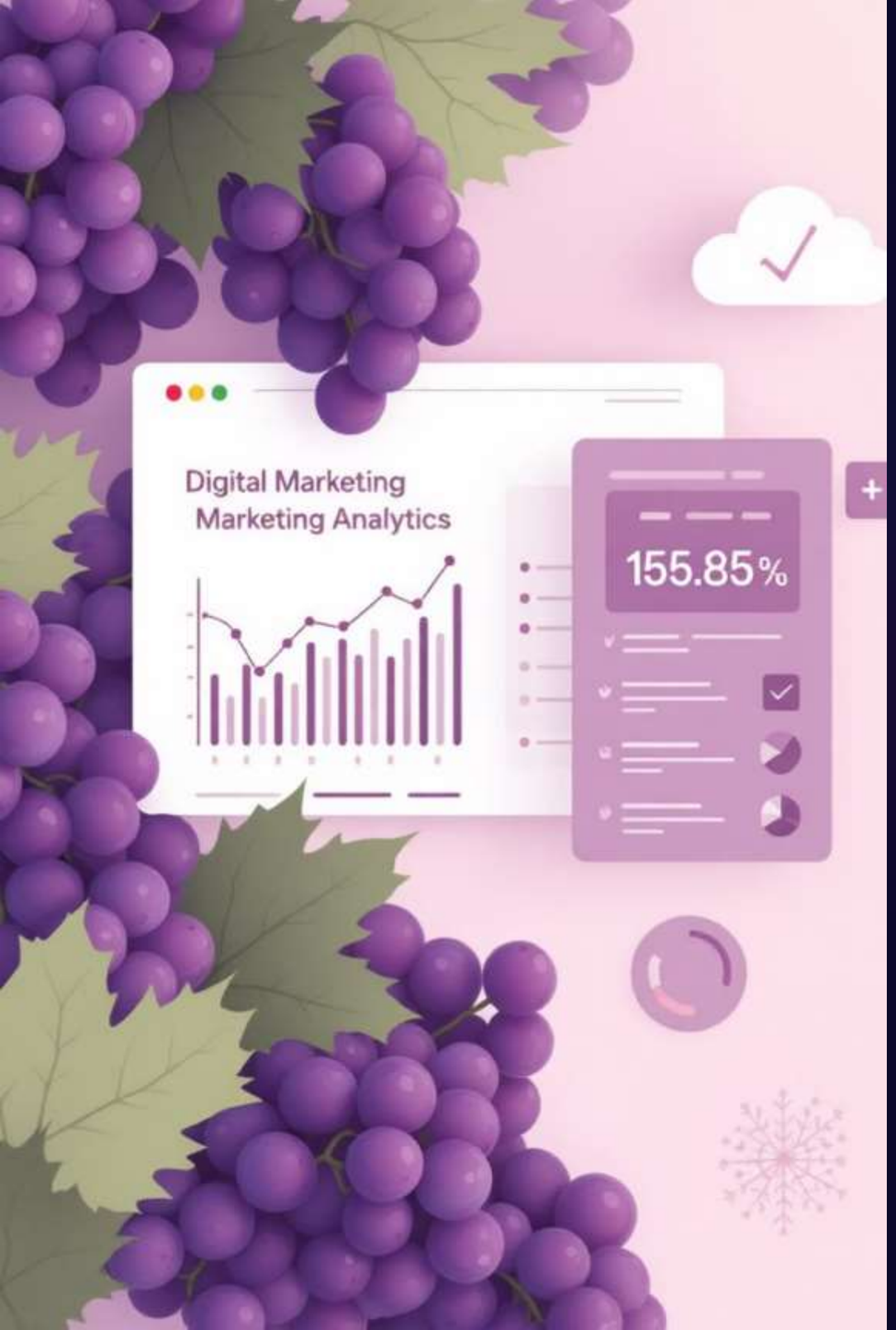

A/B Testing and Regression Analysis of Marketing Campaign Performance

This project evaluates the effectiveness of two digital marketing channels, Facebook Ads and Google AdWords, using statistical experimentation and regression modeling. The objective is to determine whether observed performance differences are statistically significant, identify key drivers of conversions, and provide data-backed recommendations for marketing spend optimization.

