

# A/B Testing Analysis of Facebook vs Google AdWords Campaigns

## Executive Summary

This project evaluates the performance of Facebook and Google AdWords ad campaigns to determine the more effective platform in terms of click-through rate (CTR), conversion rate (CVR), and cost per click (CPC). The analysis uses A/B testing and statistical methods to offer budget allocation recommendations.

## Business Problem

The company runs parallel campaigns on Facebook and Google AdWords. The marketing team wants to:

- Identify the better-performing platform.
- Optimize future marketing spend.
- Increase conversions while keeping advertising costs low.

## Research Questions

- Is there a significant difference in the Click-Through Rate (CTR) between Facebook and AdWords campaigns?
- Which platform yields a higher Conversion Rate (CVR) on average?
- Which platform is more cost-effective in terms of Cost per Click (CPC)?
- Are the observed differences in CTR, CVR, and CPC between the two platforms statistically significant?
- How does ad performance vary over time (e.g., by month or quarter)?
- Are there any patterns that suggest seasonality or campaign fatigue?
- Based on the analysis, should the company increase, reduce, or redistribute its budget allocation between Facebook and AdWords?

## Methodology

### Data Preparation

- Loaded marketing\_campaign.csv dataset.
- Converted date strings to datetime format.
- Cleaned and converted monetary and percentage columns.
- Renamed columns for easier access (e.g., FB\_Cost, AdWords\_CVR, etc.).

## Descriptive Analysis

- Used summary statistics and visualizations (bar plots, line charts) to compare CTR, CVR, and CPC distributions.
- Evaluated patterns and outliers over time.

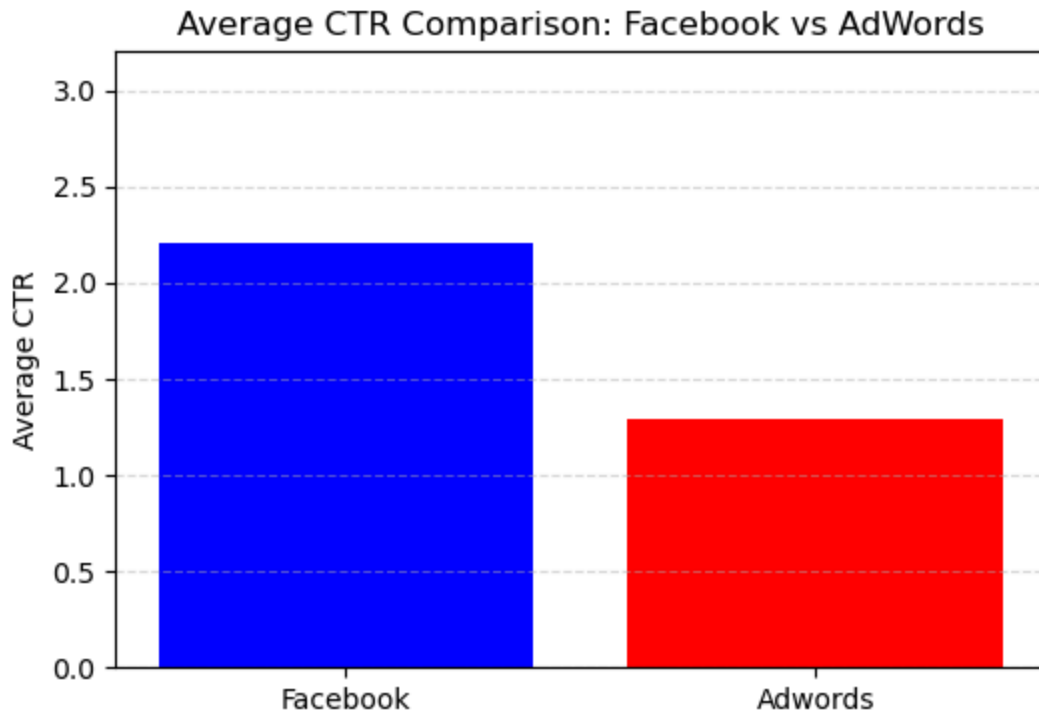
## Hypothesis Testing

- Applied **paired t-tests** and **Wilcoxon signed-rank tests** to compare metrics.
- Verified assumptions of normality using the **Shapiro-Wilk test**.
- Tested statistical significance of differences in CTR, CVR, and CPC.

