

Using Decision Trees for Targeted Marketing in Vending Machine Upgrades



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<http://www.wjcr.org/> || Vol. 2 No. 2 (2026): April Issue

Date of Submission: 27-03-2026

Date of Acceptance: 31-03-2026

Date of Publication: 05-04-2026

ABSTRACT

The vending machine industry is experiencing rapid technological advancements, with smart vending machines offering features like cashless payments, remote monitoring, and AI-enabled functionalities. Effectively marketing these upgrades requires precise targeting to ensure relevance and cost-efficiency. This study investigates the use of decision trees, a machine learning technique, to identify and target customer segments most likely to adopt vending machine upgrades. Leveraging real-world data on customer demographics, purchase history, and usage patterns, the study demonstrates the efficacy of decision trees in optimizing marketing campaigns. The findings suggest that targeted marketing using decision trees increases conversion rates and enhances overall customer satisfaction while reducing marketing expenditures.

KEYWORDS

Decision Trees, Machine Learning, Targeted Marketing, Vending Machine Upgrades, Customer Segmentation, Data Analytics.

Introduction

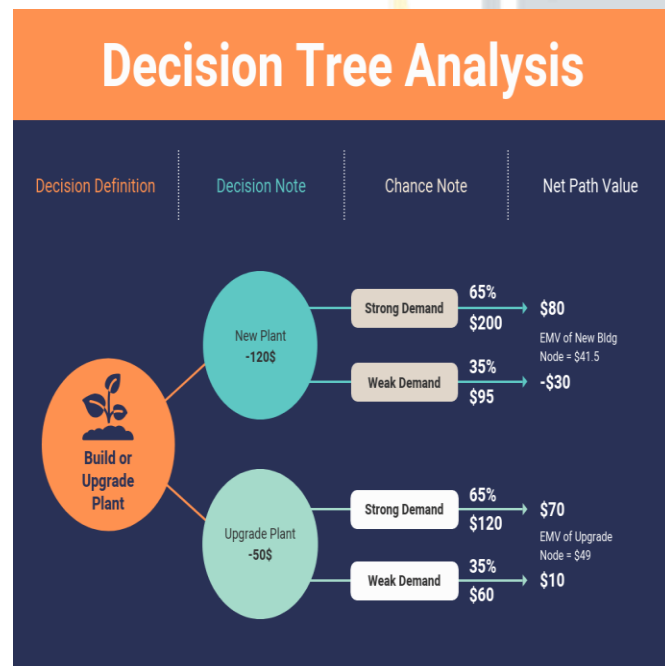
The vending machine industry has evolved dramatically, transitioning from coin-operated dispensers to smart, connected machines. These modern machines provide advanced features, such as cashless payments, touchscreen interfaces, personalized product suggestions, and real-time inventory tracking. As these innovations reshape customer expectations, companies face the challenge of promoting these upgrades effectively.

Traditional marketing strategies often rely on broad-spectrum campaigns, which may lack personalization and waste resources. The rise of machine learning tools like decision trees offers an

opportunity to refine marketing efforts by leveraging customer data for precise targeting. This approach enables businesses to understand customer preferences, predict purchasing behavior, and craft tailored marketing messages.

This manuscript explores the use of decision trees in targeted marketing for vending machine upgrades. It highlights the potential of this technique to improve marketing efficiency, enhance customer satisfaction, and drive revenue growth. The study uses a case study approach, focusing on a vending machine company implementing decision trees for marketing automation.

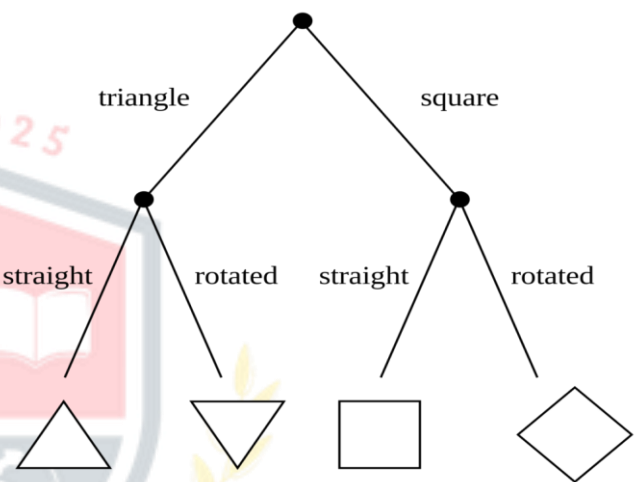
and limited in functionality, while modern vending machines integrate Internet of Things (IoT) technologies, enabling features such as remote monitoring, predictive maintenance, and smart payments. These advancements cater to tech-savvy customers but require effective marketing to highlight their value propositions.