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Business Problem & Goal

The Challenge

Marketing teams often split budget across multiple ad platforms without clear evidence of which channel truly performs better. This approach creates inefficiency and leaves money on the table.

Traditional decision-making relies on intuition or surface-level metrics, but without rigorous testing, teams can't distinguish genuine performance differences from random variation.

Key Questions

- Are performance differences between channels real or random?
- Which platform drives higher conversions and efficiency?
- How strong is the impact after controlling for other factors?

The goal: Replace intuition with statistically valid decision-making that directly impacts ROI.

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Dataset & Metrics

Time Period

365 days of daily marketing performance data providing comprehensive year-long insights

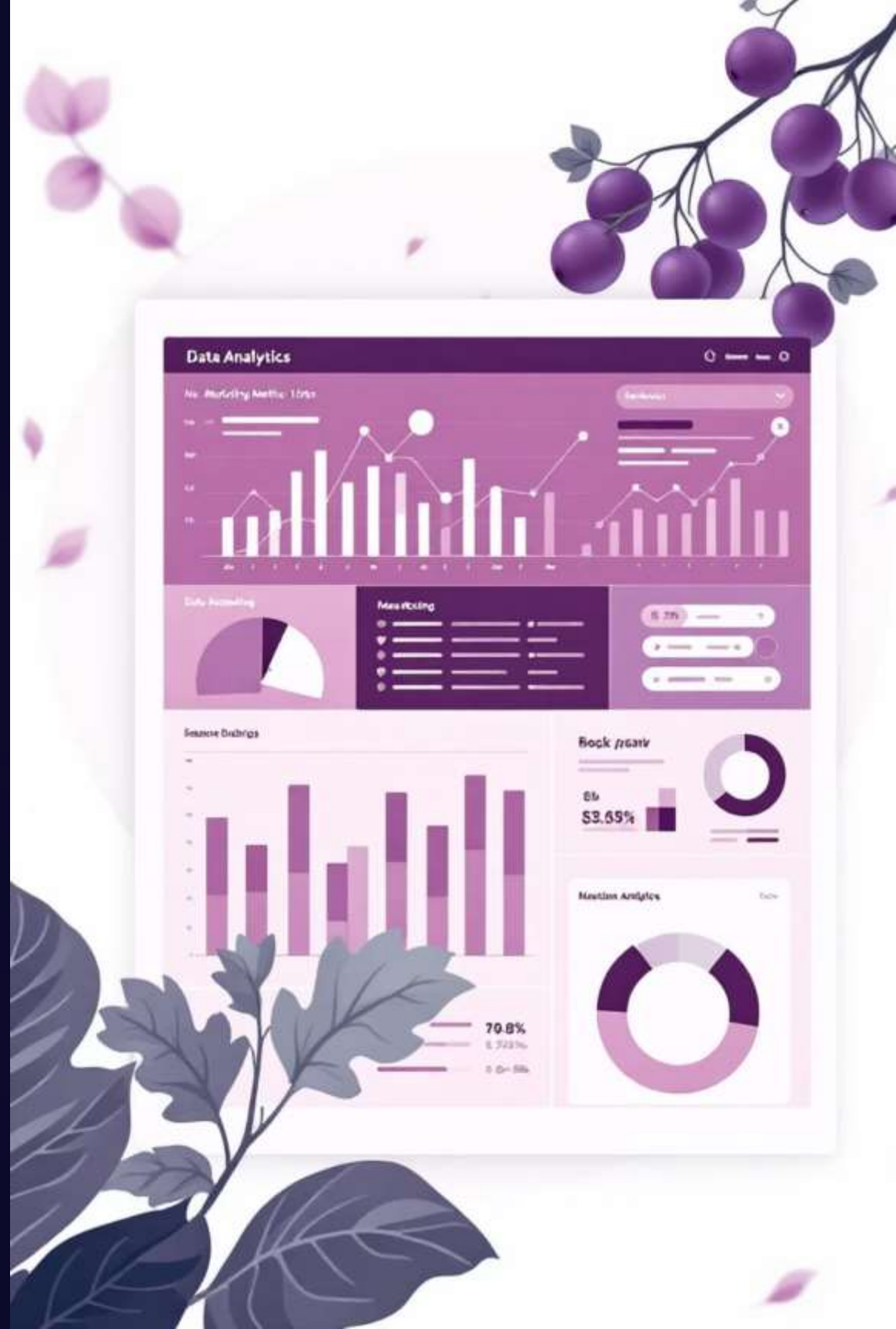
Two Channels

Facebook Ads and Google AdWords campaigns tracked independently

Six Core Metrics

Ad views, clicks, conversions, CTR, conversion rate, and cost per click

This dataset structure provides the foundation for both A/B testing and regression analysis. Each daily observation captures complete performance across all metrics, enabling rigorous statistical comparison and modeling. The comprehensive nature of the data allows us to control for confounding variables and isolate true channel effects.



Exploratory Data Analysis

Data Quality Validation

Before conducting formal statistical tests, exploratory data analysis confirmed the integrity and reliability of our dataset.

- ### Complete Records

  No missing or anomalous daily records across the entire 365-day period

- ### Consistent Patterns

  Facebook consistently showed higher conversion counts day over day

- ### Performance Gap

  Facebook exhibited higher conversion rates across most days, suggesting systematic differences

These early patterns suggested a potential performance gap that warranted formal statistical testing to confirm significance.

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Descriptive Statistics: Initial Signal

Average daily performance over 365 days revealed clear patterns in both conversion volume and efficiency. While descriptive statistics provide an initial signal, they don't confirm whether differences are statistically meaningful.

11.7	27.2%	6.0	10.2%
Facebook Conversions	Facebook Conv. Rate	AdWords Conversions	AdWords Conv. Rate
Average conversions per day	Average conversion efficiency	Average conversions per day	Average conversion efficiency

Key Observation: Facebook outperformed AdWords in both volume and efficiency, but statistical testing was required to confirm whether these differences were significant or could have occurred by chance.

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A/B Testing Methodology & Results

