

What can we learn from ancient sales ledgers?

Short Abstract

Victorian era customer purchase records from a famous London tailor reveal a close fit between actual and predicted buying using the stochastic NBD model. Within this conceptual framework, novel data can generate useful results, in this case showing that the buying patterns of high end tailoring customers in the 19th century are very familiar, and comparable to their 21st century counterparts. This is useful in categories that lack longitudinal data, such as many luxury goods. The first contribution of this research is to show that luxury goods consumer culture has remained steady over time. Second, the NBD model can be used to predict market penetration growth. Third, the results indicate that marketers should seek to increase the total number of customers rather than just focus on heavy ones and finally the NBD model can serve as a benchmark tool to evaluate any real change in buying behavior (as opposed to stochastic change), caused by marketing activities.

Keywords: Stochastic modelling, prediction, NBD, Luxury goods

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Introduction and research aim

The aim of this study is to test whether 19th century data can help to fill gaps in knowledge of luxury goods buying behaviour. The study uses newly available sales ledgers from a Savile Row tailor founded in 1806 that contain about 132,000 names. The ledgers are of great interest to biographers and fashion historians, but also hold a treasure trove of data on luxury goods buying behavior. This is useful because even today, with demand for luxury goods topping \$1.3 trillion (Bain & Co, 2019) and rising at 5% or more per year, there is little longitudinal data on buying habits. Until now, the available category data is mostly qualitative, or oriented to the media habits of buyers (Atwal & Williams, 2009) leaving a gap in our understanding of luxury goods buying (Lamb, 2013), leading to the research question:

What does historic purchase data reveal about luxury goods buying behaviour?

This paper extends the well-known stochastic negative binomial distribution (NBD) model for the first time to a luxury product. A key implication of the NBD conceptual framework is that customer buying follows predictable patterns that can provide a useful benchmark for managers to evaluate brand performance and marketing activities. The NBD has been used to model brand purchasing over the past 60 years for many different products, time periods and countries (Chatfield, Ehrenberg, & Goodhardt, 1966; Ehrenberg, 1996; Sharp & Romaniuk, 2016) making it one of marketing's most reliable models (Sharp, 2010) and a useful tool for understanding purchasing patterns (Schmittlein, Bemmaor, & Morrison, 1985).

The NBD generally shows that the purchase frequency distribution of a product has many light and few heavy buyers. Though heavy buyers are important to a brand's sales, evidence from many product categories shows that the 'top 20%' of customers account for between 50 and 60 percent of sales (Schmittlein, Cooper, & Morrison, 1993; Sharp, 2010).

Another useful property of the NBD model is its conditional expectation. When modeling purchase frequency, one can predict the number of purchases made in a subsequent time period from those observed in the current period of the same length (this is the expected mean of purchases) $E[X_2 | X_1 = x]$. Based on conditional expectation, Goodhardt & Ehrenberg (1967) introduced the benchmarking of future purchase change based on past performance, which they called conditional trend analysis (CTA). This has key managerial implications (Morrison & Schmittlein, 1988) because it enables managers to identify whether a change in sales is due to previous non-buyers, light buyers or heavy buyers (Schmittlein et al., 1985).

Methodology

A sample of 500 names was drawn randomly from sales ledgers covering the years 1890 to 1899. For each customer, all purchases during the entire period were tabulated for how many times they purchased, how much they spent on each purchase occasion, and how many items they bought. The data was organized by customer and by year. Frequency distributions were then made on total purchases and total spending. The handwritten records used pounds, shillings and pence, but these have been converted into 2019 GBP for ease of understanding.

In order to apply the NBD in this context we first assume that buying of bespoke tailoring x in successive time periods follow a Poisson distribution with parameter λ

$$(1) f(x)_{\text{poisson}} = e^{-\lambda} \lambda^x / x! \quad \text{with mean} \quad E[x] = \lambda$$

and mean of product purchasing λ of different customers in the long run differ and their distribution takes a Gamma form.

$$(2) f(\lambda; k, a) = \lambda^{k-1} * e^{-\lambda/a} / a^k \Gamma(k)$$

Results, Discussion and Contributions

Chi squared tests show no statistically significant differences between observed purchases and the NBD theoretical estimates ($r^2 = .94$, $X^2 = 1.4$, $df = 3$, $p = 0.41$). This clearly demonstrates that the NBD model fits well. In detail, the average yearly spend by Victorian gentlemen was £4,568 per customer, with a maximum of £40,014 and a minimum of £19 per year (excluding those who did not make a purchase during the year). Over the entire ten year period, the average spend per customer was £26,510 and the maximum was £240,084. When charted, the distribution of heavy and light buying takes the typical NBD shape, with far more light buying than heavy buying. The pattern was the same when looked at by number of purchases per year, purchases over 10 years or total spending over 10 years.

When the top spending 20% of customers was separated out, they accounted for 56% of all purchase revenue, in line with expectations (Kim, Singh & Winer, 2017).

Implications for Theory and Practice

The initial findings from this Victorian data are the first attempt to model luxury goods buying patterns over an extended time period. This is also a pioneering exploration of historical buying, raising the possibility that other archives may exist in other categories.

The close fit of actual buying to NBD predictions show that stochastic modelling extensions to novel data can generate useful results. When checked by the current managers of the company, they felt that the current customers mix and their buying behavior were much the same-- not only were the frequency of purchasing and the annual amounts spent similar, but so was the composition of the customer base--half British, a quarter European and a quarter from the rest of the world. This indicates that the consumer culture for bespoke tailoring has a global dimension that has persisted for at least 130 years. In other words, the buying of luxury clothing in the past tells us a great deal about the present. This is important today because of the continued lack of longitudinal data in luxury categories.

There are several important implications of the results. First, luxury goods makers can use the NBD to evaluate the contribution of light versus heavy customers to their overall product sales (e.g. which contribute most to sales). Second, managers could use the NBD model to predict market penetration growth over time. This is particularly useful for luxury goods marketers because it shows the importance of current non-customers to future sales. Third, the results indicate that targeting heavy buyers in order to increase sales is likely to fail, since the model predicts that it is unlikely that existing heavy buyers could further increase their purchasing and more significantly, that there will be many more infrequent buyers. Marketers should therefore seek to increase the total number of customers rather than just focus on the heavy ones. Finally, the NBD model could be used to benchmark any real change in buying behavior (as opposed to stochastic change), caused by marketing activities.

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