

Analysis of Facebook and AdWords Marketing Campaigns for Conversion Optimization

Introduction

In terms of cost-effectiveness, click-through rates, and conversions, this study compares the efficacy of Facebook and AdWords advertising efforts. We examine which platform maximizes return on investment (ROI) and best turns audience interaction into actions using statistical testing, correlation analysis, and predictive modeling. According to our research, Facebook has a higher conversion rate than other platforms, making it a better choice for ads with a conversion-focused goal.

By contrasting the results of Facebook and AdWords advertising efforts, this study aims to assess and improve marketing tactics. Data-driven recommendations regarding which platform offers a higher return on investment and more effective engagement-to-conversion rates are made possible by the comparison's basis in daily engagement and cost measurements. The study offers insights for the best possible resource allocation using statistical analysis and predictive modeling.

Data Preparation and Cleaning

Data Structure

The dataset comprises a collection of data comparing the performance of two separate ad campaigns conducted throughout the year 2019. Specifically, the data covers a Facebook Ad campaign and an AdWords Ad campaign. For each day of the year 2019, there is a corresponding row in the dataset, resulting in a total of 365 lines of campaign data to analyze. The dataset includes various performance metrics for each ad campaign, providing insights into their effectiveness and efficiency over time.

Key features included in the dataset are as follows:

- **Date:** The date corresponding to each row of campaign data, ranging from January 1st, 2019, to December 31st, 2019.
- **Ad Views:** The number of times the ad was viewed.
- **Ad Clicks:** The number of clicks received on the ad.
- **Ad Conversions:** The number of conversions resulting from the ad.
- **Cost per Ad:** The cost associated with running the Facebook ad campaign.
- **Click-Through Rate (CTR):** The ratio of clicks to views, indicating the effectiveness of the ad in generating clicks.
- **Conversion Rate:** The ratio of conversions to clicks, reflecting the effectiveness of the ad in driving desired actions.
- **Cost per Click (CPC):** The average cost incurred per click on the ad.

Cleaning Process

To ensure the dataset's accuracy for analysis:

- **Removing Symbols:** Monetary values and percentage columns were cleaned to remove "\$" and "%" symbols, converting them to numeric formats.
- **Date Conversion:** Converted dates to datetime format to facilitate time-based analysis.
- **Rationale:** These steps enable accurate numerical comparisons across metrics, essential for consistent analysis and reliable insights.

Descriptive Statistics and Baseline Metrics

Calculating baseline metrics helps provide a comparative overview of platform performance in terms of cost, engagement, and conversions.

Observed Baseline Metrics

Facebook:

Total Cost: \$32,040

Total Clicks: 16,078

Total Conversions: 4,286

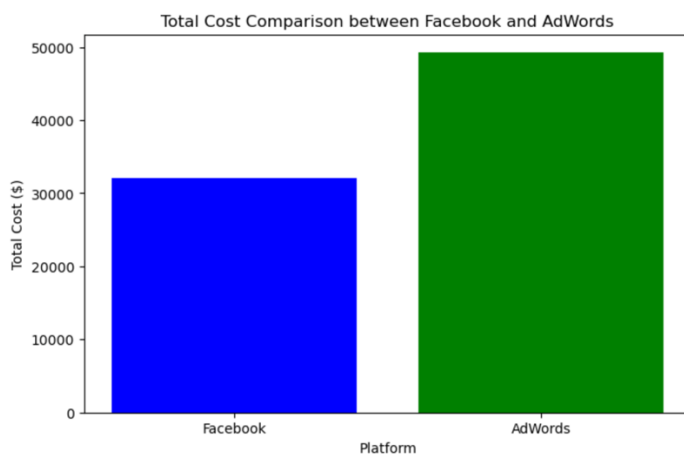
AdWords:

Total Cost: \$49,266

Total Clicks: 22,040

Total Conversions: 2,183

As we can see, Facebook was able to increase conversions while lowering overall costs, indicating increased cost efficiency.



