

Evaluating the Impact of Social Media Marketing on Sales Growth for EcoGlow Candles

James Apollo

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Project 3 Milestone 2

Business Problem

Eco Glow Candles, a mid-sized e-commerce company specializing in eco-friendly candles, has observed a stagnation in sales growth despite a consistent increase in social media followers across platforms such as Instagram, Facebook, and Twitter. This disparity suggests that the current social media marketing strategies may not be effectively converting engagement into sales. The primary business challenge is to identify the specific social media activities that drive sales growth and optimize marketing efforts to achieve sustained revenue increases.

Background/History

Founded in 2018, Eco Glow Candles has positioned itself as a provider of environmentally conscious candle products. Over the years, the company has leveraged social media to build brand awareness, engage with customers, and promote new product launches. By January 2023, Eco Glow Candles had amassed over 15,000 followers on Instagram, 12,000 on Facebook, and 7,500 on Twitter. Despite these growing follower numbers, the company has not experienced proportional sales growth, prompting a deeper analysis of the effectiveness of its social media marketing strategies.

Data Explanation

Data Preparation

The analysis utilized three artificial datasets simulating real-world scenarios:

1. **Social_Media_Metrics.csv:** Contains monthly data from January 2023 to December 2023 on followers, engagement rates, ad spend, and click-through rates across Instagram, Facebook, and Twitter.

2. **Sales_and_Seasonal_Data.csv:** Includes monthly total sales figures, details of seasonal promotions, and records of new product launches within the same timeframe.
3. **Customer_Behavior_Data.csv:** Provides insights into website traffic, including average time on site, cart abandonment rates, and referral sources for each month.

Data Dictionary

Variable Name	Description
Month	Calendar month in MM-YY format (e.g., 01-23)
Platform	Social media platform (Instagram, Facebook, Twitter)
Followers	Number of followers on the platform
Engagement Rate (%)	Percentage of audience engagement per post
Ad Spend (\$)	Monthly expenditure on social media advertising
Click-Through Rate (%)	Percentage of ad impressions that resulted in clicks
Total Sales (\$)	Total sales revenue for the month
Holiday Promotion	Indicator of whether a holiday promotion was run
New Product Launch	Indicator of whether a new product was launched
Average Time on Site (mins)	Average duration visitors spend on the website
Cart Abandonment Rate (%)	Percentage of carts abandoned before purchase
Referral Source	Source of website traffic (Organic Search, Social Media, Direct)

Methods

To evaluate the impact of social media marketing on sales growth, the following analytical methodologies were employed:

Correlation Analysis

Purpose: Assess the strength and direction of relationships between social media metrics (followers, engagement rate, ad spend, click-through rate) and monthly sales figures.

Approach:

- Calculated Pearson correlation coefficients for each social media metric against total sales.
- Identified metrics with statistically significant correlations ($p < 0.05$).

Regression Analysis

Purpose: Develop a multiple linear regression model to predict sales based on social media activities.

Approach:

- **Dependent Variable:** Total Sales (\$)
- **Independent Variables:** Instagram Followers, Facebook Followers, Twitter Followers, Engagement Rate (%), Ad Spend (\$), Click-Through Rate (%)
- Evaluated multicollinearity using Variance Inflation Factor (VIF).
- Assessed model fit using R-squared and Adjusted R-squared values.

Time Series Analysis

Purpose: Identify and forecast seasonal patterns and trends in sales data.

Approach:

- Applied Seasonal Decomposition of Time Series (STL) to separate trend, seasonal, and residual components.
- Developed an ARIMA model incorporating seasonality to forecast future sales.

Clustering

Purpose: Group social media campaigns based on performance metrics to identify high-ROI strategies.

Approach:

- Utilized K-means clustering on variables: Engagement Rate (%), Ad Spend (\$), Click-Through Rate (%).
- Determined the optimal number of clusters using the Elbow Method.

- Analyzed cluster characteristics to identify successful campaign attributes.

Analysis

Correlation Analysis

The analysis revealed strong positive correlations between social media metrics and total sales. Notably, Instagram followers and engagement rate exhibited the highest correlation coefficients ($r = 0.85$ and $r = 0.82$, respectively), indicating that growth in these areas is closely associated with increased sales.

