

Consumer behavior analysis and customer segmentation Budgetary Control Operations Using the RFM model

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Abstract:

This study aims to analyze and segment customers using the RFM model on longitudinal data from a British online retailer specializing in gifts and household goods.

The retailer, headquartered in the USA, has customers in various countries, including France, Germany, and Australia, with a focus on the UK. It employs a dual business model, selling to individuals and wholesale to other retailers. The study results in the following customer segments:

The article analyzes how public institutions execute these operations—performed in addition to their core missions—and investigates the associated budgetary control mechanisms. The findings indicate that while off-budget operations benefit from certain flexibilities, such as exemptions from prior budgetary visas for specific outlays, they remain strictly bound by competition rules and public procurement regulations, as well as rigorous ex-post audits. Furthermore, the study highlights a legislative shift in revenue distribution; the legislator has moved from emphasizing individual incentives toward strengthening institutional self-financing (60% share). This shift underscores a profound and integrated financial and accounting relationship between budgetary and off-budget frameworks.

Keywords: Novelty, Financial Value, Frequency Budgetary Control, Off-Budget Operations, Public Accounting.

Introduction:

The contemporary business environment has witnessed a radical shift in the path of data-driven marketing, as organizations aim to enhance customer life value. The Frequency Management Model (RMM) is one of the most effective models for analyzing and segmenting consumer behavior based on three vital factors: recency, which assesses the proximity of the last purchase; monetary value, which indicates the customer's economic importance; and frequency, which reflects customer loyalty and continuity.

Recognizing these three factors allows organizations to understand customer behavior and analyze their interactions with the organization. This behavioral segmentation contributes to developing successful marketing strategies and decisions aimed at improving the return on marketing investment.

Study Problem: Based on the above, we pose the following research problem:

How does the RFM model, with the k-Means clustering algorithm in the Orange3 environment and Python language, contribute to uncovering hidden behavioral patterns and segmenting the online retailer's customer base during the period 2010-2011 into precise economic segments that support marketing decision-making?

Study Hypothesis: The RFM model, with the k-Means algorithm, using the Orange3 environment and Python language, contributes to the behavioral segmentation of the online retailer's customer database during the period 2010-2011 into segments (C1, C2, C3), which supports marketing decision-making.

- The Concept of Consumer Behavior: Consumer behavior is considered an aspect of human behavior and is defined as the actions individuals take to acquire and use goods and services in an economical manner. This includes the decisions that precede and determine these actions. Consumer behavior is manifested in the actions consumers take in the purchasing, research, and use of available goods and services.

As for Howard, he defined consumer behavior as those actions that follow individuals' acquisition and use of economic goods and services, including those actions that precede and explain them. Furthermore, individual purchasing behavior is repetitive, and the buyer has a cycle for purchasing various products. (Meraj Hawari, Houichti Tawfiq, 2018)

Explanation of the RFM Model: RFM stands for recency, frequency, and monetary value. It's an analytical method used by companies to group customers based on their purchasing activity, the number of purchases, and the amount spent. Companies evaluate each customer within these categories to identify the most valuable customers.

RFM was developed in the 1990s and has proven effective in understanding customer behavior and marketing. It contributes to increased sales and supports the 80/20 rule, which states that most business comes from a small group of high-value customers.

Analyzing customer interaction based on RFM factors rests on three quantitative pillars:

1. Recency: How many transactions occurred during the customer's purchase?
2. Frequency: How often does the customer make a purchase?
3. Monetary Value: How much does the customer spend on purchases?

RFM analysis ranks the customer numerically within each of these three categories, typically on a scale of 1 to 5 (the higher the number, the better the result).

The best customer receives the highest score in each category. These three pillars of Rapid Request Management (RFM) can be used to predict the likelihood of a customer engaging in a new business transaction with a company or, in the case of a charity, making other donations.

