International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

Customer Personality Analysis using Segmentation and Exploratory Data Analysis

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Submitted: 13/09/2023 **Revised**: 21/10/2023 **Accepted**: 05/11/2023

Abstract: Customer Personality Analysis using Segmentation and Exploratory Data Analysis is a comprehensive study that leverages data-driven techniques to gain insights into consumer behavior and preferences. In today's competitive business landscape, understanding customers at a granular level is paramount for personalized marketing and improved customer experiences. This research employs segmentation methodologies and exploratory data analysis (EDA) to categorize and analyze customers based on their characteristics, behavior, and preferences. By dissecting large datasets, this study uncovers hidden patterns, identifies customer segments, and offers actionable recommendations for businesses to tailor their products, services, and marketing strategies to meet the diverse needs and expectations of their customer base. The findings of this research empower organizations to make informed decisions, enhance customer satisfaction, and drive sustainable growth in an increasingly data-centric business environment.

Keywords: *Customer Personality Analysis, Segmentation, Exploratory Data Analysis*

1. Introduction

Customer personality analysis involves the application of segmentation techniques and exploratory data analysis to dissect and understand a company's customer base. Through segmentation, customers are grouped into distinct categories based on shared characteristics, such as demographics, behavior, or preferences [1-4]. Exploratory data analysis then delves deeper into these segments, uncovering valuable insights by visualizing, summarizing, and interpreting the data. This comprehensive approach empowers businesses to identify trends, preferences, and pain points among their customers, ultimately enabling more personalized marketing strategies, product offerings, and customer experiences, thereby fostering stronger customer relationships and driving growth[6-10].

1.1 Customer personality analysis

Customer personality analysis is the process of understanding and characterizing individual consumers' behavioral, psychological, and demographic traits to gain insights into their preferences, buying habits, and decision-making processes [11-16]. By leveraging data from various sources such as transaction history, online interactions, and surveys, businesses can create detailed customer profiles and segment their customer base [17,18]. This enables more personalized marketing strategies, product recommendations, and customer experiences, ultimately fostering stronger brand loyalty, higher customer satisfaction, and increased sales [19,20].

1.2 Customer personality analysis using segmentation

Segmentation is a method for analysing your client base and dividing it into smaller groups with similar features, behaviors, and preferences [21,22,23,24,25]. This segmentation helps businesses tailor their marketing strategies, product offerings, and customer interactions to better meet the needs of each group [26,27,28,29].

1.3 Exploratory Data Analysis (EDA)

Data scientists and analysts conduct EDA as a first phase in the data analysis process [30–33] by examining and summarising datasets to better understand their essential features and possible insights. EDA involves a range of techniques, such as data visualization, summary statistics, and data cleaning, to detect patterns, outliers, missing values, and relationships within the data. By

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visually exploring the data and generating initial hypotheses, EDA helps guide subsequent modeling and analysis, ensuring that data-driven decisions are well-informed and based on a solid understanding of the underlying data [34].

1.4 Customer Personality Analysis using Segmentation and Exploratory Data Analysis

Customer personality analysis using segmentation & EDA is a crucial process for businesses aiming to understand their customers better and make data-driven decisions. Here's a step-by-step guide on how to perform this analysis:

- **Data Collection and Preparation:** Gather relevant customer data, such as demographics, purchase history, website interactions, customer support interactions, and any other relevant information.
- **Exploratory Data Analysis (EDA):** Start by performing summary statistics to get an overview of your data.
- **Interpreting the Segments:** Give meaningful names to each customer segment based on their characteristics [35].
- **Validation and Refinement:** Validate your customer segments by measuring their effectiveness.