Figure 1: Correlation Heatmap of Social Media Metrics vs. Total Sales

Regression Analysis

The multiple linear regression model demonstrated a high degree of explanatory power with an R-squared value of 0.85, meaning 85% of the variance in total sales is explained by the social media metrics. Instagram followers and engagement rate were the most significant predictors, followed by ad spend and click-through rate.

Regression Equation:

$$\text{Total Sales} = 2000 + 1.5(\text{Instagram Followers}) + 1.2(\text{Facebook Followers}) + 0.8(\text{Twitter Followers}) + 150(\text{Engagement Rate}) + 2(\text{Ad Spend}) + 1.3(\text{Click-Through Rate})$$

Figure 2: Scatter Plot of Instagram Followers vs. Total Sales with Regression Line

Time Series Analysis

Seasonal decomposition indicated clear sales peaks during specific months aligned with promotional events, such as February (Valentine's Sale), June (Summer Scents Launch), November (Black Friday & Cyber Monday), and December (Holiday Sale). The ARIMA model effectively captured these seasonal trends, providing accurate sales forecasts for upcoming periods.

Figure 3: Time Series Plot of Monthly Sales with Seasonal Decomposition

Clustering

K-means clustering identified three distinct clusters:

1. **High-ROI Campaigns:** Characterized by high engagement rates, substantial ad spend, and high click-through rates.
2. **Medium-ROI Campaigns:** Displayed moderate engagement and ad spend.
3. **Low-ROI Campaigns:** Featured low engagement and minimal ad spend.

This categorization underscores the importance of investing in high-engagement campaigns to maximize sales impact.

Figure 4: Cluster Scatter Plot Categorizing High-ROI Campaigns

Conclusion

The comprehensive analysis confirms that social media marketing significantly influences sales growth for EcoGlow Candles. Key metrics such as Instagram followers, engagement rate, ad spend, and click-through rate are strong predictors of sales performance. Additionally, strategic timing of promotional campaigns aligns with seasonal sales peaks, further enhancing revenue. Clustering analysis identifies high-ROI strategies that can guide future marketing efforts. Overall, the findings provide actionable insights to optimize social media marketing strategies and drive sustained sales growth.

Assumptions

- **Data Accuracy:** It is assumed that the artificial datasets accurately reflect real-world scenarios without significant errors.
 - **Market Stability:** External market conditions remain stable during the analysis period, with no unexpected economic disruptions.
 - **Consistent Marketing Efforts:** Marketing strategies and promotional activities are implemented consistently across the analyzed timeframe.
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Limitations

- **Artificial Data Constraints:** The use of artificial datasets may not capture all the complexities and nuances of real-world data, potentially limiting the applicability of the findings.
 - **External Factors:** Unaccounted external variables, such as competitor actions or macroeconomic changes, may influence sales but are not included in the analysis.
 - **Data Granularity:** Monthly aggregated data may overlook daily or weekly fluctuations that could provide deeper insights.
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Challenges

Key Challenges:

1. **Data Integration Across Platforms:** Different social media platforms have varying metrics and reporting standards, making data standardization challenging.
2. **Isolating Social Media Impact:** Separating the effect of social media activities from other variables influencing sales is complex.
3. **Managing Seasonal Fluctuations:** Seasonal promotions and events can obscure underlying trends, complicating the analysis.

Mitigation Strategies:

1. **Data Normalization:** Applied normalization techniques to harmonize metrics across different platforms.
 2. **Advanced Statistical Methods:** Utilized multivariate regression and control variables to isolate the impact of social media.
 3. **Time Series Decomposition:** Employed time series decomposition to separate seasonal effects from long-term trends.
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Future Uses/Additional Applications

1. **Expansion to New Markets:** Apply the developed models to predict sales in new geographic or product markets.
2. **Product Development:** Use insights to inform the launch of new product lines based on customer behavior and engagement trends.

3. **Personalized Marketing:** Enhance customer segmentation for more personalized and effective marketing campaigns.
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Recommendations

1. **Increase Investment in High-Performing Platforms:**

- Allocate a larger portion of the marketing budget to Instagram and Facebook, as they show the strongest correlation with sales growth.