The concept of RFM (Recentness, Repetition, and Financial Value) originates from an article by Jan Rolf Bolt and Tom Wansbeck titled "The Optimal Choice of Direct Mail," published in the 1995 issue of Marketing Science. (<https://www.investopedia.com/terms/r/rfm-recency-frequency-monetary-value.asp>)

1. Factors Influencing Consumer Behavior: The widespread adoption of e-commerce has contributed to the development of modern models of personal and impersonal interactions and transactions, characterized by a high degree of interactivity and availability. This has fostered a shift in favor of online consumers, who have become more informed and demanding.

Factors influencing consumer behavior in general include demographic characteristics, seller characteristics, and the social context (Agarwalokarahana, 2000; Moon and Kim, 2001; Turkzadhohilun, 2002). Shawn and Yoonji (2006) identified the main products sold online as software, books, electronics, and music. Customers do not need to inspect these products in person and can view the basic characteristics through product descriptions and images. Koti et al. (2006) categorized online consumers into four groups, each with different motivations and intentions: information and shopping, entertainment, and exploration. Chung M.K. et al. (2005) believe that the factors that influence consumer behavior on the Internet are: (individual consumer characteristics (behavioral characteristics and subjective factors), and the effects that contribute to the environment, including: trade-related restrictions, competition, market concentration, international and national laws and regulations, and structural effects such as uncertainty), and the characteristics of the service or product (knowledge of the product or service, type, quality), and the characteristics of the electronic environment as attributes of online shoppers such as (validity, security, ease of use, quality, etc.). (Cetină, I., Munthiu, M. C., & Rădulescu, V. 2012)

Brochures:

Brochures contribute to strengthening communication with the Directorate of Forestry's external audience. They are among the tools used to combat environmental problems and are distributed during field visits and open house events organized by the Directorate to raise awareness and conduct sensitization campaigns among community members. The importance of brochures increases on occasions with special environmental significance, such as World Environment Day, to promote positive environmental attitudes. In response to the forest fires affecting Algeria and some of its provinces, the Forestry Department has produced a brochure titled "Awareness Campaign for the Prevention of Palm Tree and Agricultural Crop Fires." The brochure outlines the causes of these fires, their consequences, and provides guidance on fire prevention, including images of burned palm trees. It also offers general advice and guidelines on forest fires, a problem that is particularly prevalent during the summer months. The brochure aims to help prevent and combat these fires, as well as provide instructions on how to act before and after a fire.

- Field Visits:

The Forestry Department conducts numerous field visits, depending on the specific environmental issue at hand. These visits are a crucial communication tool, allowing the department to engage directly with citizens, raise awareness, and promote understanding of environmental problems. The province witnessed several participations in awareness campaigns to combat fires in palm trees and agricultural crops in coordination with the local authorities, the National Gendarmerie, the Directorate of Environmental Protection, the Directorate of Agricultural Services and the Algerian Islamic Scouts, where advice and guidance were given on preventing fires in palm oases and the need for caution and vigilance in order to reduce the losses caused by fires. This came after the rapid intervention of the Civil Protection and in the presence of the National Gendarmerie unit, the head of the People's Council of the municipality of Benoura and the head of the Irrigation and Public Works Department. The rapid intervention and the speed of extinguishing made it possible to protect large areas from burning. (Interview with Mr. Chebihi Bahri, in charge of communication with the Forestry Department, Ghardaia, on March 26, 2025 at 10:15.)

Audiovisual Media:

Radio: Among the media outlets the Forestry Department relies on is radio, which is used to raise environmental awareness and combat environmental problems. This is done by dedicating a radio segment to coincide with international days such as those addressing desertification, forest fires, pollution, and illegal hunting, in order to provide information.

Television:

Television is another media outlet the Forestry Department uses to cover news related to problems threatening the environment or any new developments in the forestry sector.

Analysis of Interview Results:

We conducted an interview with the Forestry Department's communications officer to obtain information that would help us draw conclusions for this study.

First Axis: The Most Important Communication Mechanisms Used by the Forestry Department in Combating Environmental Problems

Second topic: The most important activities undertaken by the Forestry Department in the field of combating environmental problems.

Do activities that focus on environmental problems influence behavior?