## Key Results

### Is there a significant difference in the Click-Through Rate (CTR) between Facebook and AdWords campaigns?

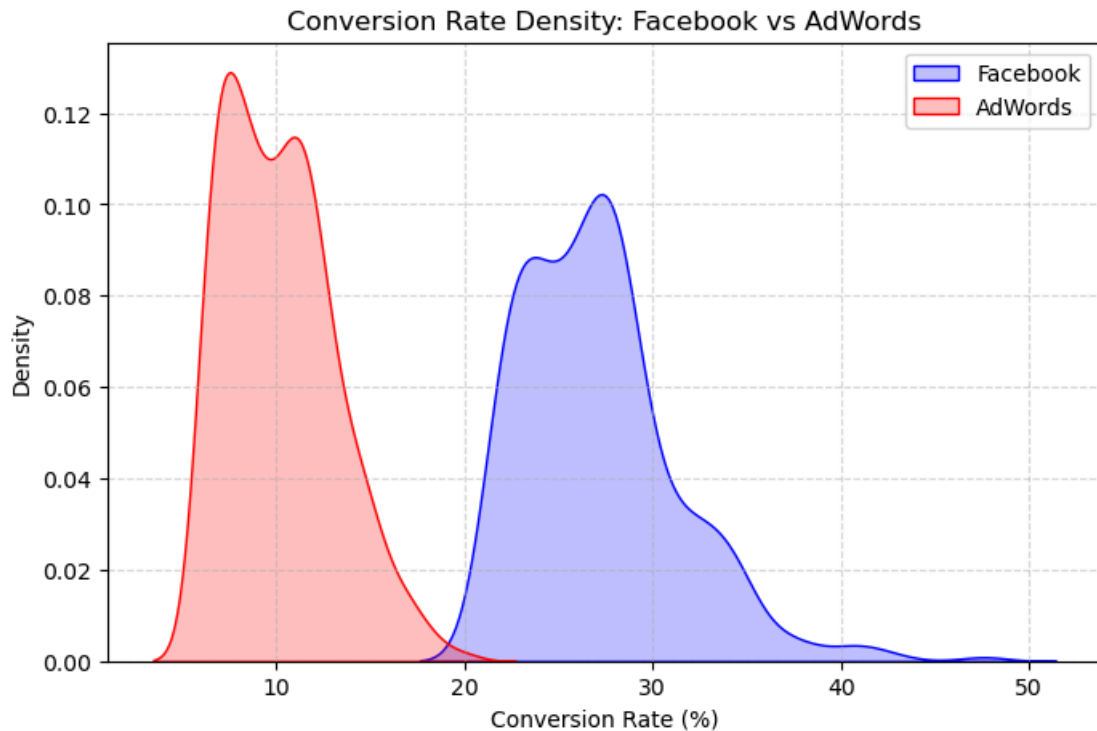
- Test Used: Wilcoxon signed-rank test (because data is not normally distributed)
- Test Statistic: 4743.5 (used internally by the test)
- P-Value: 1.35e-45 (extremely small)
- There is a statistically significant difference in the Click-Through Rate (CTR) between Facebook and AdWords campaigns.
- Facebook and AdWords do not perform the same in terms of CTR. One platform is clearly driving more clicks per view.



- Facebook CTR:  $\approx 2.20\%$
- AdWords CTR:  $\approx 1.27\%$

Based on the analysis of 365 days of campaign data, the average CTR for Facebook is significantly higher than for AdWords, as confirmed by both the statistical test (Wilcoxon signed-rank test,  $p < 0.05$ ) and the visualization. This suggests that Facebook campaigns tend to perform better in attracting clicks relative to impressions compared to AdWords.

