How Predictive Analytics Turns Mad Bulls into Predictable Animals

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ABSTRACT

Portfolio segmentation is a prerequisite in all forecasting projects. Not all products are equally predictable. Nestlé uses animal names for its segmentation, and the animal behavior translates well into how the planners should plan these products. Mad Bulls are those products that are tough to predict, if we do not know what is causing their volatility. The Horses are easier to deal with. Modern time series based statistical forecasting methods can tame Mad Bulls, as they allow adding explanatory variables into the models. Nestlé now complements its SAP based Demand Planning solution with predictive analytics technology provided by SAS®, to overcome these issues in an industry that is highly promotion-driven. In this talk, we will provide an overview of the relationship Nestlé is building with SAS, and provide concrete examples of how modern statistical forecasting methods available in SAS® Demand-Driven Planning and Optimization help us to increase forecasting performance, and therefore to provide high service to our customers with optimized stock, the primary goal of Nestlé's Supply Chains.

INTRODUCTION

Highly efficient Supply Chains are essential for *Fast Moving Consumer Goods* (FMCG) companies like Nestlé. Products need to be on the shelf and available to the shopper, wherever, whenever, however, but using an optimum amount of stock, not to block too much cash by inventory. This is the main objective of every Planner working for the Supply Chain organizations at Nestlé: ensuring high service with the optimal amount of inventory. When the manufacturing capability is not agile enough to respond in real-time to customer demand, then these Planners need to rely on forecasting, a daunting task. Why is this task so daunting? Because, by definition, every forecast is wrong. Therefore, Nestlé's Demand Planning processes need to avoid wasting time doing the impossible. That's where statistical forecasting models enter the stage.

In this paper, we illustrate how modern time series based statistical forecasting methods, one key area of *Predictive Analytics,* help Nestlé to run efficient Demand Planning processes, which provide quick, reliable and "good enough" forecasts for the more predictable part of the portfolio, and then allow Planners to tackle and tame the less predictable products, our infamous "Mad Bulls".

PORTFOLIO SEGMENTATION: NESTLE'S ANIMAL FARM

Not all of Nestlé's products have sales that are equally predictable. For example: a baby milk powder that cannot be promoted due to ethical guidelines will have a more stable demand than an instant coffee that is offered with price incentives on a regular basis. Typically, the variability of the demand, quantified through a standard deviation corrected for trend and seasonal patterns, is a very good indication of this predictability. The lower the variability, the more predictable a product is. This variability indicator is then coupled with an ABC classification, typically based on the volume or the profitability. This is known as an ABC-XYZ classification, and a useful variant is the *Animal Farm* shown below, which was originally created by an unidentified business analyst working for Whirlpool.
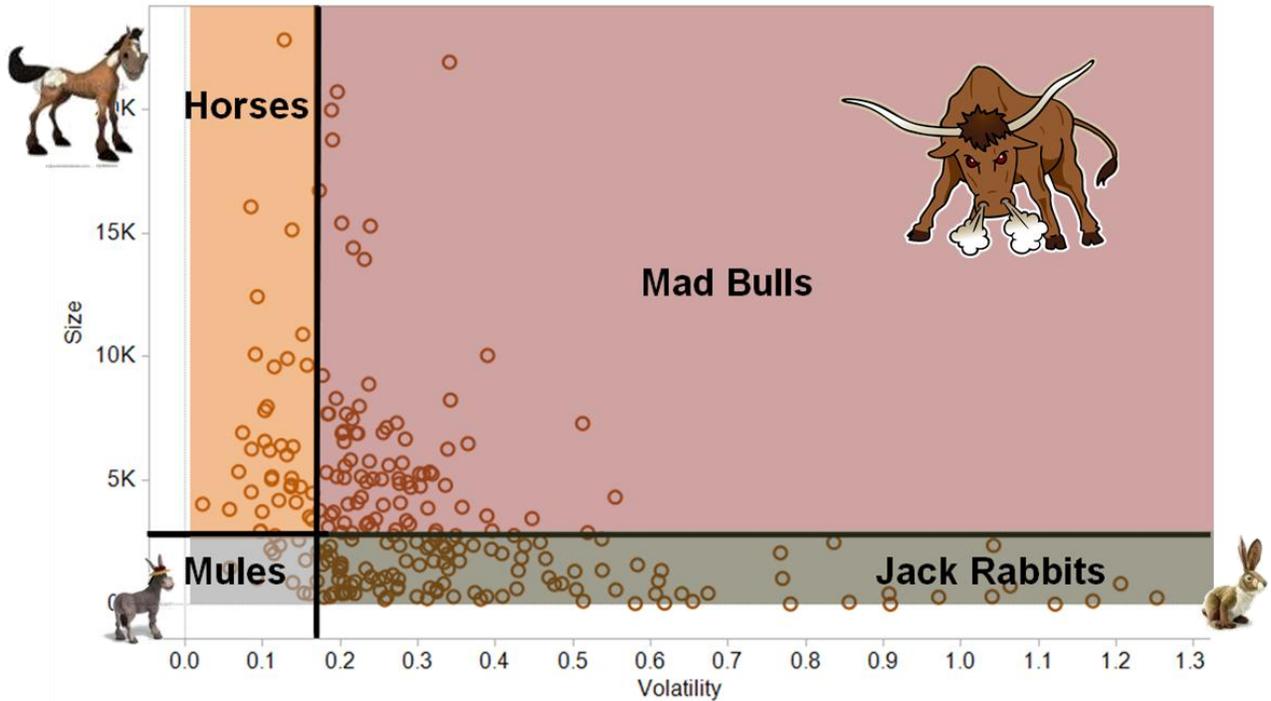
Figure 1: Nestlé's Animal Farm