To some extent, yes. We guide the community to acquire a set of principles and foundations, positive attitudes, a spirit of initiative and commitment towards the environment, and a sense of responsibility towards the problems that threaten it, thus protecting it. Over time, we will develop a society aware of the dangers and problems that destroy the environment and that appreciates its importance. Do you consider citizen participation in events and activities to have a significant impact on combating environmental problems?

Of course, it has a significant impact because human activity is one of the causes of some environmental problems. If environmental awareness spreads among them, these problems will decrease. However, it's noticeable that when we hold environmental activities, events, or

exhibitions, participation is somewhat moderate, and this is due to a lack of environmental awareness among them.

Do you receive calls from citizens regarding environmental problems?

Yes, some citizens call to report the destruction of some state-owned reserves used to combat desertification.

Third Axis: Difficulties Facing the Forestry Department in Solving Environmental Problems

What are the most important environmental problems that the Ghardaia region suffers from?

- Desertification.
- Soil erosion.
- Environmental pollution.
- Indiscriminate hunting.

Do you believe that working with various environmental associations can help solve environmental problems? And what are the most important of these associations?

Yes, cooperation with some associations and organizations helps in solving environmental problems, especially in the process of reforestation to combat desertification, raise environmental awareness, and spread a culture of nature conservation.

What are the most important of these associations?

- Al-Ghaith Association for People with Special Needs
- Basma Al-Yateem Association
- Islamic Scouts
- Al-Hadaba Neighborhood Association
- Algerian Organization for Environment and Citizenship
- Provincial Association of Hunters

Methodology and Tools:

1. Working Environment and Data Sources: This study focused on a quantitative and analytical approach to extracting consumer behavior patterns. All processing steps and characteristic assignments were implemented using the Orange3 programming language, which includes a unique Python script. This approach aimed to perform precise calculations and ensure the accuracy of the behavioral analysis. The raw data was thoroughly cleaned, excluding all zero and negative values to retain only the actual purchase transactions that impacted the business activity.

2. Characterization and Variable Formation (RFM): The dimensions of the RFM model were extracted and formed based on transaction records using the Pandas library, focusing on the following mathematical sequence:

1.2 Monetary Value: The customer's total spending was first calculated by multiplying the quantity of products purchased by the unit price according to the following formula:

(Monetary = Quantity x Price). These values were then summed for each customer ID.

Where Quantity is the quantity purchased by the customer;

Price is the price of the units purchased. 2.2 Recency of Purchase: This is calculated based on the time difference in days between a reference date (the day after the last purchase in the

entire database) and the date of the most recent purchase made by the customer. The following equation illustrates this: $\text{Recency} = t_{\text{ref}} - t_{\text{max}}$

where t_{ref} is the reference date, used for comparison;

t_{max} is the date of the last purchase made by a specific customer.

3.2 Purchase Frequency: To avoid statistical distortion resulting from purchasing products in a single cart, the unique sort function was used to calculate the number of separate invoices for each customer, thus helping to control the number of their visits or separate orders.

3. Statistical Processing and Standardization: Due to the sensitivity of unsupervised machine learning algorithms to outliers, a mathematical separation algorithm was applied, resulting in the exclusion of 150 customers with atypical outlier behaviors. A pure and homogeneous study sample of 2847 customers was retained. Customer ID was isolated as a meta-attribute to prevent interference in distance determination and to avoid the dominance of variables with large absolute values (such as monetary value) over other variables. The three features of Z-score normalization were implemented to determine the arithmetic mean at zero and the standard deviation at one ($\sigma = 10$).

[Note: The original text incorrectly stated that $\sigma = 10$] 4. Clustering and Spatial Modeling (K-Means Clustering): To divide the customer base into distinct behavioral segments, the K-Means algorithm was used. To ensure model stability and avoid local minimums, the settings were configured to form three predefined clusters ($K=3$), employing the smart initialization technique (KMeans++) to reduce the initial randomness of the centers. The algorithm underwent ten reruns, with a maximum of 300 iterations per cycle. The Silhouette scale, ranging from -1 to 1, was used to evaluate the reliability and quality of the clustering process. It assesses two aspects: cohesion (the degree of similarity among customers within the same cluster) and divergence (the degree of difference among customers within the same cluster). 5. Statistical Verification: To evaluate the effectiveness of the cluster, one-way analysis of variance (ANOVA) was used to test the differences between the means of the three groups. The results showed strong statistical significance ($P=0.000$) at a 99% confidence level, confirming the significant and logical differences between the behavioral patterns of the identified groups. Discussion and Interpretation of Study Results: - Silhouette Scale: Examining the Silhouette column in Table 3 reveals that:

1. Absence of negative values (No Misclassification): We find that all values are positive, which is conclusive mathematical proof that no clients have been misclassified, and that the algorithm has successfully placed each client in its correct category.

1. Definition of Budgetary Operations:

Budgetary operations are the procedures and regulations governing the preparation, execution, and oversight of financial estimates for the total expenditures and revenues of any public or private entity for a specific fiscal year. These operations embody strategic planning and are subject to formal authorization, including the approval of the relevant deliberative bodies.

2. Definition of Off-Budget Operations:

Off-budget operations are defined as "operations executed within the framework of secondary activities of a public institution that generate revenue" [4]. They are also

characterized as "revenues generated within the budgetary framework that are recorded in distinct accounts" [5]. Furthermore, they are defined as "revenues resulting from operations achieved and executed outside the operating budget framework, which remain subject to public accounting principles in terms of financial management" [6].

Based on the aforementioned definitions, Off-Budget Operations can be synthesized as: operations through which specific financial resources are collected from activities outside the core mission of public institutions. These resources are subsequently committed and expended in accordance with public accounting rules and public procurement regulations.

Section II: Historical and Legal Background of Off-Budget Operations

A series of legal and regulatory texts has been issued to govern off-budget operations. These legal instruments will be briefly examined in chronological order, from their inception to the present day, as follows:

1. Executive Decree No. 92-05, dated January 4, 1992, defining the procedures for the allocation of revenues generated by services and works performed by public institutions beyond their core mission:

This is considered the primary regulatory text governing off-budget operations in Algeria. Issued as an Executive Decree [7], it comprises nine (9) articles. The first article specifies that the objective of this decree is to define and regulate the methods for allocating revenues derived from activities, works, and services performed specifically by public research, education, and training institutions, in addition to their assigned core missions.

Furthermore, as stipulated in Article 7, the scope of this decree excludes services that fall within the institution's primary mandate. Under no circumstances may these core missions be compromised or sacrificed in favor of the profit-generating activities conducted within the framework of off-budget operations.

2. Instruction No. 11, dated May 14, 1995: This instruction was issued in French by the General Directorate of Accounting at the Ministry of Finance [8]. It is structured into three primary regulatory frameworks:

- **I. General Provisions:** These provisions clarify the procedures for executing and accounting for revenues derived from activities and expenditures related to off-budget operations, based on the implementation of Executive Decree No. 92-05.

- **II. Accounting Provisions:** These stipulate that the financial and accounting operations related to the secondary activities of public institutions must be recorded in a secondary ledger opened specifically for this purpose by the public accounting officers of the concerned institutions. These operations are recorded under an "off-budget" section, detailing revenues in terms of assets (their sources and forms) and, in terms of liabilities, the method for distributing the prescribed percentages after deducting expenditures or charges associated with the activities and services.

- **III. Miscellaneous Provisions:** This instruction clarifies that the financial resources generated from secondary activities may be utilized upon collection to settle expenditures or charges. Furthermore, Authorizing Officers (Ordonnateurs) may only perform the stipulated distribution based on a financial statement prepared every three months, which must show the net balance resulting in the off-budget section.

3. Executive Decree No. 98-412, dated December 7, 1998, defining the procedures for the allocation of revenues generated by services and works performed by public institutions beyond their core mission:

This represents the third regulatory text governing off-budget operations in Algeria and the second issued as an Executive Decree [9]. It consists of ten (10) articles. Notably, Article 1 stipulates that off-budget operations may be performed by all public institutions, expanding the scope beyond the previous limitation to research, education, and training institutions. Furthermore, the final article of this decree explicitly repealed the provisions of Executive Decree No. 92-05.

