# **Data-Driven A/B Testing for Digital Marketing Optimization**

## Project Overview

This project implements a complete **A/B testing analysis** to evaluate the effectiveness of a digital marketing campaign. The dataset consists of two groups:

* **Test Group:** Users who were exposed to a new marketing strategy.
* **Control Group:** Users who continued with the existing strategy.

The objective is to determine whether the new strategy leads to a significant improvement in user engagement and conversions.

## Data Description

The datasets contain key marketing metrics such as:

* **Spend (USD):** Amount spent on the campaign.
* **Impressions & Reach:** Number of times the ad was shown and the number of unique users it reached.
* **User Engagement Metrics:** Clicks, searches, content views, add-to-cart actions, and purchases.

## Methodology

1. **Data Preprocessing**
   * Loaded the datasets and parsed the date column.
   * Handled missing values by filling them with 0.
   * Ensured that all numeric columns were correctly formatted for analysis.
   * Calculated conversion rates (e.g., Clicks/Impressions, Purchases/Impressions).
2. **Exploratory Data Analysis (EDA)**
   * Plotted **conversion rate distributions** for both groups to visualize differences.
   * Created **time series plots** to observe conversion rate trends over time.
   * Used **box plots** to compare conversion rate distributions between groups.
3. **Statistical Hypothesis Testing**
   * Performed **independent t-tests** to compare conversion rates between the test and control groups.
   * Ensured data validity by filtering out NaN and infinite values.
   * Evaluated statistical significance using a **p-value threshold of 0.05**.
4. **Results Interpretation**
   * The statistical test results help determine whether the new marketing strategy significantly outperforms the old one.
   * If significant differences exist, the test group’s strategy may be considered for wider implementation.

## Key Takeaways

* This project provides a **data-driven approach** to decision-making in marketing.
* The use of statistical analysis helps eliminate bias and ensures **objective performance evaluation**.
* The visualizations allow for an intuitive understanding of the impact of the new strategy.