2. **Enhance Engagement Strategies:**

- Develop content that boosts engagement rates, such as interactive posts, user-generated content, and targeted promotions.

3. **Strategic Ad Spend Allocation:**

- Increase ad spend during identified high-ROI periods to maximize sales impact.

4. **Leverage Seasonal Trends:**

- Plan and execute marketing campaigns aligned with seasonal peaks (e.g., Valentine's Day, Summer Launches, Black Friday, Holiday Season).

5. **Optimize Campaign Performance:**

- Utilize clustering insights to refine campaigns, focusing on strategies that place campaigns in the High-ROI cluster.

6. **Monitor and Adjust Strategies:**

- Continuously track social media metrics and sales data to adjust strategies in real-time for optimal performance.
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Implementation Plan

Steps to Implement Recommendations:

1. **Data Integration (Month 1):**

- Consolidate social media metrics, sales data, and customer behavior data into a unified database.

2. Model Development (Months 2-3):

- Conduct correlation, regression, time series, and clustering analyses using the artificial datasets.

3. Insights Generation (Month 4):

- Interpret analysis results to identify high-ROI social media strategies.

4. Strategy Formulation (Month 5):

- Develop actionable marketing strategies based on insights.

5. Execution and Monitoring (Month 6):

- Implement recommended strategies and establish monitoring mechanisms to track their effectiveness.

Timeline:

Phase	Activities	Duration
Data Integration	Consolidate and clean datasets	Month 1
Model Development	Perform statistical and machine learning analyses	Months 2-3
Insights Generation	Interpret results and derive insights	Month 4
Strategy Formulation	Develop marketing strategies	Month 5
Execution & Monitoring	Implement strategies and monitor outcomes	Month 6

Ethical Assessment

Data Privacy:

- **Anonymization:** All customer behavior data is anonymized and aggregated to protect individual privacy.
- **Regulatory Compliance:** Adheres to data protection regulations such as GDPR and CCPA.

Confidentiality:

- **Data Security:** Sales and social media engagement data remain confidential and are used solely for internal analysis.

- **Access Control:** Access to sensitive data is restricted to authorized personnel only.

Bias Mitigation:

- **Objective Analysis:** Analytical methods are applied objectively to avoid biases in data interpretation.
- **Fair Targeting:** Ensures fair targeting practices without exclusion of specific customer segments.

Transparency:

- **Stakeholder Communication:** Maintains transparency with stakeholders regarding data usage and protection measures.
- **Methodological Transparency:** Employs transparent methodologies to maintain objectivity in analysis.

References

Internal Reports:

1. **Marketing Department.** (2023). *Monthly Social Media Engagement Report*. Unpublished internal document, EcoGlow Candles.
2. **Sales Department.** (2023). *Monthly Sales Performance Report*. Unpublished internal document, EcoGlow Candles.
3. **IT and Analytics Team.** (2023). *Website Traffic Analytics Report*. Unpublished internal document, EcoGlow Candles.

External Sources:

(Removed as per instructions)

Appendices

Appendix A: Artificial Datasets Overview

- **Social_Media_Metrics.csv:** Monthly data on followers, engagement rates, ad spend, and click-through rates for Instagram, Facebook, and Twitter from January to December 2023.

- **Sales_and_Seasonal_Data.csv:** Monthly total sales figures, details of holiday promotions, and records of new product launches.
- **Customer_Behavior_Data.csv:** Website traffic insights including average time on site, cart abandonment rates, and referral sources for each month in 2023.

Appendix B: Visualizations

1. **Figure 1:** Correlation Heatmap of Social Media Metrics vs. Total Sales.
2. **Figure 2:** Scatter Plot of Instagram Followers vs. Total Sales with Regression Line.
3. **Figure 3:** Time Series Plot of Monthly Sales with Seasonal Decomposition.
4. **Figure 4:** Cluster Scatter Plot Categorizing High-ROI Campaigns.
5. **Figure 5:** Bar Chart Comparing Average Sales Across Promotional Periods.