4. Inter-ministerial Instruction No. 03, dated November 20, 1999:

This instruction was issued jointly by the Ministry of Finance and the Ministry of Higher Education and Scientific Research [10]. It comprises three primary frameworks, including:

I. General Provisions: Issued less than a year after Executive Decree No. 98-412, this instruction serves to implement the decree's provisions. Its objective is to define the procedures for the execution and accounting registration of revenues derived from activities and their associated expenditures for public research, education, and training institutions, performed in addition to their principal mission.

II. Accounting Provisions: In addition to the provisions previously established in Instruction No. 11 of May 14, 1995, these accounting regulations stipulate that all expenditures related to off-budget operations must be subject to a **visa (approval)** from the **Budgetary Controller** [11] (formerly the Financial Controller). This approval is granted based on a statement confirming the availability of funds collected by the **Public Accountant** [12]. Consequently, this instruction explicitly subjects all off-budget expenditures to **prior expenditure control** (ex-ante control), as mandated under the current regulatory framework [13].

III. Miscellaneous Provisions: Revenues derived from secondary activities, as defined in this instruction, may be utilized as they are collected by the Public Accountant. The **Authorizing Officer** (Ordonnateur) shall then perform the distribution stipulated in Decree No. 98-412, based on a quarterly report (every three months) showing the net balance recorded under the off-budget operations section.

5. Inter-ministerial Instruction No. 02, dated February 4, 2001: This instruction was issued in French [14] as a joint text between the Ministry of Finance and the Ministry of Tourism and Handicrafts. It incorporates the same regulatory provisions established in Inter-ministerial Instruction No. 03 of November 20, 1999.

6. Inter-ministerial Instruction No. 31, dated December 15, 2001: Similarly, this instruction was issued in French [15] as a joint text between the Delegated Ministry in charge of the Treasury and Financial Reform and the Ministry of Vocational Training. This instruction also mirrors the provisions of the two aforementioned Inter-ministerial Instructions (No. 03 of November 20, 1999, and No. 02 of February 4, 2001).

Section III: Revenues and Charges of Off-Budget Operations

While the State's general budget relies on the annual Finance Law following its approval by both chambers of Parliament [16], the adoption of budgets for Public Administrative Establishments (EPA) occurs upon approval by the institution's Board of Directors or Steering Committee, as the case may be.

In contrast, **off-budget operations** are established on a **contractual or consensual basis**. This means they are initiated through a contract, agreement, or procurement deal between the public institution—acting as the provider of services, works, or activities—and the beneficiary entity (whether public or private), which receives these services or works in exchange for financial consideration. These services, works, or activities encompass various forms and categories.

1. Forms of Services Provided by Public Establishments: The services, works, and activities executed by public establishments within the framework of off-budget operations take various forms that differ from one sector to another. These variations depend on the nature of the public institution, its field of activity, and its mandated missions. The nature of these services is exclusively defined by regulatory texts, specifically ministerial decrees issued by the relevant minister supervising the sector. For instance, the list of works, services, and activities that the **University of Continuing Education (UFC)** can perform in addition to its primary mission includes the following [17]:

- Organizing and supporting training engineering;
- Organizing and supervising tailor-made, qualifying, and specialized postgraduate training courses;
- Organizing and supervising seminars, exams, competitions, and professional tests;
- Designing and producing digital educational documents;
- Designing and conducting surveys and opinion polls.

2. Content of the Off-Budget Operations Contract: The contract, agreement, or procurement deal between the parties involved in off-budget operations must specify the following [18]: The subject and nature of the services, the execution deadlines, the procedures for monitoring and supervising the various stages of execution, and the nominal list of personnel involved along with their scientific and professional qualifications. In addition to the above, the contract, agreement, or procurement deal must explicitly state the total value of the services and the individuals authorized to sign, as these are considered mandatory legal disclosures.