The animals basically represent the behavior a planner should adopt when forecasting future demand of such products. Horses can be trained, they are predictable in their behavior, but they are also of high value. Therefore, Planners should rely on statistical methods for such products, but naturally still keep an eye on them. However, for the Mules, with low variability and low relative value, no time should be wasted, they must be run fully automatically.Finally, the Jack Rabbits are the achilles heel source of complexity of many companies: again, the idea is not to loose time with them.

The Mad Bulls are of particular interest: they generate high volume and profit, but they suffer from highly volatile demand. To some extent it may be possible to "tame" them by close collaboration with retailers, but ultimately we have to understand that part of the volatility that we cannot control, and apply this understanding in our handling of these beasts, to better predict their future behaviour.

UNDERSTAND THE CAUSE OF VARIABILTY

Here is a graph with a typical demand pattern of a *Mad Bull*. These are real weekly point of sales data of a Coffee product in Europe:
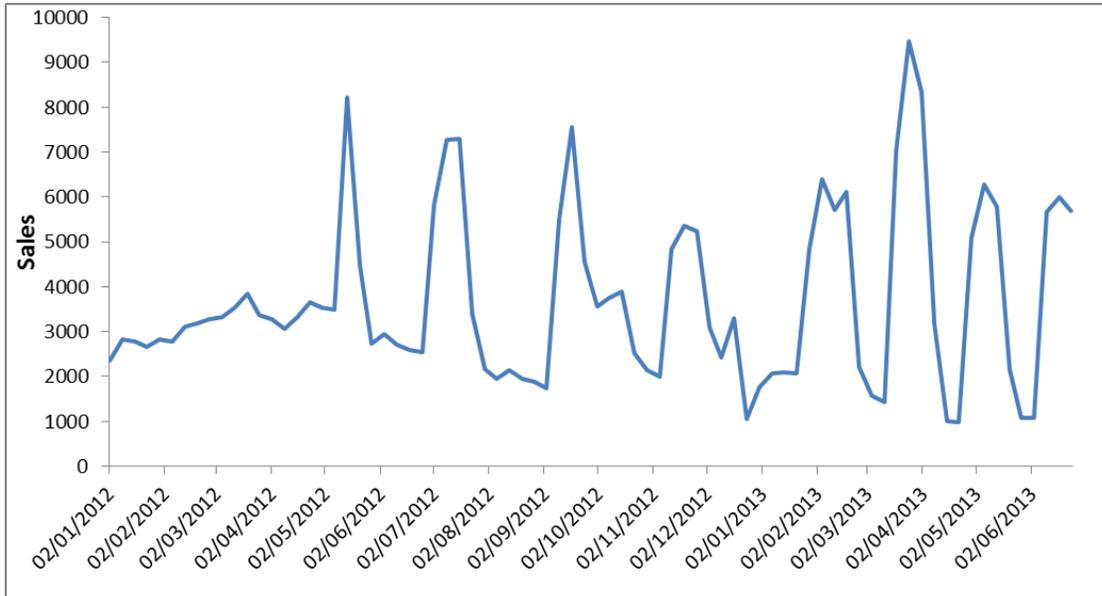

