Customer Segmentation & Spending Analysis

1. Introduction

This report delivers an in-depth analysis of customer purchasing behavior and segmentation strategies for XYZ Retail, based on anonymized transaction data collected between January 2024 and February 2025. The objective is to generate actionable insights that enhance targeted marketing, optimize customer experience, and ultimately boost revenue growth.

2. Product and Spending Highlights

A. Top Selling Products and Categories

- **Top 5 Products:** Calming Serums, Soothing Creams, Lip Scrub, Micellar Water, Cream Moisturizer
- **Top 3 Categories:** Moisturizers, Cleansers, Lip Care

These findings underscore the popularity of skincare and lip care products. Strategic promotions such as bundling or loyalty incentives for these bestsellers could further enhance sales.

B. Spending Statistics

- **Minimum Transaction:** $20
- **MaximumTransaction:** $200
- **Average Transaction:** $90.73
- **Average Spend per Customer per Transaction:** See: Data/result/Average_spending_per_customer_per_transaction.csv

The data reflects a mid-tier purchasing behavior with opportunities for upselling and cross-selling to higher spending tiers.

3. Customer Segmentation Analysis

A. Rule-Based Segmentation: Understanding Behavioral Personas

This segmentation relies on predefined rules based on behavioral attributes such as spending habits, frequency, and recency. These personas help marketers align outreach strategies with customer behaviors.

Segmentation Type	Segments	Purpose & Business Benefit
Total Spending	Low, Medium, High Spenders	Target budget deals vs. VIP perks
Average Spend per Order	Budget Buyer, Value Shopper, Big Buyer	Personalized product recommendations
Transaction Frequency	One-time, Occasional, Frequent Buyers	Re-engagement and loyalty targeting
Recency (RFM)	Active, At-risk, Lapsed	Timely campaigns to reduce churn
Purchase Pattern	New, Returning, Loyal Customers	Onboarding & retention strategies
Seasonal Behavior	Holiday, Regular, Off-season Buyers	Seasonal promotion planning
Basket Value	Low, Moderate, High Basket Buyer	Upselling and bundling strategies
Items per Transaction	Selective, Mixed, Bulk Buyer	Bundle optimization and messaging

Detailed segment assignments are available at:

- Customer_Segmentation_based_on_Purchase_Behavior.csv
- Customer_Segmentation_based_on_Purchase_Pattern.csv
- Customer_Segmentation_based_on_Basket_Composition.csv

B. K-Means Clustering: Data-Driven Grouping

To enhance segmentation precision, we implemented K-means clustering—an unsupervised machine learning algorithm that groups customers based on similarities in behavior.

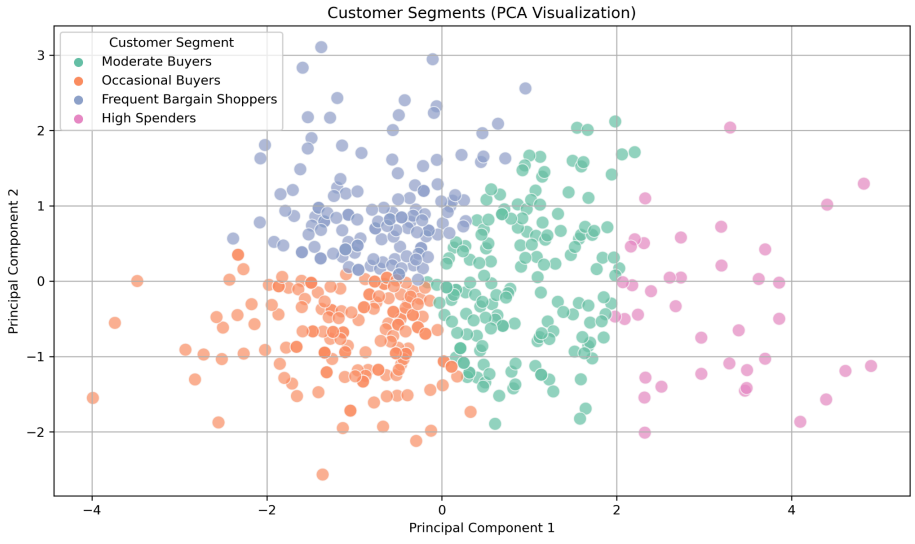
Methodology:

- **Features Used:** Total Spend, Average Spend per Transaction, Purchase Count
- **Dimensionality Reduction:** Principal Component Analysis (PCA) for visual clarity
- **Optimal Cluster Count:** Determined using the Elbow Method, k=4

Clustering Summary:

Cluster	Label	Total Spend	Avg Spend	Purchase Count
3	High Spenders	$1616.54	$26.33	61.59
1	Moderate Buyers	$1116.99	$26.06	42.94
2	Frequent Bargain Shoppers	$723.07	$27.14	26.65
0	Occasional Buyers	$679.97	$23.90	28.45

Clustering Visualization:



Detailed segment assignments are available at:
Data/result/Customer_Segmentation_based_on_K-means_Clustering.csv

C. Rationale for Segmentation Techniques

Rule-Based Segmentation:

- **Advantages:** Straightforward, explainable, and aligned with business rules
- **Use Case:** Ideal for targeting defined behaviors (e.g., lapsed customers)

K-means Clustering:

- **Advantages:** Reveals latent patterns and naturally occurring groups
- **Use Case:** Valuable where customer behavior is nuanced or dynamic

PCA for Visualization:

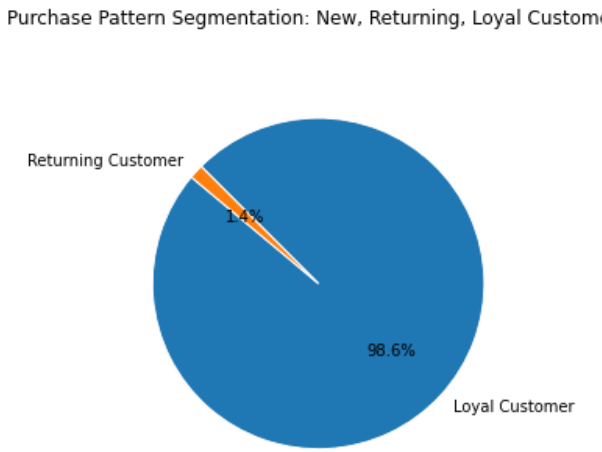
- **Advantages:** Simplifies multi-dimensional data to 2D for interpretation
- **Use Case:** Enables stakeholders to grasp clustering structure visually

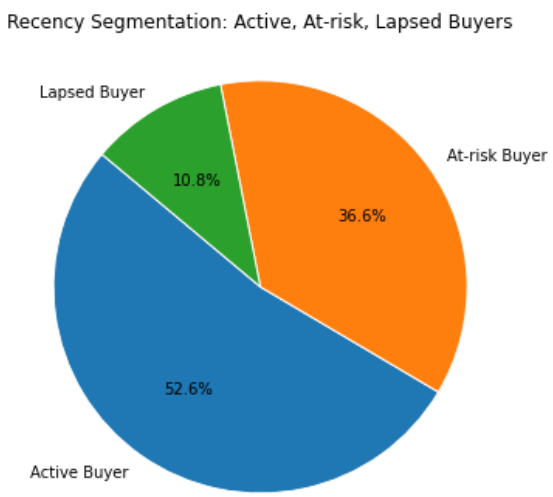
D. Visualizing Customer Segments

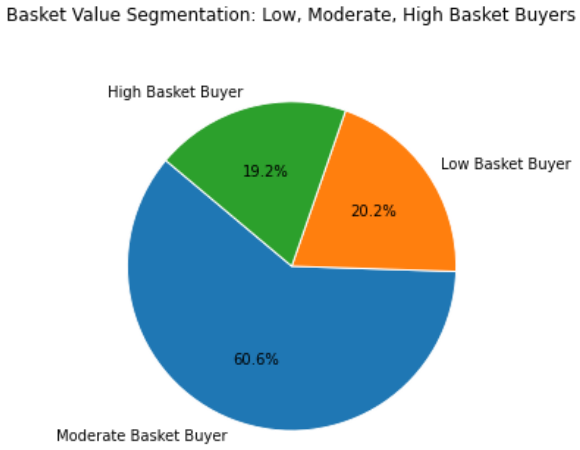
Pie charts were used to represent the proportional distribution of customers across various segmentation dimensions:

- **Recency (RFM):** Active, At-risk, Lapsed
- **Purchase Pattern:** New, Returning, Loyal Customers
- **Seasonal Behavior:** Holiday, Regular, Off-season Shoppers
- **Basket Value:** Low, Moderate, High Basket Buyers

These visualizations provide intuitive summaries that inform strategic marketing decisions.







E. Strategic Recommendations

- **Personalized Marketing:** Align outreach with behavioral segments (e.g., lapsed users, VIP bundles).
- **Loyalty Programs:** Encourage repeat purchases from loyal and frequent buyers.
- **Seasonal Promotions:** Strategically time campaigns to Holiday or Off-season segments.
- **Upselling Tactics:** Target Moderate Basket Buyers with value-added offers.
- **Churn Mitigation:** Proactively engage At-risk or Occasional Buyers.

4. Product Recommendation Strategy

To enhance the shopping experience and drive cross-selling opportunities, we implemented two complementary product recommendation techniques:

- Collaborative Filtering – leveraging customer similarity
- Association Rule Mining – identifying co-purchase patterns