01

Test Design

Group A: Facebook Ads | Group B: Google AdWords

02

Hypothesis Framework

Null: No difference exists | Alternative: Significant difference exists

03

Statistical Analysis

Applied formal testing framework to conversion performance data

04

Significance Testing

Calculated probability that observed differences occurred by chance

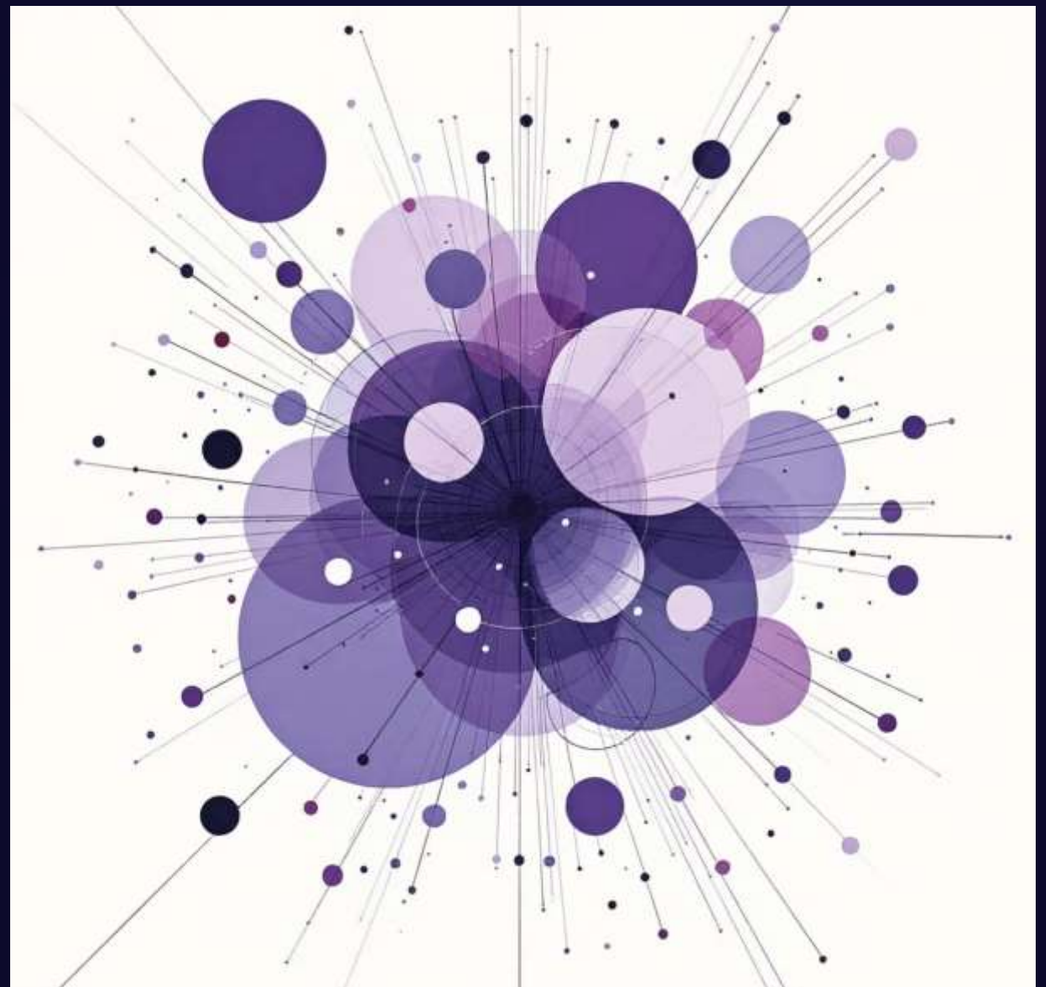
Results: Null Hypothesis Rejected

Facebook Ads showed significantly higher conversions and conversion rates. The probability that this difference occurred by chance was extremely low, confirming a statistically significant performance difference between channels.

Why Regression Analysis Was Used

Beyond A/B Testing

A/B testing confirms *that* a difference exists between channels, providing a critical first validation. However, it doesn't reveal the complete picture of what drives performance.



Isolate Channel Impact

Separate the effect of marketing channel from other variables

Quantify Effect Size

Measure precisely how much the channel choice matters

Control for Variables

Understand roles of clicks, views, conversion rate, and cost

Regression analysis provides the depth needed to make sophisticated budget allocation decisions with confidence.

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Regression Results & Interpretation

Regression modeling revealed the nuanced relationships between marketing inputs and conversion outcomes, providing actionable insights beyond simple channel comparison.

Channel Effect

Marketing channel choice is a strong predictor of conversions. Facebook Ads have a positive and statistically significant coefficient, confirming superiority even after controlling for other factors.

Click Performance

Clicks demonstrate a strong positive relationship with conversions across both channels, validating the importance of traffic volume.

Conversion Rate Impact