Figure 2: A Mad Bull

The overall variability in demand is high, due to the irregular peaks that multiply typical weekly demand by factors of up to 5. A method like *Single Exponential Smoothing*, the workhorse for time series forecasting, cannot really cope with such a pattern. As it is not provided with the cause of the peaks, it can only average somehow the weekly sales, and provide a forecast that is not really useful:
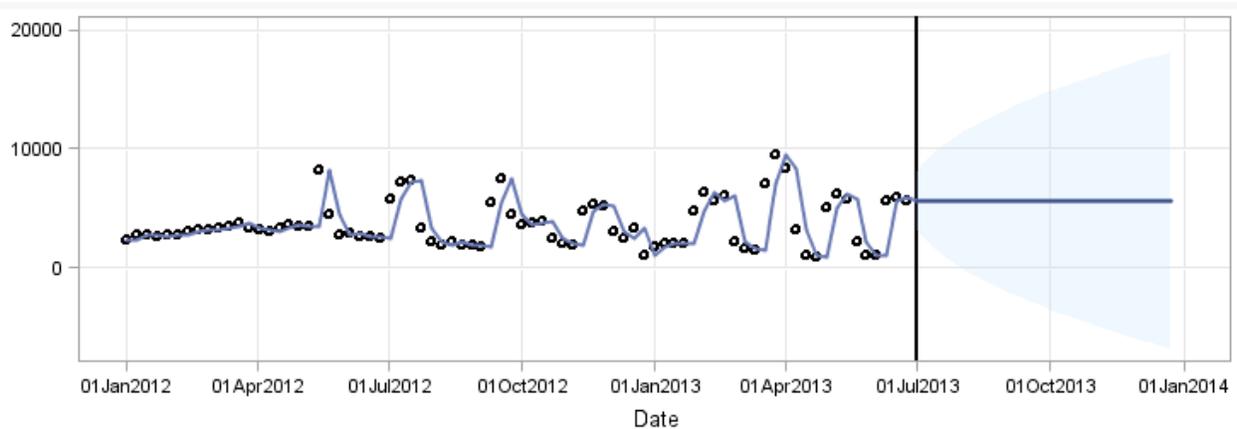
Figure 3: Not a useful forecast

The only way to tame this Mad Bull is to find the cause behind the peaks, and quantify it. Fortunately, in this case, this is quite straightforward. It turns out that this product is regularly promoted by price discounts, of up to 20%, and the next figure illustrates the strong relationship between demand in volume and the price discounts:
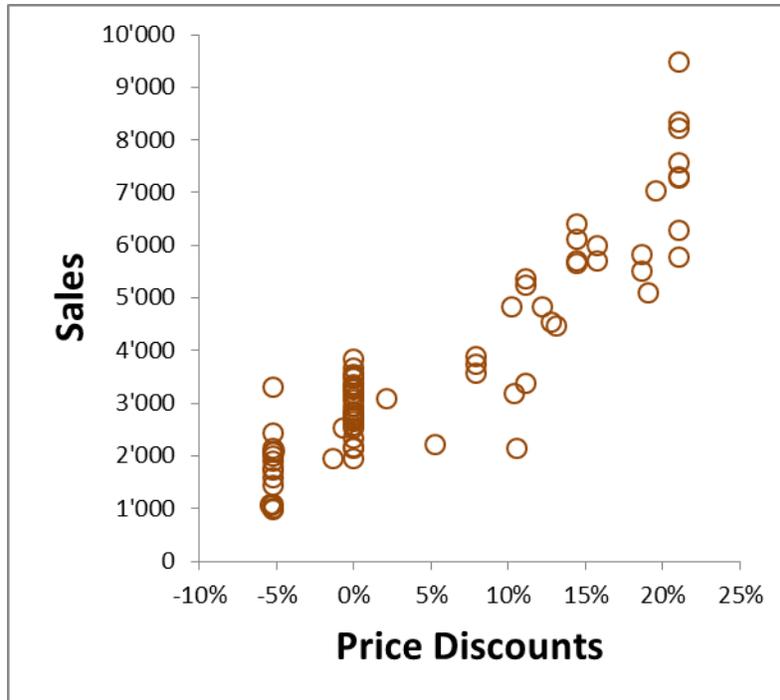
Figure 4: Relationship between Price Discounts and Sales

This chart simply illustrates the *Price Elasticity* of this product. All what we need now is a statistical method that allows to incorporate such explanatory variables.

