# Evaluating the Impact of a New Landing Page on User Conversion Rates: An A/B Testing Analysis for an E-Commerce Platform

🧾 Project Overview

This project investigates whether a newly designed landing page improves user conversion rates compared to the existing page on an e-commerce platform. By leveraging **A/B testing**, we aim to determine whether any observed differences in conversion rates are statistically significant and translate into actionable business insights. The analysis follows a rigorous data science workflow including experimental design, data cleaning, exploratory data analysis, statistical hypothesis testing, and business impact assessment.
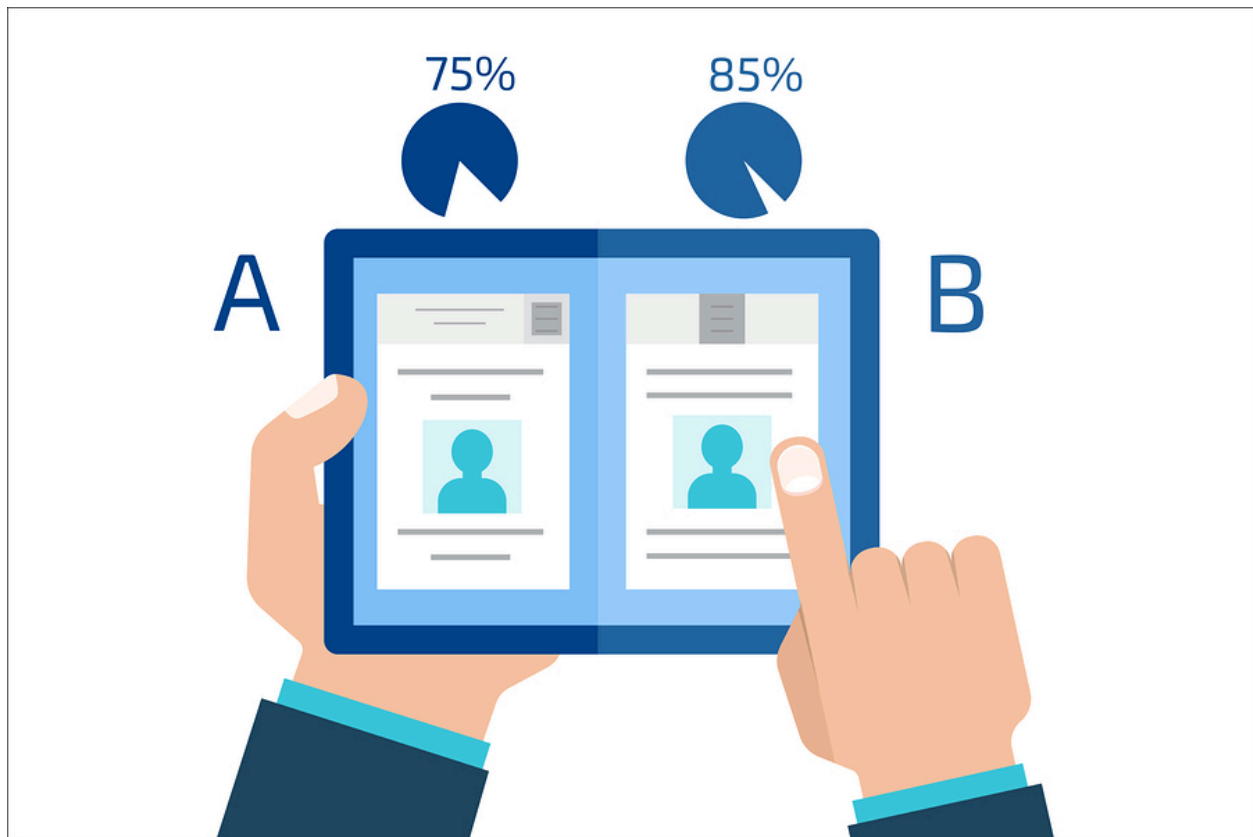
🎯 Business Objective

To **evaluate the performance of a redesigned landing page**, with the goal of increasing the **user conversion rate**, which is a critical metric for revenue growth in e-commerce.

🧪 Experimental Design

- **Test Type**: A/B Testing (Between-subjects)

- **Unit of Analysis**: Unique user session

- **Metric of Interest (Primary KPI)**: Conversion Rate = Number of Conversions / Total Visitors

- **Null Hypothesis (H_0)**: There is no difference in conversion rates between the old and new landing pages.

- **Alternative Hypothesis (H_1)**: The new landing page has a different (higher or lower) conversion rate than the old one.

📦 Dataset Description

The dataset includes two groups:

- **Control Group**: Users who were shown the original landing page.