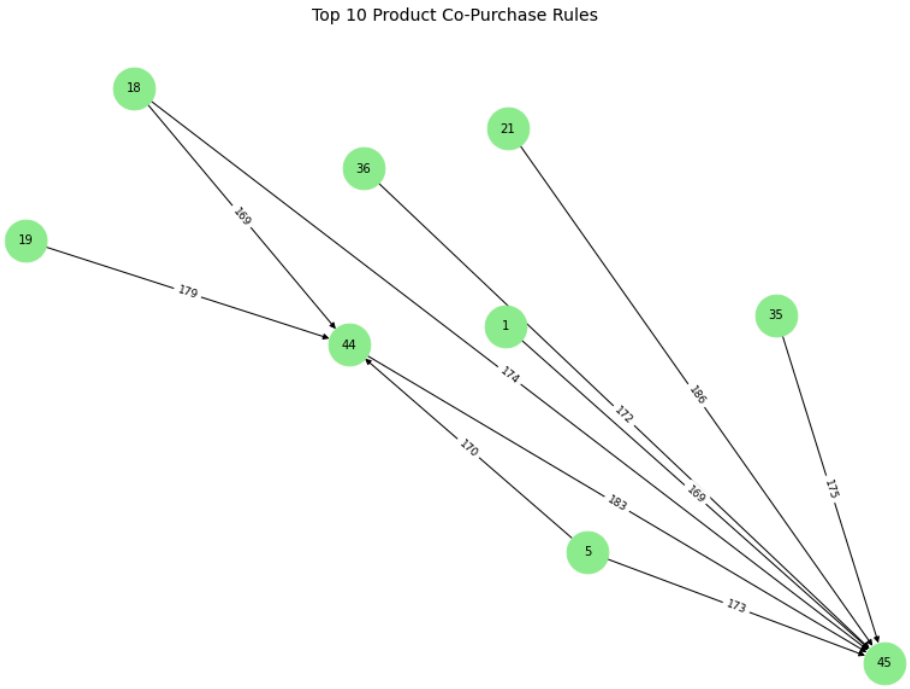
These methods provide data-driven recommendations tailored to customer behavior and preferences.

A. Association Rule Mining (Market Basket Analysis)

Technique: Association Rule Mining (using the Apriori algorithm) is applied to transactional purchase data to find frequently co-purchased items. Eg: "Customers who bought Product A also often bought Product B."

Use Case: This is useful for identifying bundle opportunities, placement strategies, and upsell suggestions.

Visualization: Below figure illustrates the Top 10 co-purchase rules, where nodes represent products and arrows show the direction of association (i.e., from antecedent to consequent).



Product Recommendation: Product_Recommendation-Market_Basket_Analysis.csv

Product Recommendation Example:

- Customer ID: 1
- Purchase History: 18 skincare products including:
  - **Cleansers:** Gel Cleansers, Oil Cleanser, Micellar Water, Foam Cleanser, Cleansing Balm
  - **Lip Care:** Lip Balm, Lip Scrub, Lip Mask
  - **Moisturizers:** Gel, Cream, Oil-Based, Water-Based, Night Cream
  - **Acne/Pore Care:** Pimple Patches, Acne Spot Treatment, Scar Treatment Cream
  - **Others:** Post-Sun Care, Healing Ointments

Top 5 Recommended Products:

Product	Reason for Recommendation	Score
Soothing Creams	Frequently bought with moisturizers	18
Calming Serums	Often co-purchased with acne treatments	17
Eye Cream	Common with night creams & moisturizers	13
Eye Gel	Bought with eye cream & hydration routines	13
Under-Eye Patches	Associated with post-sun care & eye products	13

Logic:

- Co-occurrence scores represent how frequently the recommended product appears with the customer's past purchases.
- Already purchased products are excluded.
- Recommendations are sorted by relevance.

B. Collaborative Filtering (User-Based)

Technique: Collaborative Filtering uses cosine similarity to compare users based on their product interaction patterns. Products are recommended based on what similar users have purchased but the current user hasn't.

Use Case: Ideal for personalized product discovery based on peer behavior.

Product Recommendation: Product_Recommendation-Collaborative_Filtering.csv

Product Recommendation Example:

- Customer ID: 238
- Purchase History: 18 skincare products including:
  - **Cleansers:** Gel, Micellar Water, Cleansing Balm
  - **Lip Care:** Lip Balm, Lip Scrub, Lip Mask
  - **Moisturizers:** Gel, Night Cream, Cream, Oil-Based, Water-Based
  - **Acne/Pore Care:** Pore Minimizing Serum, Pore Strips
  - **Others:** Calming Serums, Eye Cream, Eye Gel, Soothing Creams, Under-Eye Patches

Top 5 Most Similar Customers:

Customer ID	Similarity Score
359	0.894
252	0.846
204	0.846
304	0.838
320	0.831

Top 5 Recommended Products:

Product	Reason for Recommendation	Score
Soothing Creams	Common among users with moisturizing preferences	6
Oil Cleanser	Frequently purchased by similar customers	5
Foam Cleanser	Part of typical cleansing routines	4
Pimple Patches	Popular among acne-care focused users	4
Acne Spot Treatment	Consistently bought by users with similar behavior	4

Logic:

- Recommendations come from the top 5 most similar users.
- Products already bought by the target user are removed.
- Scores reflect how many similar users purchased the product.

5. Limitations and Considerations

- **Cold Start for New Products:** Recommend based on category or related behavior.
- **New Customers:** EInitially use top-selling or category-leaders until enough data is gathered.

6. Business Value

- Enhances personalization and user experience
- Increases conversion and basket size through smarter suggestions
- Promotes cross-sell and upsell through learned associations
- Assists with onboarding and retention of new or at-risk customers