basic assortment management tools or spreadsheets.

The Apriori algorithm (and other association algorithms, such as Eclat and FP-growth) handles this challenge by considering only potentially "interesting" associations, thereby eliminating the vast majority of associations. From a marketing standpoint, that is a perfectly acceptable sacrifice, because only the strongest, most prevalent and most positive associations matter to the merchant. From a SKU value standpoint, however, the merchant needs to calculate the sum of *all* of each product's associations, small and large, prevalent and rare, positive and negative.



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Unfortunately, association algorithms do not consider the quantity of each item in a basket. They treat a basket with 30 shirts and 20 pairs of pants exactly the same as a basket with one shirt and one pair of pants. Again, from a marketing standpoint, the association itself is what is important; however, from a SKU value standpoint, quantity is crucial.

L.E.K.'s merchandising process

To surmount the obstacles that both product associations and association algorithms present, our advanced analytics team has devised a standardized process to limit analysis to pair-wise associations only. The process analyzes the associative properties of every possible pair of items and ignores larger sets of items. A set of 10,000 SKUs has just under 100 million pairs — or half that if we view each pair as a combination rather than as a permutation. This is still a large number, but it is well within the reach of modern computing. Once the value of each item pair is quantified, the result can be layered into each item's nominal value to add another dimension to the true value an item provides within the context of the entire portfolio.

We accomplish this by following a straightforward calculation process:

1. Use transaction tables and supporting data to create a list of unique SKUs and aggregated metrics, such as:
 - a. Transaction count
 - b. Quantity sold
 - c. Revenue and profit earned
2. Calculate the nominal value of each SKU
3. Create a list of all possible SKU pairs
4. Calculate association metrics for each SKU pair
5. Layer the association value into the nominal value for each SKU

These layers of information can make the difference between value-creating SKU rationalization and the elimination of significant profit dollars.

About us

L.E.K.'s advanced analytics team works with clients to conduct product portfolio reviews, SKU analyses and other critical merchandising processes. We train experienced merchants and organizations on how to use our new-school merchandising process, ensuring they have appropriate data to inform their major portfolio decisions, thereby driving significant profit for years to come.

Does your merchandising team employ the right balance of science versus art? If not, let L.E.K.'s advanced analytics team accelerate your organization's evolution. For more information, contact analytics@lek.com.

¹<http://www-users.cs.umn.edu/~kumar/dmbook/ch6.pdf>.