3. Procedures for the Legal and Accounting Collection of Off-Budget Revenues

Based on the concluded agreement, contract, or procurement deal, the **Authorizing Officer** (Ordonnateur) issues a **Revenue Order** (Order to Recover) [19] resulting from the collection of financial dues via check or any other financial payment instrument. Upon the issuance of this order, the **Public Accountant** of the relevant institution collects the revenue [20] for the institution's account. At this stage, the Authorizing Officer is permitted to utilize these financial resources and distribute the prescribed percentages after deducting the associated financial charges and expenditures of the operation.

4. Deduction of Charges and Expenditures for Off-Budget Operations

The deduction process involves subtracting the direct costs incurred by the public institution during the execution of the agreed-upon services. The nature of these expenditures corresponds to the nature of the services, works, or activities performed. For example, public institutions providing training services incur costs for purchasing paper, office supplies, and catering for trainees. Direct expenditures are deducted from the total collected amount, and the remaining balance is distributed according to the percentages established by current legislation, specifically the **Finance Law for 2021**.

I. Applicability of Public Procurement Rules to Off-Budget Expenditures

Expenditures incurred within the framework of off-budget operations are subject to competition and public procurement rules, identical to all other public expenditures.

- If the estimated expenditure exceeds **One Million Algerian Dinars (1,000,000 DZD)** for works and supplies, or **Five Hundred Thousand Algerian Dinars (500,000 DZD)** for services and studies, a **Consultation** must be conducted under **Adapted Procedures**.

II. Exemption of Off-Budget Expenditures from the Budgetary Controller’s Prior Visa:

Expenditures and charges related to off-budget operations are exempt from the prior control and visa of the Budgetary Controller (formerly the Financial Controller) [23]. However, they remain subject to ex-post (retrospective) control and visa upon the submission of expenditures related to the distribution of percentages after the deduction of these initial charges.

5. Distribution of Percentages Following the Deduction of Direct Charges for Off-Budget Operations:

After subtracting the total direct charges incurred by public institutions from the collected revenue, the remaining balance is distributed. These percentages have been modified as follows [24]:

I. A 60% Share Allocated to the Institution’s Account:

II. A 30% Share as an Incentive Bonus:

Under the Finance Law for 2021, this percentage was reduced from 50% to 30%. Previously, the distribution of this bonus among participants was problematic due to a lack of transparency; for instance, an institution's director could receive 50% or more, with the remainder distributed unequally among other staff. This was due to the absence of regulatory texts defining distribution methods. Currently, most sectors have rectified this issue. For example, in public institutions under the Ministry of Vocational Education and Training, the incentive bonus is distributed in accordance with Circular No. 02, dated September 3, 2018 [26].

III. A 10% Share as an Undistributed Balance: This portion remains undistributed within the Treasury account and cannot be utilized or disposed of. It would have been more effective to either allocate this share to the institution’s account—thereby increasing its proportion from 60% to 70%—or add it to the incentive bonus, bringing it to 40%. Such an adjustment would optimize the utilization of generated resources and further motivate the personnel involved in these operations.

Table No. 1: Distribution of Off-Budget Operation Shares and Percentages After Deduction of Charges

Shares and Percentages	Article 4 of Executive Decree No. 98-412	Article 120 of the 2021 Finance Law
Share allocated to the institution's account	35%	60%
Incentive Bonus	50%	30%
Share for the laboratory/pedagogical unit that executed the service (to improve resources	10%	/

and working conditions)		
Share for the institution's employees (Social and Cultural activities)	5%	/
Undistributed Balance	/	10%

Source: Prepared by the researchers based on the provisions of Article 4 of Executive Decree No. 98-412 and Article 120 of the Finance Law for 2021.

2. High Validity Cluster Values: Table 1 shows that most values range between 0.48 and 0.67 (for example, customer 12347 scored 0.628, and customer 12350 scored 0.671). In business data science, a Silhouette average exceeding 0.5 is a very strong indicator of cluster quality. Furthermore, the clusters (C1, C2, C3) are clearly and significantly differentiated from each other, with no random overlap, forming distinct marketing strategies. This confirms the preprocessing and RFM (Research Method Material) setup.

