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Data Analytics and Strategic Planning in a Bioproducts Micro-Enterprise

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Abstract

This case study illustrates the use of data analytics in a Portuguese bioproducts micro-enterprise. Pareto distribution and K-Means clustering were utilized to analyse consumer behaviour, product performance and sales dynamics. The findings show a strong concentration of revenue on just 10 products, accounting for almost half of the total revenue, and a low retention rate, with 88.3% of consumers being one-time purchasers. Additionally, geographic data indicates that Lisbon, Sintra, and Cascais together constitute a key sales hub, accounting for 21% of total revenue, while the remaining revenue is broadly distributed across the rest of the country. The findings demonstrate that analytical frameworks are an effective managerial tool, despite of limitations with sample size and data richness. Ultimately, the descriptive and unsupervised analytical approach successfully suggested several insights that are impactful for NM.

Keywords: *Business Analytics; Micro, Small and Medium-sized Enterprises; Personalized Marketing; Sustainability.*

1. Introduction

Micro, small and medium-sized enterprises are the backbone of the European economy and are at the heart of the continent's green transition. With 99% of all businesses and employing approximately 85 million people across the EU, these enterprises are crucial in Europe's shift toward a sustainable, circular and bio-based economy (European Commission, 2025). In recent years, the global bio products landscape has witnessed a notable increase (DataIntelo, 2024). These products, often perceived as a healthier and environmentally responsible choice, have gained prominence as individuals seek to make mindful and conscientious decisions about their dietary and well-being habits. Precise numbers for "micro-sized" (typically 1–9 employees)

companies specifically focused on bioproducts are not officially aggregated in a single database. However, the bioproducts and biotechnology sector is overwhelmingly composed of Small and Medium-sized Enterprises (SMEs), with a significant micro-business presence in innovation-focused regions (European Commission, 2014).

With the growth of digital platforms and shifting consumer behaviors, micro-sized companies increasingly rely on e-commerce to expand their business (Chatterjee 2023). In this context, data analytics can be used to extract valuable insights from diverse data sources, such as online consumer surveys, social media, and online transactions. This information can then be used to provide companies with several benefits, including (Chakraborty, 2023):

- Improved understanding of consumer behavior: analytics can help companies to understand the factors that influence consumer decisions to purchase bioproducts, such as health concerns, environmental awareness, and price sensitivity.
- Enhanced marketing effectiveness: analytics can be used to develop targeted marketing campaigns that are more likely to resonate with bioproducts consumers.
- Increased sales: analytics can help companies to increase sales by improving product placement, optimizing pricing, and personalizing the shopping experience.
- Increased customer base: analytics can be used to predict customer retention and help define strategies to enhance loyalty.

The potential benefits of data analytics to improve competitiveness are not devoid of challenges. First, data analytics to be effective must be integrated with strategic planning (Chaudhry *et al.*, 2014, AlQershi, 2021). However, many owner-manager entrepreneurs often prioritize survival, autonomy and personal satisfaction over profit maximization or growth, which diminishes their motivation to adopt data-based evidence in decision making (Terpelle & Erceg, 2025). Second, analytical tools are often costly and complex, leaving these companies at a disadvantage compared to larger organizations. Additionally, issues related to data quality, quantity, and availability constrain the effective use of data analytics. Micro-sized enterprises often lack sufficient data to support analytical solutions, highlighting the need to first structure and automate data collection processes before adopting more advanced analytical approaches (De Simone *et al.*, 2023).

2. The NM company

NM is a Portuguese micro-enterprise (2 employees) targeted at the sustainable and organic market. The company operates primarily through an e-commerce platform, offering a range of organic foods, raw materials for do-it-yourself (DIY) production, and sustainable lifestyle products. NM also maintains a physical store, which works mainly as a showroom for its products and a pick-up point for online orders.

NM was established in 2019 to bridge a significant gap in the local market or bioproducts, where consumers lacked a single location offering a wide variety of certified goods that would otherwise require considerable effort to find. The concept of providing a curated experience is particularly relevant to the company's strategic positioning, as NM seeks to serve not only B2C customers but also the B2B segment.

After an initial success during the 2020-2021 period, coinciding with the growth of e-commerce driven by the COVID-19 pandemic (Gu et al., 2021), NM is now facing a phase of stagnation and even a decrease in the number of new customers. This situation calls for a change in the management approach in order to invert this trend and increase overall turnover.

This paper uses NM's transactional data to illustrate the application of data analytics to identify customer profiles, products performance and sales trends. It then discusses how these insights can inform strategic decisions aimed at increasing sales and overall revenue.

3. Data Analytics of Online Sales

Data was extracted from the Wix e-commerce platform to create a longitudinal dataset starting in 2020. A data refinement process was applied to exclude incomplete orders and other non-commercial entries. The final dataset comprised 486 orders and 403 unique customers. The analysis aimed to: (a) identify customer profiles based on purchasing behavior, (b) assess product performance, and c) evaluate sales trends. The entire analytical process was conducted using Python.

3.1. Customer profiles

K-means clustering algorithm was applied to segment customers based on purchase behavioral features. The variables (with customer granularity) used in this analysis are Recency (R), which is the number of days since the last purchase, Frequency (F), which corresponds to the number of orders and Monetary (M), the total amount spent. The elbow method suggests four distinct clusters based on a mathematical analysis of the Euclidean distance between the customers' RFM coordinates and their respective cluster centroids.

Figure 1 plots the four clusters revealed by K-means analysis. An important finding was the identification of the loyal core of customers, Cluster 1, which accounts for 34.1% of the total monetary value, even though it only represents 11.7% of the total customer base.

