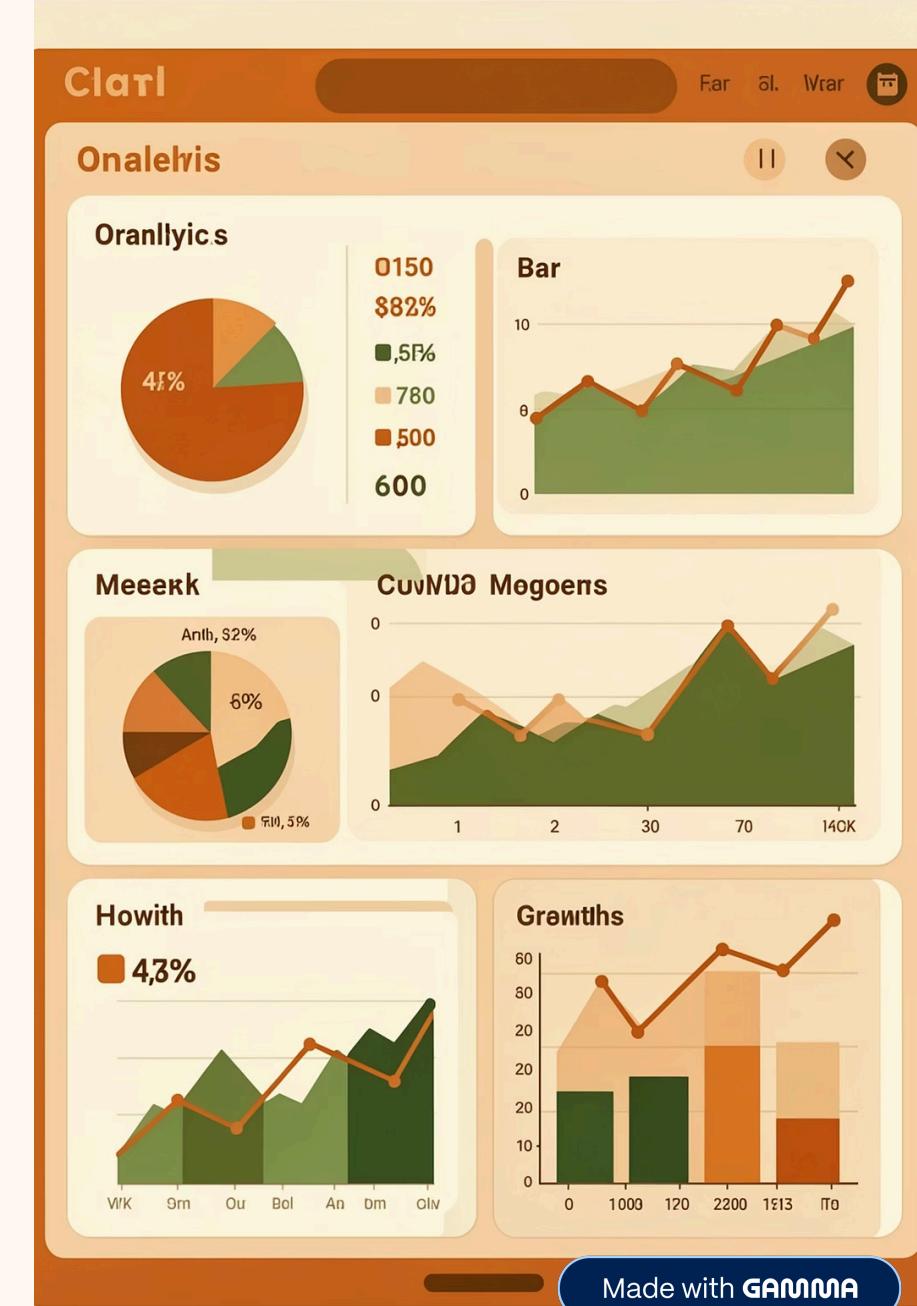


A/B Testing & Campaign Performance Analysis

This project leverages advanced analytical techniques to dissect marketing campaign performance, providing actionable insights for strategic decision-making.



Project Overview & Objectives

Project Scope

We analyzed and compared marketing campaign performance using A/B testing, statistical hypothesis testing, and regression modeling. The objective was to determine which advertising platform performs better in terms of conversions, clicks, and overall effectiveness.

Business Objective

- Evaluate campaign performance across advertising platforms.
- Identify statistically significant differences in conversion rates.
- Estimate expected conversions based on click data.
- Provide actionable insights to improve marketing ROI.



Research Question & Tech Stack

? Which Ad Platform is More Effective?