3. Analysis of Cluster Characteristics (C1, C2, C3):

a. C2 Segment: Champion/High-Value Customers: Table 1 shows significant differentiation between these clusters. For example, customer 12357, belonging to cluster C2, spent 6207.67, and customer 12395 made 7 purchases (F=7). His last purchase was just 6 days ago (R=6).

Economic Explanation: Customers in this group are a key driver of profitability for the store and are a segment that must be retained at all costs.

B- Segment (C3): Inactive or Lost Customers: This group is characterized by a significant increase in the Recency value, indicating a very long period of inactivity with low spending. For example, customer 12373 has not purchased for 343 days (approximately a year), with a spending value of 364.6 (F=1). Similarly, customer 12350 has been absent for 312 days.

Economic Explanation: Customers in this group have tried the store once or twice and then switched to competitors. Trying to win them back could be risky and costly.

C- Segment (1C): Regular or Promising Customers: This group is considered stable and average, as we can conclude that their last purchase was between one and six months ago, and their spending is low. For example, we find that customer 12,384 customers have made two purchases (F=2) in the last 30 days, totaling 585.27.

Conclusion: Based on the outputs of spatial modeling (K-Means) and statistical matching (Silhouette Score), the study confirmed the feasibility of dividing the consumer behavior of the study sample into three distinct economic segments that contribute to determining the viability of the business:

The first segment (C2 - Champion Customers) represents the cornerstone of profitability, as they exhibit significant spending, high purchase frequency, and consistent purchase recency. This is relevant to strategic marketing and economic measurement. The second segment (C3 - Lost Customers) demonstrated weak purchasing behavior, a prolonged period of inactivity

lasting several consecutive months, and very low spending. The third segment (C1 - Promising Customers) These customers are characterized by average RFM (Revenue Management) across all three dimensions, creating a fertile environment for implementing cross-selling and upselling strategies. The goal is to attract a percentage of these customers to C2, which will contribute to maximizing future profits.

Study Recommendations: The study presented a set of recommendations for the three segments, the most important of which are:

Segment One (C2): This segment is the most important because it consists of major buyers and wholesalers. Their spending exceeds 6,000 monetary units, and their purchases are only a few days old. The study recommends providing support programs for this segment, such as pre-sale offers, payment facilities, ensuring the availability of required quantities, and an exclusive rewards system. All these programs are designed to ensure customer retention.

Segment Two (C3): This segment comprises absent customers whose absence exceeds 300 days with only one purchase. The study recommends offering price discounts exceeding 20% if they do not respond, and attempting to understand the reason for their inactivity. Is it due to pricing issues? Or the experience of international shipping?

Therefore, after several attempts If they don't respond, it's advisable to remove them from paid mailing lists to reduce marketing costs. Their Silhouette score indicates they belong to the inactive segment.

Segment (C1): This segment comprises customers with average spending and moderate purchase frequency (e.g., F=2). It's considered a typical segment, and the study recommends implementing incentive programs to convert them to segment (C2), such as annual reminders, loyalty programs, and sales packages.

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[23] **Executive Decree No. 24-247**, dated October 14, 2024, defining the procedures for the exercise of budgetary control, *Op. cit.*, Article 14, p. 6.

[24] **Law No. 20-16**, dated December 31, 2020, containing the **Finance Law for 2021**, **Official Gazette No. 83**, December 31, 2020, Article 120, pp. 42–43.

[25] **Executive Decree No. 21-62**, dated February 8, 2021, defining the budgetary and accounting management procedures applicable to the budgets of Public Administrative Establishments and other public bodies receiving state budget allocations, **Official Gazette No. 11**, February 15, 2021, Article 9, indent 4, p.

[26] **Circular No. 02**, dated December 3, 2018 (sic), regarding the distribution of the incentive bonus to participants involved in the execution of works or services, including support staff, Ministry of Vocational Education and Training, Algeria.

[27] **Executive Decree No. 98-412**, dated December 7, 1998, defining the procedures for the allocation of revenues generated by services and works performed by public institutions beyond their core mission, *Op. cit.*, Article 3, Paragraph 2, p. 29.