2. Literature Review

M. Alves Gomes et al. (2023) presented method of consumer segmentation for targeted marketing in online stores were discussed [1]. Y. Arisandy et al. (2023) introduced data analysis with machine learning as a delayed payment service for gen Z [2]. V. Shukla et al. (2023) analyzed customer data for e-commerce [3]. S. Garg et al. (2023) reviewed approximate data exploration using reinforcement learning [4]. P. Melki et al. (2022) presented pixel-level image segmentation and their potential use in proximal sensing [5]. S. Fedushko et al. (2022) considered cohort analysis for studying the buying habits of online shoppers [6]. R. Singh et al. (2021) provided smartphone users' data and classifier the market [7]. J. Ye et al. (2021) analyzed the online shopping return rate from a segmentation viewpoint [8]. A. Chauhan et al. (2021) presented machine learning for market segmentation [9]. M. Abukmeil et al. (2021) provided data analysis and representation learning using unsupervised generative models [10]. A. Chopra et al. (2021) introduced the factor that shape millennials' buy habits through influencer market [11]. J. C. Anestis et al. (2021) looked the consistency between the client's and the therapist's preferred styles of personality assessment and psychotherapy [12]. J. Leunissen et al. (2021) presented nostalgia's hedonistic side a systematic review and meta-analysis [13]. D. Jaiswal et al. (2021) focused on the consumer segmentation and profile in the green market using a cluster analysis [14]. A. Funk et al. (2021) explained market segmentation for the sustainable food industry based on consumers' declared environmental consciousness [15]. R. Singh et al. (2021) presented data mining and smartphone market segmentation through exploratory research [16]. A. Graser et al. (2021) explained a technique for exploratory data analysis to spot issues in continuous motion record [17]. N. Verbeeck et al. (2020) presented data analysis with unsupervised machine learning in imaging mass spectrometry [18]. C. S. Pitt et al. (2020) provided methods for categorized consumer based on their personality [19]. D. Potoglou et al. (2020) intoduced cross-national study of consumer attitudes towards electric and autonomous automobile [20].

3. Challenges

Customer Personality Analysis using Segmentation and Exploratory Data Analysis encounters several challenges. Firstly, obtaining high-quality, comprehensive, and up-to-date data from diverse sources can be problematic, affecting the accuracy of analysis. Secondly, selecting appropriate segmentation criteria and methods is crucial, as missteps can lead to ineffective segmentations. Thirdly, ensuring data privacy and complying with regulations while analyzing customer data presents legal and ethical dilemmas. Communicating complex findings effectively to non-technical stakeholders can also be challenging. Finally, the computational demands of analyzing large datasets pose scalability issues. Addressing these challenges is vital for businesses to harness the full potential of customer personality analysis for informed decision-making and personalized marketing strategies.

4. Proposed Work

Research Methodology for Customer Personality Analysis using Segmentation and Exploratory Data Analysis involves a structured approach to gather, analyze, and interpret data to gain insights into customer behavior and preferences.

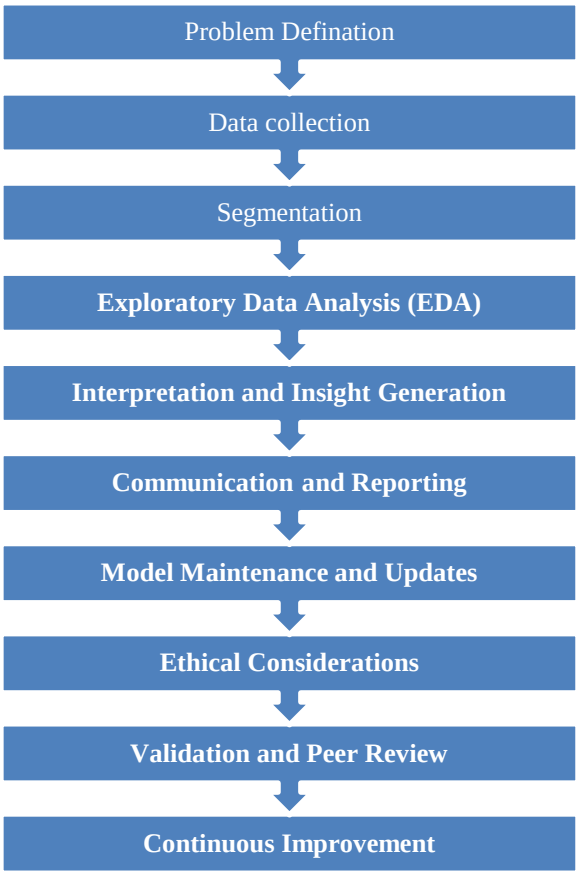

Fig 1. Process flow of Research

Here is a general outline of the research methodology for this purpose:

1. **Problem Definition:**
   - Define goals of the study precisely.
   - Use data segmentation and exploratory analysis to determine which research questions need to be addressed.
2. **Data Collection:**
   - Gather relevant data from various sources.
   - Ensure data quality by cleaning and preprocessing data to handle missing values, outliers, and inconsistencies.
3. **Segmentation:**
   - Choose appropriate segmentation variables.
   - Apply segmentation techniques like k-means clustering, hierarchical clustering, or latent class analysis to group customers into meaningful segments.
   - Validate the segmentation results to ensure that they align with the research objectives.
4. **Exploratory Data Analysis (EDA):**
   - Conduct EDA to gain insights into each customer segment..
5. **Interpretation and Insight Generation:**
   - Interpret the results of the EDA to draw meaningful conclusions about customer personality and behavior.
   - Identify key findings, trends, and patterns within each customer segment.
   - Explore relationships and correlations between different variables and segments.
6. **Communication and Reporting:**
   - Prepare clear and concise reports or presentations that convey the insights gained from the analysis.
   - Use visual aids to make complex findings more accessible to stakeholders.
   - Clearly articulate the implications of the analysis for decision-making and marketing strategies.
7. **Model Maintenance and Updates:**
   - Recognize that customer behavior is dynamic, and segmentation models may become outdated over time.
   - Establish a plan for regularly updating the models and reanalyzing customer data to keep the insights relevant.
8. **Ethical Considerations:**
   - Ensure compliance with data privacy regulations and ethical standards when handling customer data.
   - Anonymize and protect sensitive customer information.
9. **Validation and Peer Review:**
   - Validate the results and methodology through peer review or internal validation processes to ensure the robustness of the analysis.
10. **Continuous Improvement:**
    - Continuously seek feedback and evaluate the effectiveness of the analysis in meeting the research objectives.
    - Be open to refining the methodology and approaches based on lessons learned from previous analyses.

By following this research methodology, organizations can effectively leverage segmentation and exploratory data analysis to gain deeper insights into customer personalities, behaviors, and preferences, ultimately informing data-driven strategies and decision-making.

5. Result and Discussion

5.1 Dataset

Dataset of customer-credit-card-data has been obtained from kaggle. The source of dataset is https://www.kaggle.com/datasets/fhabibimoghaddam/customer-credit-card-data/. Details of attributed has been shown in table 1.

Table 1 Details of dataset

Id	Features	Description
1	Cust_Id:	Proof of cardholder's identity
2	Balance:	A sum of money available on a credit card or in an account for future purchases
3	Balance_Frequency:	How frequently the balance is updated, score between 0 and 1 (1 = frequently updated, 0 = not frequently updated)
4	Purchases:	The sum of all account expenditures
5	One_Off_Purchases:	The highest single-transaction spending limit
6	Installments_Purchases:	Total amount of installment payments made
7	Cash_Advance:	The User's Upfront Cash Contribution
8	Purchases_Frequency:	How frequently the Purchases are being made, score between 0 and 1 (1 = frequently purchased, 0 = not frequently purchased)
9	One_Off_Purchases_Frequency:	How frequently Purchases are happening in one-go (1 = frequently purchased, 0 = not frequently purchased)
10	Purchases_Installments_Frequency:	How frequently purchases in installments are being done (1 = frequently done, 0 = not frequently done)
11	Cash_Advance_Frequency:	How frequently the cash in advance being paid
12	Cash_Advance_Trx:	Cash-in-advance transactions as a percentage of total.
13	Purchases_Trx:	The quantity of shopped-for items
14	Credit_Limit:	User Credit Card Limits
15	Payments:	The sum of all purchases made by the user.
16	Minimum_Payments:	User's bare minimum payment amount
17	Prc_Full_Payment:	User's Contribution as a Percentage of Total Cost
18	Tenure:	Credit Card Activation Term

5.2 Simulation

In order to perform simulation following python script is executed on co laboratory for visualization of clusters that are generated considering customer dataset for customer personality analysis.