Our core research question aimed to identify the ad platform that delivers superior results in terms of conversions, clicks, and overall cost-effectiveness. This involved a deep dive into platform-specific data to uncover key performance indicators.



Tech Stack & Libraries

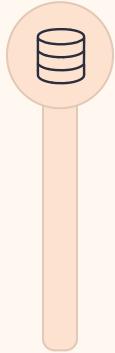
Python

The primary programming language for all data manipulation and analysis.

Key Libraries

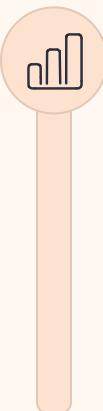
Pandas, NumPy, Matplotlib, Seaborn, SciPy, Scikit-learn, and Statsmodels for comprehensive statistical and machine learning tasks.

Project Workflow: Data & EDA



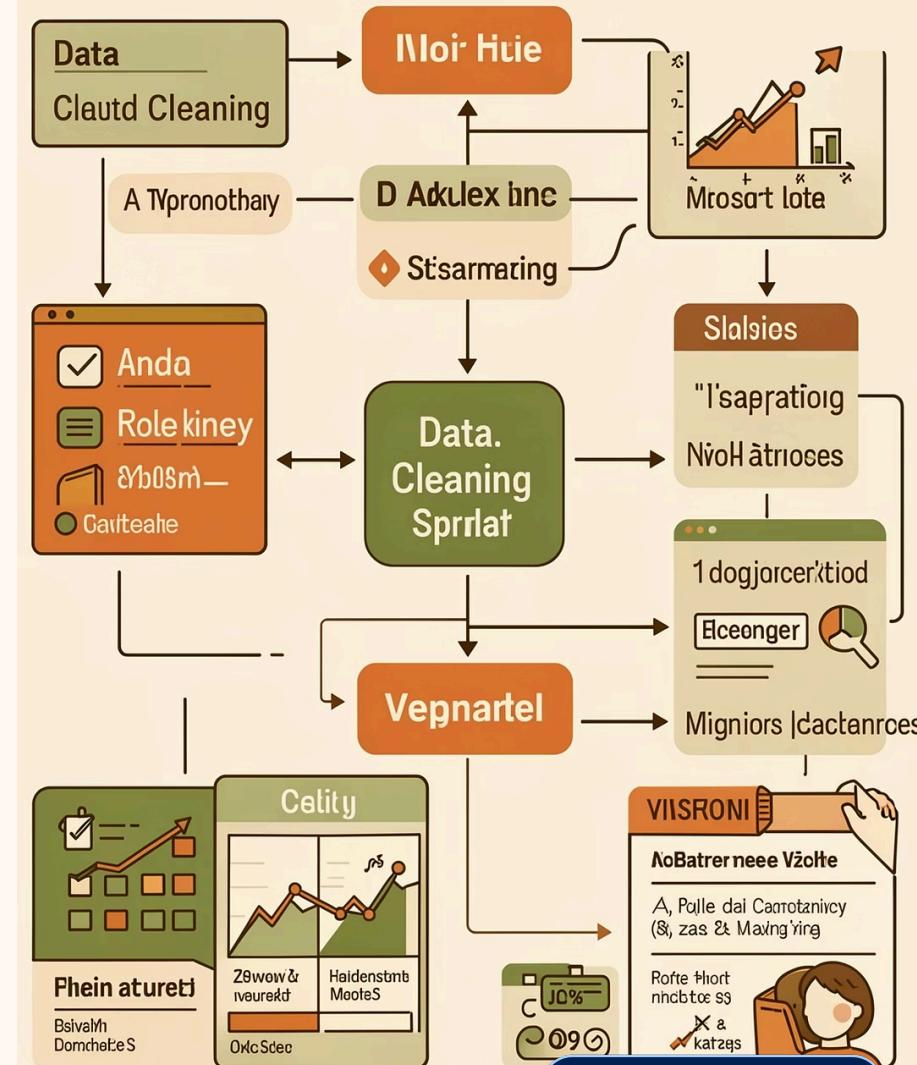
Data Collection & Preparation

We imported the campaign performance dataset, meticulously cleaned missing values, and validated data consistency. This included verifying data types and removing anomalies to prepare for robust statistical analysis.



Exploratory Data Analysis (EDA)

EDA involved comparing conversions across campaigns, analyzing click-to-conversion behavior, and visualizing daily conversion distributions. We evaluated overall campaign performance trends, with a key focus on conversion rates, click volumes, distribution patterns, and performance over time.