Higher conversion rates strongly increase total conversions, highlighting the value of landing page optimization and audience targeting.

Cost Dynamics

Cost per click shows diminishing returns beyond a certain point, suggesting optimal bid strategies exist for each channel.

The regression results reinforce the A/B test findings with model-based evidence, providing confidence in our recommendations.

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Business Insights & Recommendations

What The Data Shows

Channel Efficiency

Facebook Ads convert traffic more efficiently than Google AdWords across all key metrics

Meaningful Gap

The performance difference is both statistically significant and practically meaningful for business outcomes

Strategic Clarity

Budget allocation should favor Facebook Ads to maximize ROI and conversion volume

Recommended Actions

Increase Facebook Spend

Reallocate budget toward the higher-performing channel to capture efficiency gains

Optimize AdWords

Redesign Google AdWords campaigns focusing on targeting, creative, and landing pages

Institutionalize Testing

Implement ongoing A/B testing as standard practice for continuous optimization

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Conclusion & Skills Demonstrated

This project demonstrates how structured experimentation and statistical modeling drive better marketing decisions. By combining A/B testing with regression analysis, we transformed raw performance data into actionable strategy.

Key Takeaways

1

Validated Performance

A/B testing confirmed real differences between channels

2

Quantified Impact

Regression analysis measured effect size and key drivers

3

Strategic Direction

Results directly inform ROI-focused budget allocation

Skills Demonstrated

Experimental Design

Hypothesis Testing

Regression Analysis

Business Translation

Analytical Storytelling

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