Relationship Between Clicks and Conversions

Analyzing the relationship between clicks and conversions allows us to evaluate if increased engagement reliably translates into more conversions.

Method: Correlation Analysis

Correlation measures the degree to which two variables move in relation to each other. Here, we examine if clicks predict conversions.

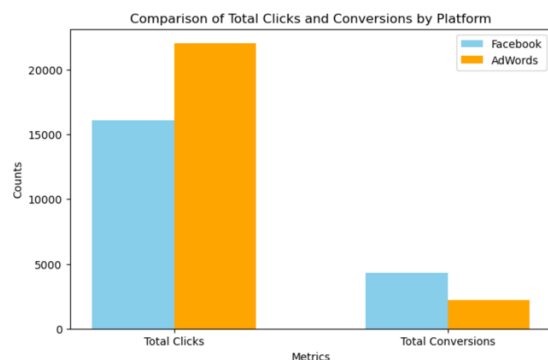
Pearson correlation coefficients were computed between clicks and conversions for each platform.

```
# Calculate the correlation between clicks and conversions for Facebook and AdWords
correlation_facebook = data["Facebook Ad Clicks"].corr(data["Facebook Ad Conversions"])
correlation_adwords = data["AdWords Ad Clicks"].corr(data["AdWords Ad Conversions"])
```

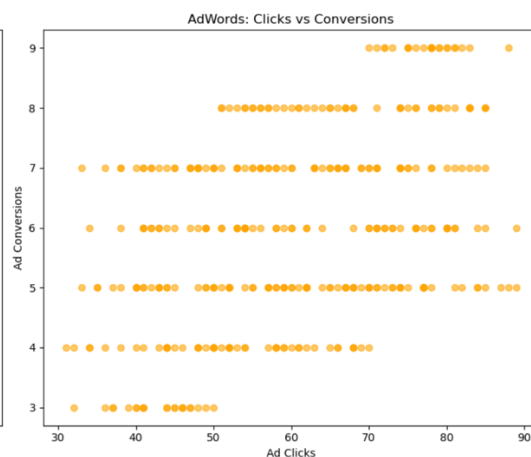
Observed Correlations

- **Facebook:** Strong positive correlation (0.87) indicates that higher clicks strongly predict conversions.
- **AdWords:** Moderate correlation (0.45), suggesting a weaker relationship.

The high correlation implies that more clicks on Facebook ads tend to result in higher conversions, making it an effective platform for engagement-to-conversion strategies.



*Relationship between Clicks and Conversions



Identifying High- and Low-Conversion Days Using Mean and Standard Deviation

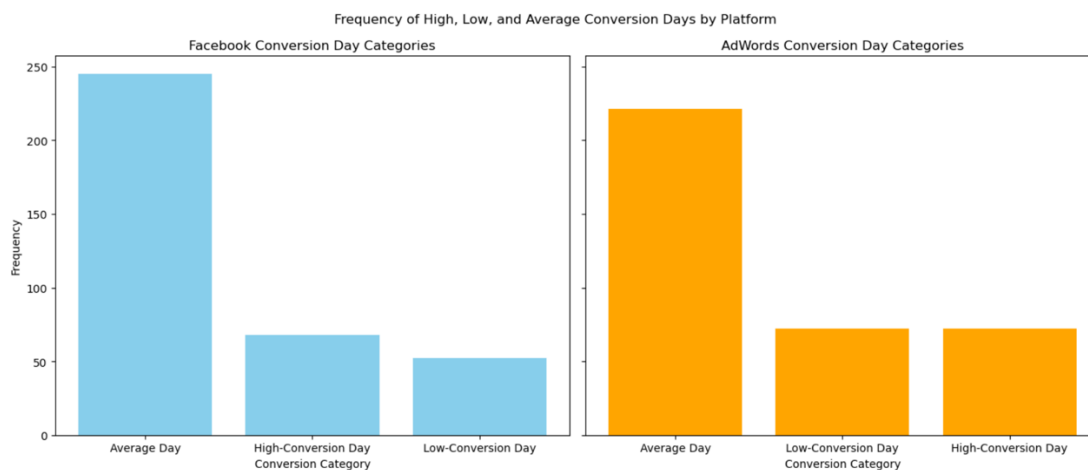
By identifying days of exceptionally high or low conversions, we can better understand when campaigns perform best, allowing for targeted strategies.