SAS FORECAST SERVER AND SAS FORECAST STUDIO

SAS has provided for many years high performance forecasting solutions, allowing companies to forecast statistically hundreds of thousands of products in a highly automatic way. SAS uses exponential smoothing and ARIMA methods, and provides them in a context with fast and robust model selection and parameter fitting, coupled with the ability to forecast an entire hierarchy using different hierarchical reconciliation strategies (e.g. bottom-up vs. top-down). This in itself already takes care of our Horses, Mules and parts of the Jack Rabbits, by providing reliable forecasts that no human can beat by investing the same amount of time, that is very little.

For the Mad Bulls, once explanatory variables like price discounts or any other promotion mechanic have been identified, one can then rely on Autoregressive Integrated Moving Average (ARIMA) and Unobserved Component Model (UCM) techniques within SAS Forecast Sever. These allow the forecaster to add such explanatory or independent variables to the models. And all this still within a high-performance, highly industrial context (fast, automatic, robust, …). Here is the forecast for our Mad Bull, assuming two future price discounts at 20% and 30% discounts:
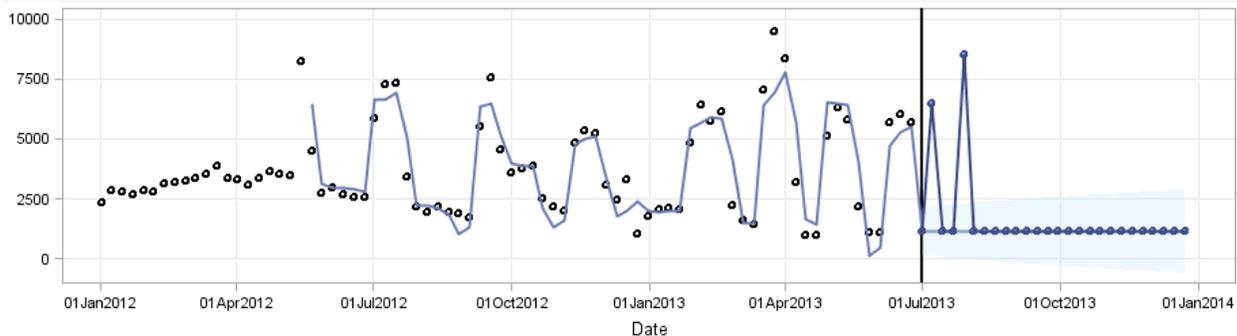
Figure 5: The Tamed Mad Bull

And that's basically all we need. We have proven that this process works: it can be run efficiently, week by week, providing highly reliable demand signals for the upstream processes (manufacturing and distribution). This is in place

in Australia, where two retailers share roughly 80% of the market and fight among themselves with large and irregular promotions, and where Demand Planners tame Mad Bulls directly in SAS Forecast Studio. This is also in place in the US for the Nestlé's direct delivery business for Ice Cream and Pizza, which needs to build plans for a very detailed geographical network with frequent promotions. The team there, a small group of highly skilled statisticians, uses SAS code to run the SAS HPF (High Performance Forecasting) procedures.

CONCLUSION

Thanks to modern statistical forecasting methodology, we have found ways to tame our Mad Bulls, whenever we are capable to quantify the causes for the volatility of the demand. This was not possible within our existing Demand Planning solutions, and SAS provides us with the appropriate complementary solution. Nestlé will use this technology to empower skilled *Demand Analysts*, trained Statisticians with a motivation to work for a company like ours, so that they can provide the forecasts as a service to the *Demand Planners* and all the participants in our *Sales & Operations Planning* (S&OP) processes. This highly reliable signal, obtained through an efficient process that minimizes waste, is then the key input to do the seemingly impossible: provide high service levels to our customers whilst minimizing our inventory.

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