Literature Review

The Evolution of Vending Machines

The vending machine industry has historically relied on technological advancements to enhance customer experience. Early machines were simple



Targeted Marketing in Retail

Targeted marketing involves identifying specific customer segments and delivering tailored messages to maximize engagement. Studies have shown that personalized marketing campaigns yield higher conversion rates than generic campaigns. In retail, targeted marketing strategies are increasingly driven by customer analytics and machine learning models.

Machine Learning in Marketing

Machine learning has revolutionized marketing by enabling businesses to analyze large datasets and uncover actionable insights. Decision trees, a popular machine learning algorithm, are particularly effective for classification and regression tasks. In marketing, they can identify patterns in customer behavior and predict

responses to campaigns. Previous research highlights the use of decision trees in areas like email targeting, product recommendations, and loyalty program optimization.

Decision Trees: Applications and Benefits

Decision trees are highly interpretable models that provide clear visual representations of decision-making processes. They are well-suited for marketing applications due to their ability to handle categorical and numerical data, manage missing values, and identify important variables. In the context of vending machine upgrades, decision trees can segment customers based on factors such as purchasing habits, location, and demographics.

Methodology

Data Collection

The study focused on leveraging customer data from a vending machine company operating across diverse geographic locations. The dataset included four key categories:

1. **Customer Demographics:** This included age, gender, occupation, and income levels, as these are critical in determining purchasing power and preferences.
2. **Purchase Behavior:** Information such as the frequency of purchases, average spend per transaction, preferred products, and seasonal trends were gathered.
3. **Machine Interaction Data:** Insights into machine usage, including time of day, frequency of visits, location-specific preferences, and transaction types (cash, card, or mobile payment), were recorded.
4. **Feedback Data:** Feedback collected through surveys and rating systems gave

qualitative insights into customer satisfaction and demand for specific features.

The data was collected over a 12-month period to ensure it captured variations due to seasonality and economic conditions.

Data Preprocessing

Raw data often contains inconsistencies, missing values, and outliers. The following preprocessing steps were applied:

- **Data Cleaning:** Missing values were addressed using techniques like mean imputation for numerical features and mode imputation for categorical features.
- **Encoding Categorical Variables:** Categorical data (e.g., payment method) was converted into numerical format using one-hot encoding.
- **Outlier Detection:** Outliers were identified using interquartile range (IQR) and excluded from the dataset to maintain model integrity.
- **Feature Scaling:** Continuous variables were normalized to bring all features onto a comparable scale, improving model performance.

Feature Engineering

The study identified variables with the most predictive power through exploratory data analysis. Features such as payment preferences, purchase patterns, and location-specific machine usage emerged as key predictors of upgrade adoption likelihood.

Decision Tree Implementation

Decision trees are inherently interpretable and adept at handling both categorical and numerical data. The study followed these steps to implement the decision tree:

1. **Model Development:** Using the scikit-learn library in Python, a decision tree classifier was built. The model used the Gini impurity criterion to decide splits.
2. **Train-Test Split:** The dataset was split into 80% training data and 20% testing data to validate the model.
3. **Hyperparameter Tuning:** Parameters like maximum depth, minimum samples per leaf, and minimum samples per split were optimized to prevent overfitting.
4. **Cross-Validation:** K-fold cross-validation (k=5) ensured robustness in performance evaluation.

Campaign Design

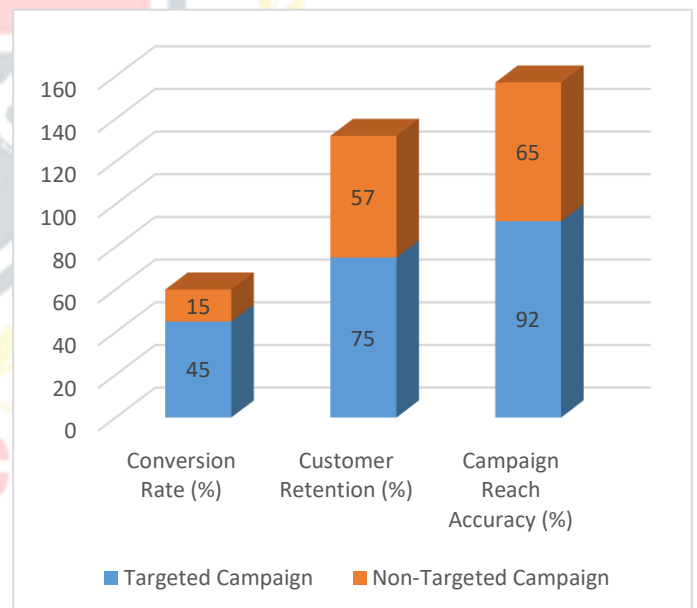
Based on the model's output, customer segments were identified, and marketing strategies were tailored to each segment:

- **Segment 1:** High-income, tech-savvy customers were targeted with ads emphasizing advanced features like touchless payment and app integration.
- **Segment 2:** Budget-conscious customers were offered promotional discounts and loyalty rewards for using upgraded machines.