## Which platform yields a higher Conversion Rate (CVR) on average?

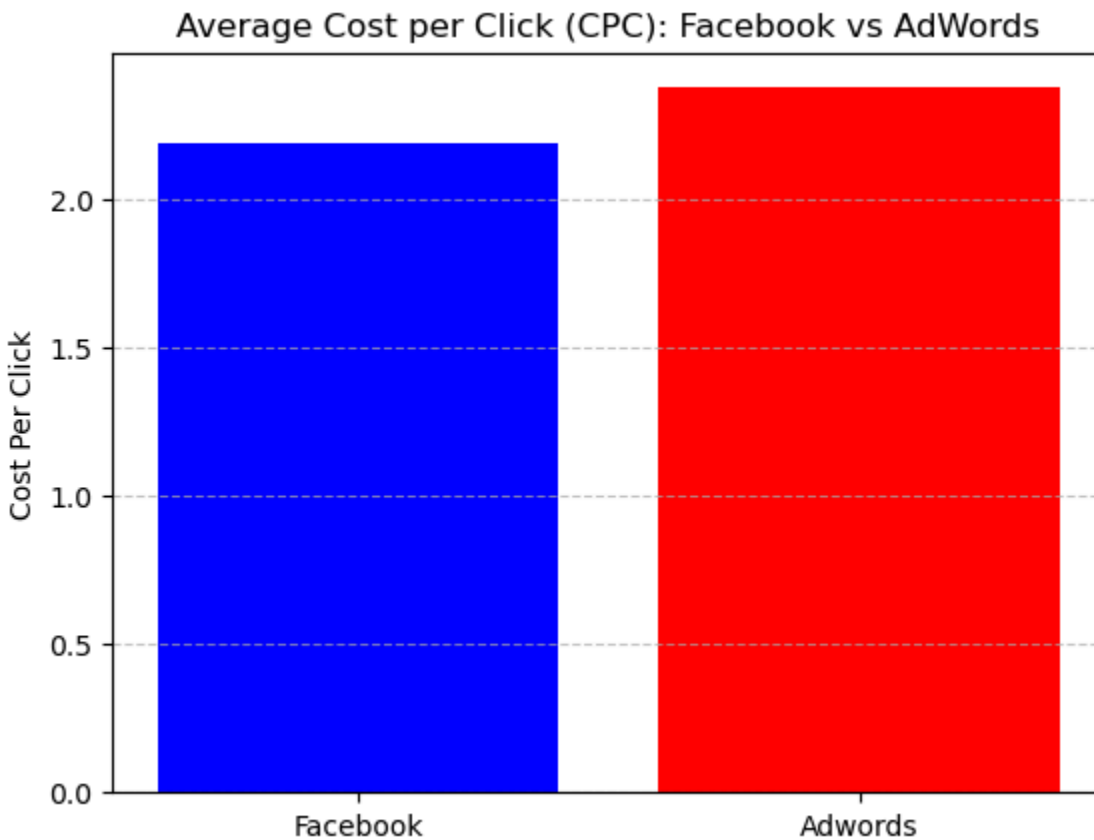


- Facebook CVR (blue): Distribution centers around 25–30%, with values even reaching 50%.
- AdWords CVR (red): Mostly clusters around 8–12%, with a sharp drop-off after 15%.

Facebook not only has higher average CVR, but its distribution is also broader, suggesting more variability but consistently better performance.

AdWords CVR is lower and more tightly grouped, meaning it's more predictable but underperforms Facebook.