Method: Threshold Categorization

- **High-Conversion Day:** Days where conversions exceed the mean plus one standard deviation.
- **Low-Conversion Day:** Days with conversions below the mean minus one standard deviation.

Facebook had More frequent high-conversion days, indicating consistent performance in achieving conversions.

AdWords had primarily average-conversion days with fewer high-conversion occurrences.



The frequent high-conversion days suggest that campaigns on Facebook are more likely to exceed performance expectations.

Hypothesis Testing

Hypothesis testing aims to statistically validate if the observed differences in conversion rates and click-through rates between Facebook and AdWords are significant, rather than occurring by random chance. Conversion rate differences can highlight which platform provides better conversion efficiency, while CTR differences indicate audience engagement effectiveness.

1. Conversion Rate Hypothesis Testing

Conversion Rate is the percentage of clicks that result in conversions. It is a key metric for evaluating how effectively each platform drives meaningful actions from engaged users. A higher conversion rate typically suggests a platform's stronger ability to turn engagement into conversions, a critical factor in optimizing campaign ROI.

Methodology

Null and Alternative Hypotheses

- **Null Hypothesis (H_0):** There is no difference in conversion rates between Facebook and AdWords, or Facebook's conversion rate is less than or equal to AdWords. $H_0: \mu_{\text{Facebook}} \leq \mu_{\text{AdWords}}$
- **Alternative Hypothesis (H_1):** Facebook has a higher conversion rate than AdWords. $H_1: \mu_{\text{Facebook}} > \mu_{\text{AdWords}}$

Statistical Test

- **Two-Sample Proportion Z-Test:** This test evaluates if the observed difference in conversion rates between two independent groups (Facebook and AdWords) is statistically significant. A z-test is appropriate here as it compares proportions across large samples.
- **Formula for the Z-Test Statistic:**

$$z = \frac{(\hat{p}_1 - \hat{p}_2)}{\sqrt{\hat{p}(1 - \hat{p}) \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

where:

- \hat{p}_1 and \hat{p}_2 are the sample proportions for Facebook and AdWords.
- \hat{p} is the combined proportion: $\hat{p} = \frac{x_1 + x_2}{n_1 + n_2}$.
- n_1 and n_2 are the sample sizes for each platform.

```
{'Facebook Conversion Rate': 0.26657544470705313,  
'AdWords Conversion Rate': 0.09904718693284936,  
'Z-Statistic': 43.03049682241507,  
'p-value': 0.0}
```

2. Click-Through Rate (CTR) Hypothesis Testing

Click-Through Rate (CTR) is the percentage of ad views that result in clicks, serving as an indicator of ad engagement. A higher CTR reflects a platform's effectiveness in capturing audience interest, crucial for maximizing initial engagement before conversions.

Methodology

Null and Alternative Hypotheses

- **Null Hypothesis (H_0):** There is no significant difference in CTRs between Facebook and AdWords.

$$H_0 : \mu_{Facebook} = \mu_{AdWords}$$

- **Alternative Hypothesis (H_1):** There is a significant difference in CTRs between Facebook and AdWords.

$$H_1 : \mu_{Facebook} \neq \mu_{AdWords}$$

Statistical Test

- **Two-Sample Proportion Z-Test:** The same z-test approach used for conversion rates is applied here to compare CTRs across the two platforms.
- **Formula:** Same as outlined for conversion rates, applying the observed CTR values for each platform.