A/B Testing & Hypothesis Testing

Hypothesis Setup

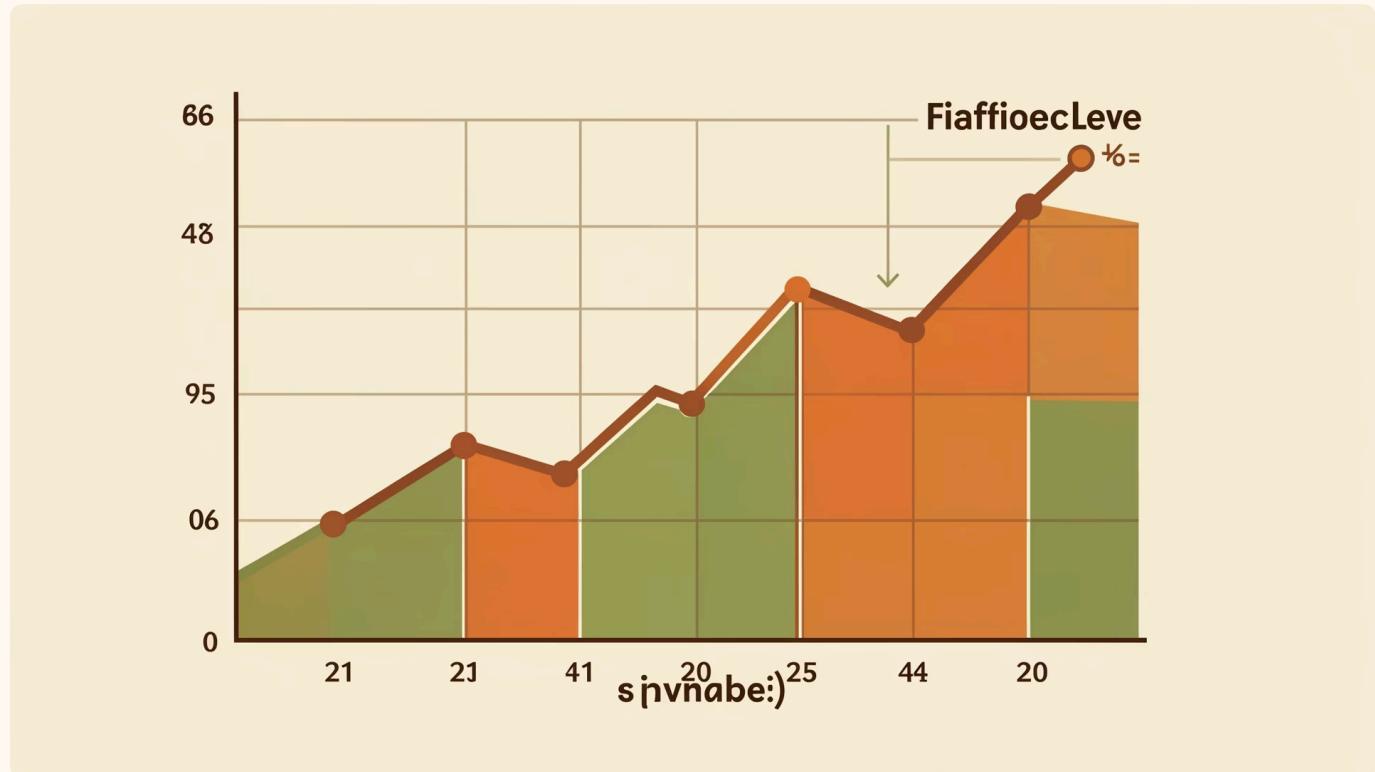
Null Hypothesis (H_0)

No significant difference in conversions between campaigns.

Alternative Hypothesis (H_1)

One campaign generates significantly higher conversions.

Significance Level: $\alpha = 0.05$



Statistical Testing & Key Result



Methodology

We conducted appropriate statistical tests to compare means, meticulously evaluating p-values to determine statistical significance. This rigorous approach allowed us to confidently interpret results and either validate or reject our null hypothesis.

Key Result:

Campaign B achieved a **higher conversion rate** with statistical significance ($p < 0.05$), indicating its superior performance over Campaign A.