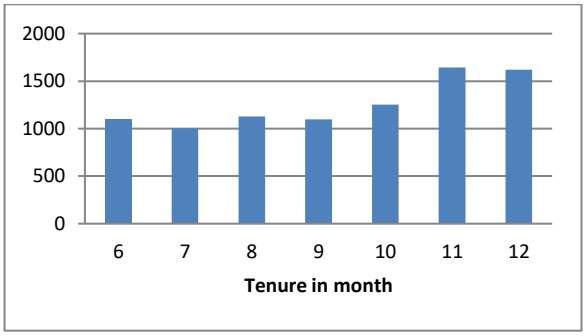

Fig 2 Customer personality analysis on the bases of balance considering tenure as cluster

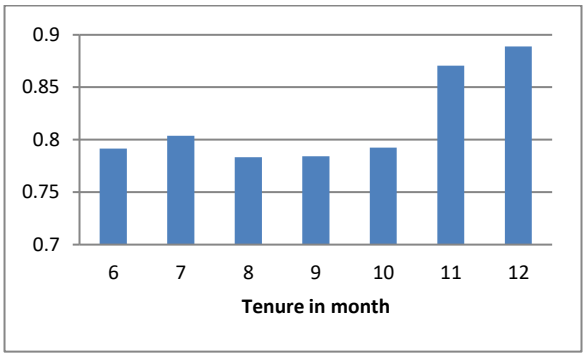

Fig 3 Customer personality analysis on the bases of balance frequency considering tenure as cluster

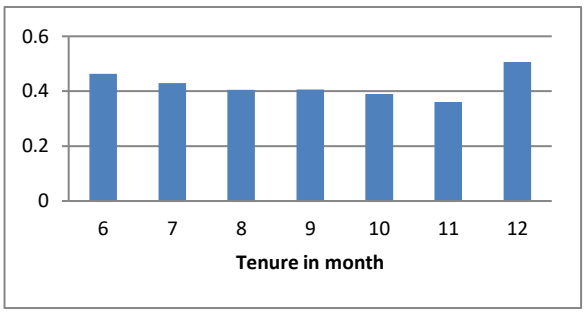

Fig 4 Customer personality analysis on the bases of Purchase frequency considering tenure as cluster

6. Conclusion

The balance and purchase frequency of customers can have a significant impact on customer personality analysis and segmentation. These two factors provide valuable insights into customer behavior, preferences, and engagement with a business. Here's how they can influence the analysis:

1. Balance:

- **Financial Health Assessment:** A customer's account balance or financial status can indicate their overall financial health.
- **Spending Capacity:** High balance customers may have a greater capacity for spending, making them attractive for high-end product recommendations or premium services.
- **Loyalty and Retention:** Customers with consistently high balances may indicate loyalty to a business, while fluctuations in balance could signal potential churn or attrition.
- **Risk Assessment:** In financial and banking contexts, balance can be used to assess credit risk.

2. Purchase Frequency:

Engagement and Loyalty: Frequent purchasers are often considered more engaged and loyal customers.

Segmentation: Purchase frequency is a key criterion for segmenting customers.

Churn Prediction: A sudden decrease in purchase frequency can be a warning sign of potential churn.

Upselling and Cross-Selling: Understanding purchase frequency can help in identifying opportunities for upselling or cross-selling complementary products or services to existing customers.

Feedback and Satisfaction: Frequent purchasers may be more invested in the business, making their feedback and satisfaction levels critical.

Seasonal Trends: Analyzing purchase frequency over time can reveal seasonal trends and peak buying periods, which can inform inventory management and marketing strategies.

In customer personality analysis and segmentation, both balance and purchase frequency are often used as key features or attributes. These features, when considered alongside other customer characteristics, can lead to more robust and nuanced customer segments. For example, combining high balance and high purchase frequency might define a segment of affluent, loyal customers, while low balance and low purchase frequency might represent a different segment. The impact of balance and purchase frequency in customer personality analysis is substantial, as they can help businesses tailor their strategies to meet the unique needs and preferences of different customer groups.

7. Future Scope

Segmentation and exploratory data analysis, when applied to the study of customers' identities, provide enormous potential for future development. With the advent of advanced data analytics techniques, machine learning, and artificial intelligence, the granularity and accuracy of customer segmentation will substantially improve.

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