Output

{'Facebook CTR': 0.020209003175018163,

'AdWords CTR': 0.012800728549632153,

'Z-Statistic': 44.7504324903407,

'p-value': 0.0}

Interpretation

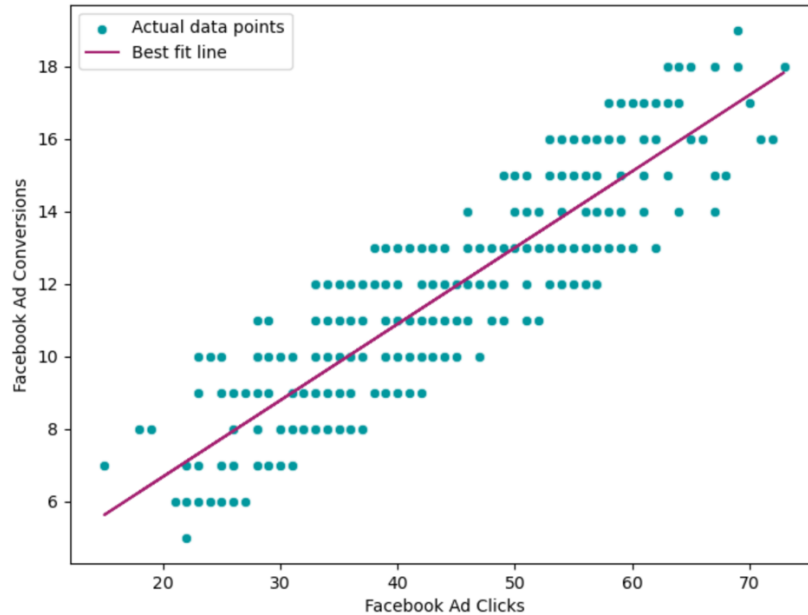
- **Result:** The low p-value leads to rejection of the null hypothesis, indicating a statistically significant difference in CTR between Facebook and AdWords.
- **Implication:** Facebook's higher CTR suggests that it is more effective in capturing audience engagement than AdWords. For campaigns where initial user interest and ad engagement are primary objectives, Facebook is the stronger option.

Linear Regression

To predict Facebook conversions based on clicks, enabling better planning and resource allocation.

Method: Linear Regression Model

- **Independent Variable (X):** Facebook Ad Clicks
- **Dependent Variable (Y):** Facebook Ad Conversions
- **Model Performance:**
 - **R² Score:** 76.35%, indicating a high degree of predictability.
 - **Mean Squared Error (MSE):** 2.02.



- The model has a reasonably good predictive power, with an R2 score of 76.35%. This suggests that it can effectively predict Facebook ad conversions based on the number of Facebook ad clicks.
- With the insights provided by the Linear Regression model, businesses can make informed decisions about resource allocation, budget planning, and campaign optimization.
- For instance, knowing the expected number of Facebook ad conversions based on a certain number of Facebook ad clicks can help in setting realistic campaign goals, optimizing ad spend, and assessing the ROI of Facebook advertising efforts.