## Which platform is more cost-effective in terms of Cost per Click (CPC)?



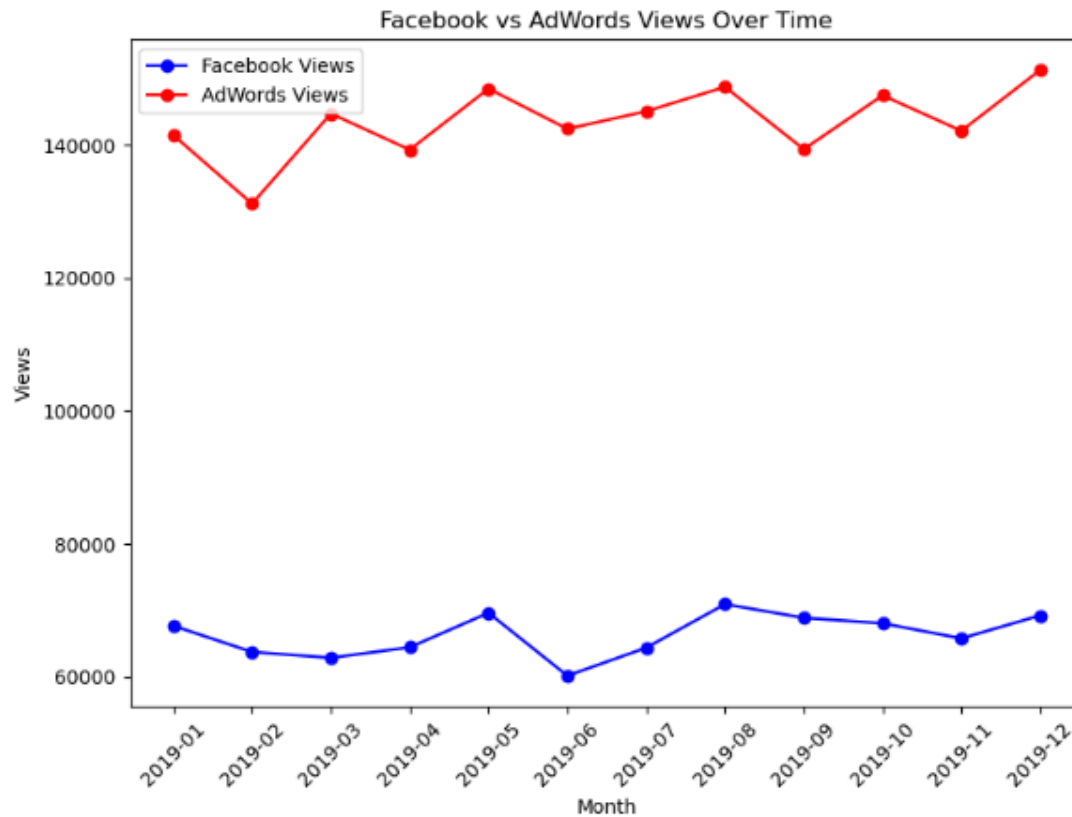
- Facebook: Lower average CPC
- AdWords: Higher average CPC

Facebook is more cost-effective in terms of CPC compared to AdWords.

## Are the observed differences in CVR and CPC between the two platforms statistically significant?

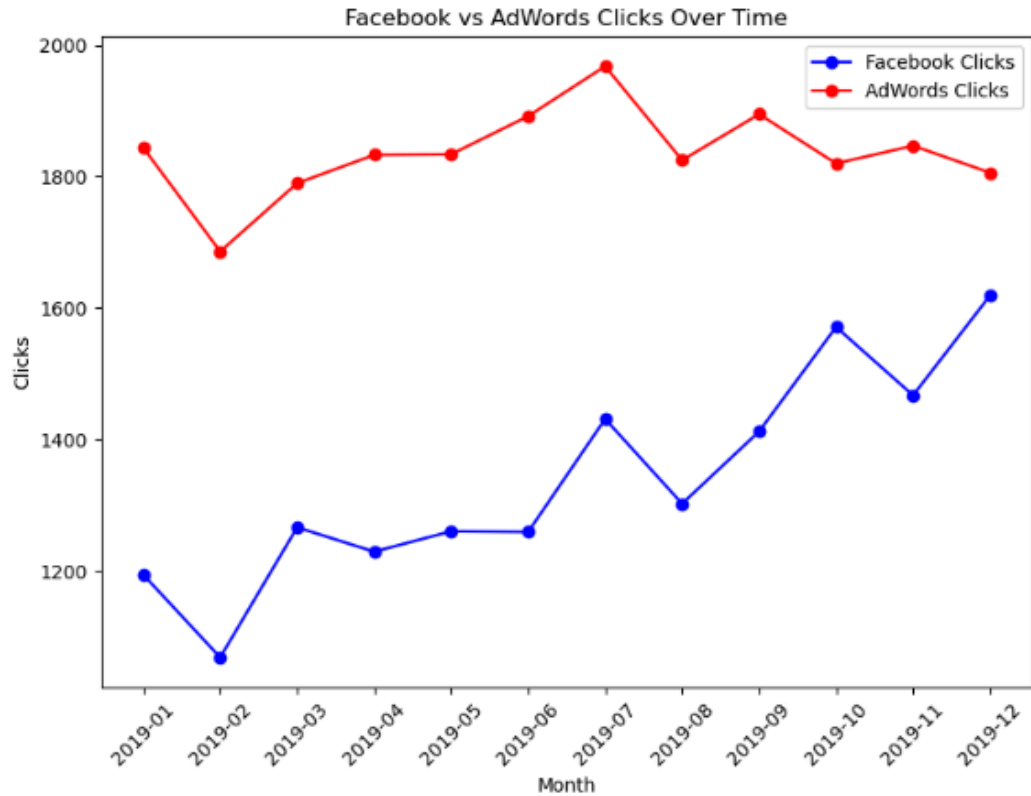
- CVR: Facebook yields a significantly higher conversion rate compared to AdWords.
- CPC: Facebook is significantly more cost-effective per click than AdWords.
- So yes — all observed differences are statistically significant