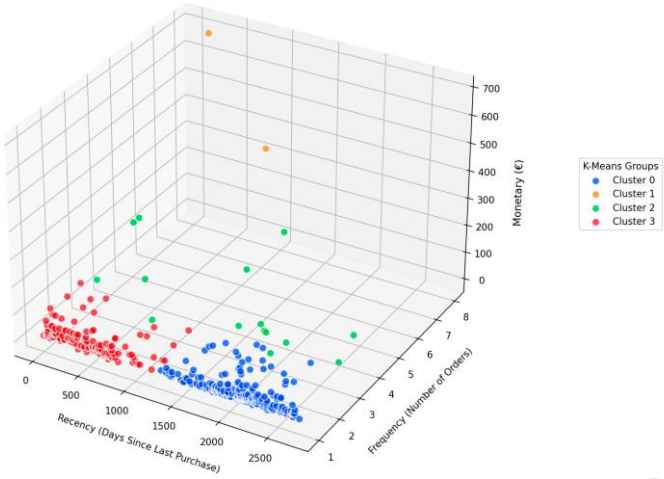

Figure 1. 3D Visualization of K-means Clustering based on Recency, Frequency and Monetary.

On the other hand, the largest number of customers (representing 75.9% of total customer base) are classified either on Cluster 0 or Cluster 3. These consumers interacted solely one time with NM, failing the transition to recurrent buyers. What differentiates them is that Cluster 0 were one-time clients on the 2020-2021 period, who had a low average order amount (AOA), whilst Cluster 3 includes more recent one-time buyers, that show a slightly higher AOA.

Cluster 2 consists of customers with a higher AOA, representing 12.4% of the total, but low frequency and moderate recency. They are mainly one-time buyers, but unlike the rest, these customers spent bigger amounts on their purchases, with a higher monetary value.

3.2. Products' analysis

Figure 2 presents the Pareto distribution of product revenue contribution allowing an ABC analysis of NM products. Class A is defined as the top 70% of the revenue, Class B as the next 20% and Class C as the final 10%. There are 34 Class A products that jointly account for 70% of the total revenue. More specifically, there is one organic food product that stands out, grain alcohol, accounting for 12.8% of total revenue, while the remaining of Class A's products are mainly cork yoga mats and reusable hygiene products. Class B consists of 73 products which are frequently part of a market basket, with a catalog of eco-friendly household cleaners, therapeutic essential oils. On the other hand, Class C products account for the remaining revenue and include a wide range of products (170).

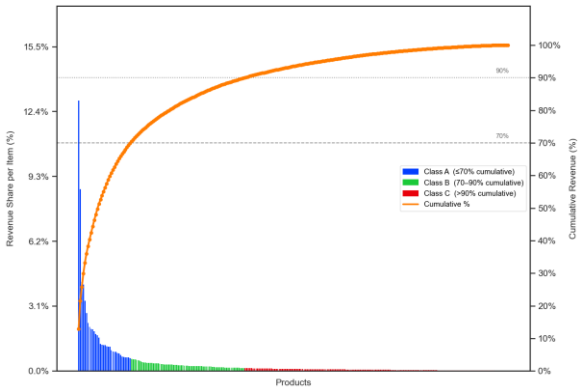

Figure 2. Pareto Distribution of Product Revenue Contribution.

3.3. Sales analysis

Table 1 presents information about the clients on the period 2020-2025. On a temporal perspective, after the peak in 2020, with 111 new customers, sales present a stagnation during 2022 and 2023, with only 20 and 15 new customers per year, and finally a rise in 2024 and 2025, with 63 and 55 new customers respectively. The percentage of one-time buyers remains consistently high throughout the years.

Table 1. New Customer Acquisition (2020-2025)

Year	2020	2021	2022	2023	2024	2025
AOA	26.68€	19.14€	29.41€	38.64€	26.25€	38.05€
New clients	111	49	20	15	63	55
One-time buyers	83.8%	84.3%	85%	80%	93.7%	88.1%

Furthermore, geospatial analysis reveals a strong geographic concentration of sales in one hub: nearly 21% of total revenue is focused on three major urban areas - Lisbon, Sintra and Cascais. The remaining revenue is quite scattered by different geographical areas, being Porto and Setúbal, the most relevant accounting for 4.0% and 2.8% of the total revenue, respectively.

4. Insights and Managerial Implications

The analysis identified vulnerabilities that require a shift in NM operation focus. There is a substantial retention gap in NM, with 88.3% of customers as one-time buyers, suggesting a lack of engagement after purchase. MN should consider the adoption of new retention techniques, utilizing the different clusters identified in this research, to create specific e-mail marketing campaigns and other CRM frameworks for each segment of clients.

On the operational side, the Pareto distribution showed that 70% of the revenue is tied to only 34 products. MN can optimize its supply chain for these Class A products and consider the

possibility of optimizing its stock, by reducing products that do not sell, with a lean inventory strategy.

The concentration of revenue in Lisboa, Sintra and Cascais show that marketing campaigns specific for these regions can strength MN position while new campaigns need to be created for other big geographic areas, that do not perform as well.

5. Conclusion

This case study provided a data-driven diagnosis of NM and generated several insights to support the company to define its future strategy. However, the analytical process was confronted with significant limitations, namely the scarcity and limited richness of the data extracted from the Wix platform. Furthermore, the absence of key demographic variables, such as age and gender, constrained the development of more refined predictive models. Despite these constraints, the descriptive and unsupervised analytical approach successfully suggested several insights that are impactful for NM.

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