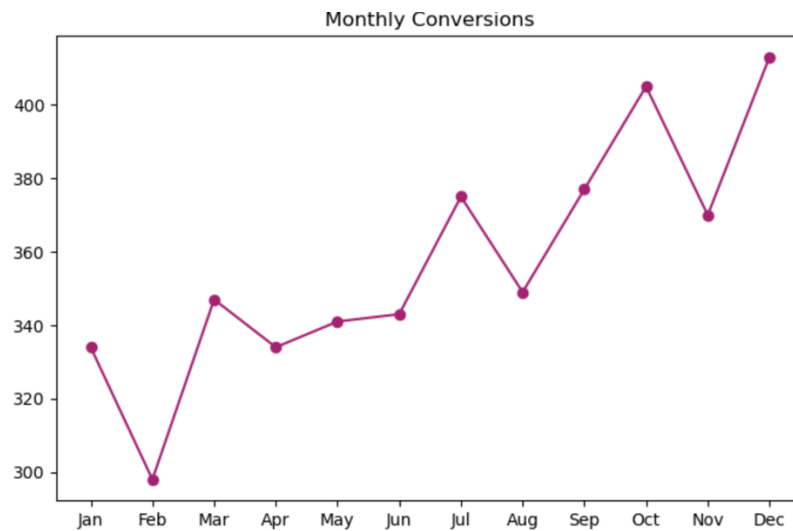
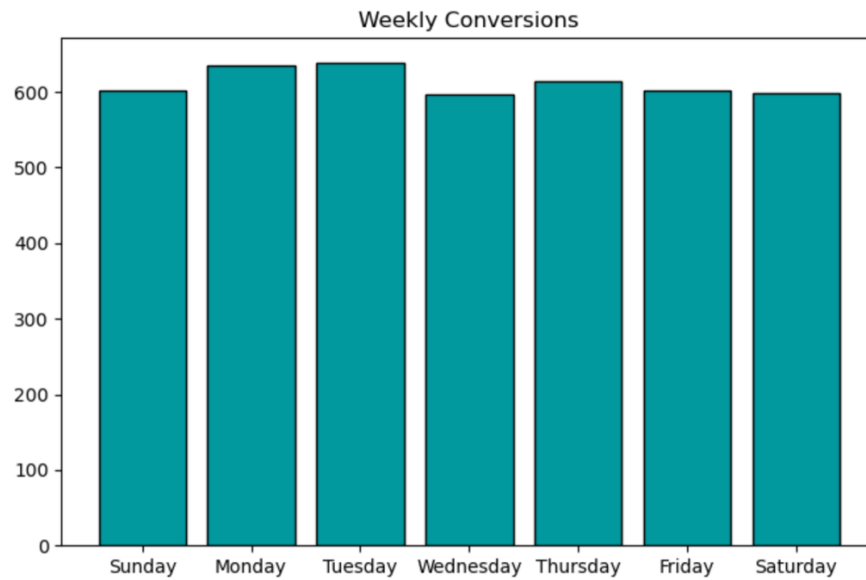
Temporal Analysis of Facebook Campaign Performance

To assess whether conversions on Facebook follow any weekly or monthly patterns, aiding in the optimization of ad spend.

Observations

- **Weekly:** Stable conversion rates across days, suggesting no strong weekly fluctuations.

- **Monthly:** Consistent conversion performance without major seasonal trends.

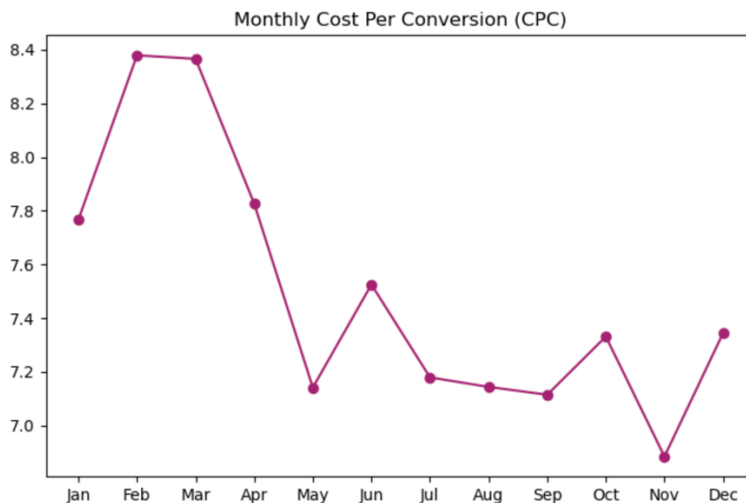


- Across the weekdays over a year, the total number of conversions remains relatively consistent, indicating a consistent level of engagement throughout the week. However, Mondays and Tuesdays consistently exhibit the highest conversion rates compared to other days, suggesting that the beginning of the workweek sees heightened user engagement or responsiveness to marketing efforts.
- Examining the monthly trend in conversions reveals an overall upward trajectory, indicating a general increase in conversions over time. However, certain months stand out with variations in conversion rates. February, April, May, June, August, and November experience a decline in conversions compared to neighboring months. These periods of decreased conversion rates could be influenced

by factors such as seasonal fluctuations, changes in consumer behavior, or adjustments in marketing strategies.

How does the Cost Per Conversion (CPC) trend over time?