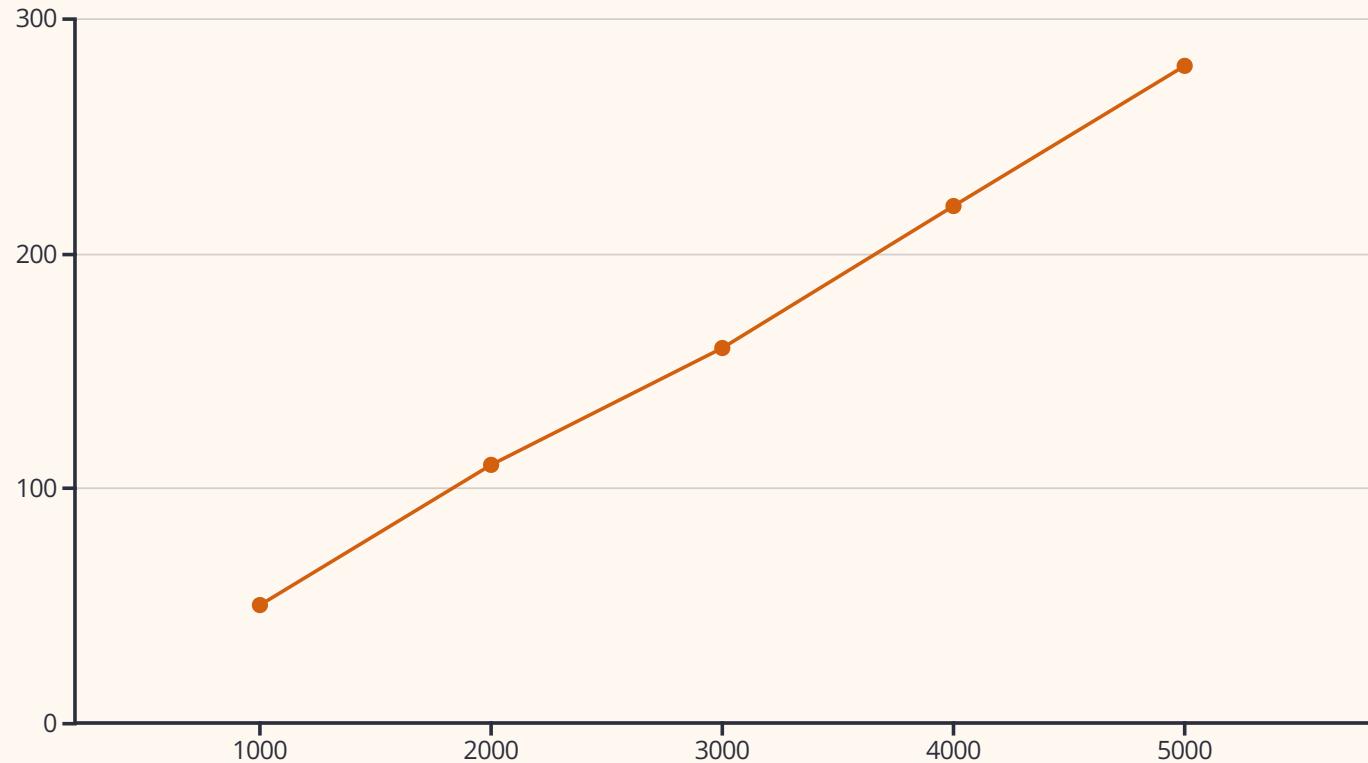
Regression Analysis: Clicks to Conversions

Objective:

To estimate expected conversions based on the number of clicks, providing a predictive model for future campaign planning.

Steps:

- Built a linear regression model.
- Evaluated model performance using R^2 score and Mean Squared Error (MSE).
- Interpreted the relationship between clicks and conversions.



Outcome:

Established a clear predictive relationship, enabling accurate forecasting of expected conversions based on click volume.

Comprehensive Performance Comparison



Total Conversions

Analyzed the raw number of successful outcomes for each campaign.



Conversion Rate

Compared the percentage of clicks that resulted in conversions.



Campaign Lift

Calculated the quantitative improvement one campaign had over another.



Trend Behavior

Examined performance trends over time to identify stability or fluctuations.

Data-Driven Business Insights

1

Campaign B Outperforms

Statistically, Campaign B demonstrated a superior conversion rate compared to Campaign A.

2

Rollout Recommendation

The statistical evidence strongly supports a full rollout of Campaign B.

3

Clicks Drive Conversions

Our regression model confirms that increasing click volume directly positively impacts conversion output.

4

Optimized ROI

Leveraging these data-driven optimizations can significantly improve ROI without necessarily increasing ad spend.

Limitations & Future Improvements



Limitations

- Limited sample size impacted statistical power.
- Absence of user segmentation (new vs. returning users).
- External factors (seasonality, targeting) were not controlled.
- Linear regression assumes a linear relationship.



Future Improvements

- Conduct power analysis pre-experimentation.
- Segment user groups for deeper insights.
- Implement multi-arm bandit testing for variants.
- Incorporate time-series modeling for seasonality adjustments.
- Add comprehensive cost-per-acquisition (CPA) and ROI analysis.