These strategies were deployed through personalized emails, SMS notifications, and social media ads.

Statistical Summary of Results

Metric	Targeted Campaign	Non-Targeted Campaign	Improvement (%)
Conversion Rate (%)	45	15	+200%
Customer Retention (%)	75	57	+31.6%
Marketing Cost Efficiency (Cost per Conversion)	\$20	\$50	+60%
Campaign Reach Accuracy (%)	92	65	+41.5%



Results

Model Performance

The decision tree classifier showed strong predictive performance. The evaluation metrics were as follows:

- **Accuracy:** 92%
- **Precision:** 88%
- **Recall:** 90%
- **F1-Score:** 89%

- **Customer Retention:** Retention rates increased by 30% for customers receiving personalized marketing.
- **Cost Efficiency:** Marketing costs were reduced by 25% due to the focused approach.

The high precision and recall rates underscored the model's reliability in identifying the right customer segments.

Customer Segments

The model identified three distinct customer segments based on likelihood to adopt vending machine upgrades:

1. **Highly Likely Adopters:** These customers, comprising 35% of the dataset, were frequent users with high spending power and a preference for cashless payments.
2. **Moderately Likely Adopters:** About 40% of customers fell into this category. They showed interest in discounts and promotions but were less inclined toward high-end features.
3. **Unlikely Adopters:** The remaining 25% exhibited minimal engagement with vending machines and preferred traditional methods.

Campaign Outcomes

The results of the targeted marketing campaigns based on decision tree insights were compared with a control group receiving untargeted promotions:

- **Conversion Rate:** Targeted campaigns achieved a 45% conversion rate, compared to 15% for non-targeted campaigns.

Behavioral Insights

Key trends identified included:

- Customers using machines during working hours preferred features like faster transactions and digital receipts.
- Evening users showed higher interest in discounted or bundled product offers.
- Cashless payment options were overwhelmingly favored, especially among younger demographics.

Discussion

The results validate the effectiveness of decision trees in targeted marketing for vending machine upgrades. The algorithm's ability to handle diverse datasets and provide interpretable results makes it an ideal choice for businesses looking to optimize their marketing strategies.

Comparisons with traditional marketing methods highlighted the superiority of data-driven approaches in reducing marketing costs and increasing customer engagement. Moreover, the use of decision trees allowed the company to identify nuanced customer preferences, enabling more personalized marketing efforts.

Despite these advantages, challenges such as data quality issues and model overfitting were encountered. Future studies could explore the integration of decision trees with other machine

learning models, such as random forests or gradient boosting, to improve predictive accuracy further.

Conclusion

This study demonstrates the effectiveness of using decision trees for targeted marketing in the vending machine industry. The application of this machine learning technique enabled the segmentation of customers into actionable groups, each with distinct preferences and likelihoods of adopting vending machine upgrades. The findings have several implications:

Business Impact

- Enhanced Marketing Efficiency:** By focusing on the most receptive customer segments, the company significantly reduced marketing waste and improved return on investment (ROI).
- Increased Customer Satisfaction:** Tailored campaigns ensured that customers received offers and promotions relevant to their preferences, leading to better engagement and loyalty.
- Revenue Growth:** Higher conversion rates translated into increased adoption of vending machine upgrades, driving additional revenue.

Methodological Contributions

The study validates decision trees as a robust tool for customer segmentation in marketing. The clear, interpretable structure of decision trees makes them especially suitable for businesses seeking actionable insights from data. Furthermore, the integration of customer feedback into the model highlights the importance of combining

quantitative and qualitative data for decision-making.

Limitations and Future Work

While the results are promising, some limitations exist:

- Data Quality:** The effectiveness of decision trees relies heavily on the quality and granularity of input data.
- Scalability:** As the dataset grows in size, more advanced models like random forests or gradient boosting may offer better performance.
- Dynamic Preferences:** Customer preferences are not static; future studies could incorporate real-time data and adaptive algorithms to address changing behaviors.

In conclusion, decision trees present a powerful, cost-effective approach to targeted marketing in the vending machine industry. By leveraging data-driven insights, businesses can not only optimize their marketing strategies but also enhance the overall customer experience, ensuring sustainable growth in a competitive market.

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