Cost Per Conversion (CPC): This metric is used to evaluate the cost effectiveness and profitability of an online advertising campaign. This metric helps marketers understand how much they are spending to obtain each conversion, allowing them to optimize their spending and targeting strategies effectively.



- The CPC trend over the 12-month period shows some fluctuations but overall maintains a relatively stable range.
- May and November have the lowest CPC values, indicating potentially more cost-effective advertising or higher conversion rates during these periods.
- February has the highest CPC value, suggesting that advertising costs may be relatively higher during this month compared to others.
- Lower CPC values in certain months (e.g., May and November) could indicate periods of higher advertising effectiveness or more favorable market conditions.
- Consider allocating more advertising budget to months with historically lower CPC values (e.g., May and November) to maximize ROI.

Is there a long-term equilibrium relationship between advertising spend and conversion rates that suggests a stable, proportional impact of budget changes on conversions over time?

```

score, p_value, _ = coint(data['Cost per Facebook Ad'], data['Facebook Ad Conversions'])
print('Cointegration test score:', score)
print('P-value:', p_value)
if p_value < 0.05:
    print("\np-value is less than significance value, Reject the null hypothesis")
else:
    print("\np-value is greater than significance value, Accept the null hypothesis")

```

Cointegration test score: -14.755428385103226

P-value: 2.1337375979060546e-26

p-value is less than significance value, Reject the null hypothesis

- Since the p-value is significantly lower than the chosen significance level, we reject the null hypothesis. This indicates that there is a long-term equilibrium relationship between advertising spend (cost) and conversions.
- Businesses can use this understanding of the stable relationship between cost and conversions to optimize their advertising strategies. By investing in campaigns that demonstrate a strong return on investment (ROI) and adjusting spending based on performance, companies can maximize conversions while minimizing costs.

Conclusion

This analysis compared the performance of Facebook and AdWords campaigns in terms of conversion rates, click-through rates (CTR), and overall cost-effectiveness. Through comprehensive statistical testing, correlation analysis, and predictive modeling, several key findings were uncovered:

1. **Conversion Efficiency:** Facebook demonstrated a significantly higher conversion rate (26.66%) compared to AdWords (9.90%), indicating its superior ability to translate clicks into meaningful actions. Hypothesis testing confirmed that this difference is statistically significant, highlighting Facebook as the preferred platform for conversion-focused campaigns.
2. **Audience Engagement:** Facebook also achieved a higher click-through rate (2.02% vs. AdWords' 1.28%), suggesting it is more effective in engaging viewers. The higher CTR on Facebook underscores its advantage in attracting initial user interest, a crucial first step in the conversion process.
3. **Cost-Effectiveness:** Despite a lower total ad spend than AdWords, Facebook achieved nearly twice as many conversions. This efficiency implies that Facebook provides a better return on investment (ROI) for conversion-driven campaigns.
4. **Predictive Value of Engagement:** Correlation analysis showed that Facebook clicks have a strong, positive relationship with conversions, providing a reliable pathway from engagement to conversion. Linear regression modeling further demonstrated that Facebook's clicks can accurately predict conversions, aiding in budget forecasting and target setting.
5. **Stable Performance Over Time:** Time-series analysis revealed that Facebook conversions are consistent week-to-week and month-to-month, suggesting stable performance unaffected by seasonality. Additionally, a long-term equilibrium relationship between cost and conversions on Facebook supports reliable budget planning with predictable conversion outcomes.

Strategic Implications

For campaigns aimed at maximizing conversions and audience engagement, Facebook is the more effective platform. By prioritizing ad spend on Facebook, businesses can achieve higher conversions at a lower cost and with greater predictability, making it an optimal choice for ROI-focused marketing strategies. AdWords may still be suitable for specific cases where broader reach and higher impressions are the primary objectives, but for conversion-oriented campaigns, Facebook clearly offers a superior performance profile.

This analysis provides a data-driven foundation for strategic decision-making, suggesting that Facebook should be the primary platform for maximizing conversion efficiency and campaign success.