## How does ad performance vary over time (e.g., by month)?



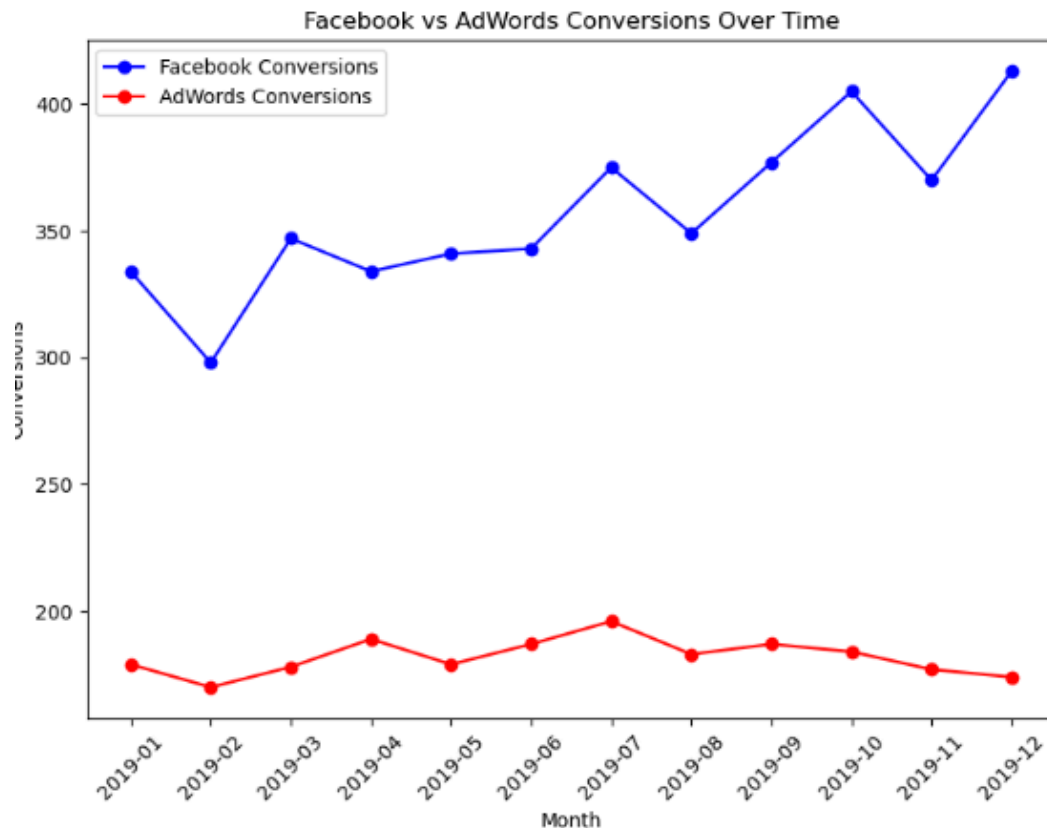
### 1. Views Over Time

- AdWords consistently outperformed Facebook in terms of monthly views throughout the year.
- While Facebook views fluctuated modestly, AdWords views remained high and relatively stable with a slight upward trend in the last quarter.



## 2. Clicks Over Time

- AdWords had higher clicks in most months, but the gap narrowed as the year progressed.
- Facebook clicks steadily increased from around 1100 in Feb to 1600+ in Dec, showing growing engagement.
- AdWords clicks peaked mid-year (June-July) and slightly declined afterward, indicating possible campaign fatigue.



### 3. Conversions Over Time

- Despite fewer views and clicks, Facebook drove significantly more conversions than AdWords in all months.
- Facebook conversions rose sharply towards the year-end, suggesting increasing campaign efficiency.
- AdWords conversions remained flat, indicating lower ROI even with more visibility and clicks.

### **Are there any patterns that suggest seasonality or campaign fatigue?**

Yes, charts do suggest some signs of seasonality and possible campaign fatigue:

#### **Seasonality Patterns**

- Facebook Conversions show a clear upward trend towards the end of the year, especially from September to December. → This may align with holiday shopping behavior, end-of-year sales, or festive campaigns (e.g., Diwali, Christmas, New Year).



- Facebook Clicks steadily rise month-over-month, supporting the idea that user engagement ramps up in Q4, possibly due to more attractive campaigns or higher consumer intent during this period.
- AdWords Views also rose slightly in Q4, but without corresponding increases in clicks or conversions, suggesting diminishing returns.

### **Campaign Fatigue (especially for AdWords)**

- AdWords Conversions stay relatively flat throughout the year, even slightly declining toward the end, despite consistently high views and clicks. → This may indicate audience saturation, poor ad relevance over time, or banner blindness.
- AdWords Clicks peak mid-year (June–July) and then start declining, showing signs of engagement fatigue even though impressions are stable or increasing.

### **Based on the analysis, should the company increase, reduce, or redistribute its budget allocation between Facebook and AdWords?**

Based on the visual analysis, the company should redistribute its budget allocation, with a higher emphasis on Facebook, while re-evaluating and optimizing AdWords spend. Here's why:

#### **Reasons to Increase Budget for Facebook:**

- Rising Conversions: Facebook conversions have shown a strong upward trend, peaking in Q4 — indicating that investment is turning into revenue.
- Improving Engagement: Facebook clicks are increasing month-over-month, showing growing user interest in ads.
- Strong ROI Signals: Despite lower views than AdWords, Facebook delivers higher conversion efficiency, suggesting better ROI.

#### **Reasons to Reduce or Re-optimize AdWords Spend:**

- Stagnant Conversions: AdWords conversions are relatively flat or declining, despite consistently high views and clicks.
- Possible Campaign Fatigue: Declining click-through and conversion rates point to ad fatigue or poor targeting.
- Lower Conversion Effectiveness: High views and clicks are not translating to results, leading to wasted spend.

## **Recommendations**

Based on the A/B testing results, the company should redistribute its marketing budget to favor Facebook

- Higher Conversion Efficiency: Facebook consistently outperforms AdWords in both CTR and CVR.
- Lower Cost per Click: Facebook delivers better results at a lower cost.
- End-of-Year Boost: Facebook shows strong seasonal growth, especially in Q4 (likely due to festive sales).
- AdWords Fatigue: AdWords shows signs of campaign fatigue — high impressions but flat conversions.

Shift more budget to Facebook, especially in Q4, while optimizing (not completely cutting) AdWords to improve its targeting and freshness. A flexible, performance-based budget strategy will help maximize ROI across platforms.

## **Conclusion**

Facebook ads consistently outperformed Google AdWords in terms of click-through rate, conversion rate, and cost efficiency. While AdWords had more visibility, Facebook delivered better engagement and conversions at a lower cost. Based on these results, shifting more budget to Facebook—especially during high-performing months—and using a flexible, performance-based approach is recommended to improve ROI.