- **Treatment Group**: Users who were shown the new landing page.

Each record includes:

- `user_id` : Unique identifier for each visitor

- `group` : 'control' or 'treatment'

- `landing_page` : 'old_page' or 'new_page'

- `converted` : Binary variable indicating whether the user converted (1) or not (0)

🧹 Data Cleaning & Validation

Key cleaning and sanity checks:

- Verified one-to-one mapping between `group` and `landing_page` .

- Removed inconsistent rows where treatment group did not receive new page or control group did not receive old page.

- Checked for duplicate `user_id` s and removed any overlaps to maintain experimental integrity.

- Final cleaned sample sizes:

  - **Control group**: N_1 = 144,226

  - **Treatment group**: N_2 = 144,314

📊 Exploratory Data Analysis (EDA)

Conversion Rates:

- **Control Group**: 12.02%

- **Treatment Group**: 11.87%

At first glance, the new page has a **slightly lower** conversion rate than the original. However, a formal statistical test is required to determine if this difference is

statistically significant.

We visualized conversion rates for both groups using a bar plot to get an immediate sense of performance differences:

Conversion Rate by Group
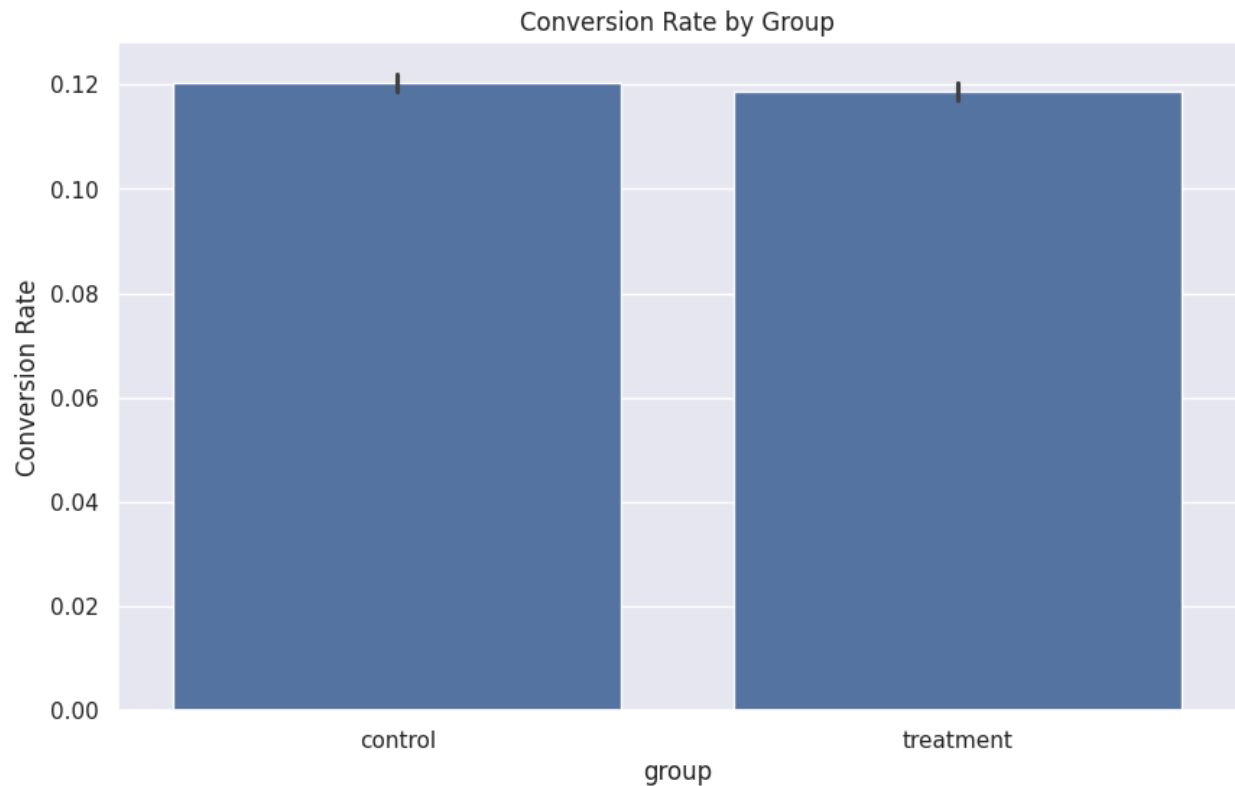
We also explored the distribution of users across different countries for both groups to ensure a
balanced experiment across regions:

Country	Control	Treatment
CA	7,138	7,256
UK	36,100	35,861
US	100,988	101,197

User Distribution by Country and Group
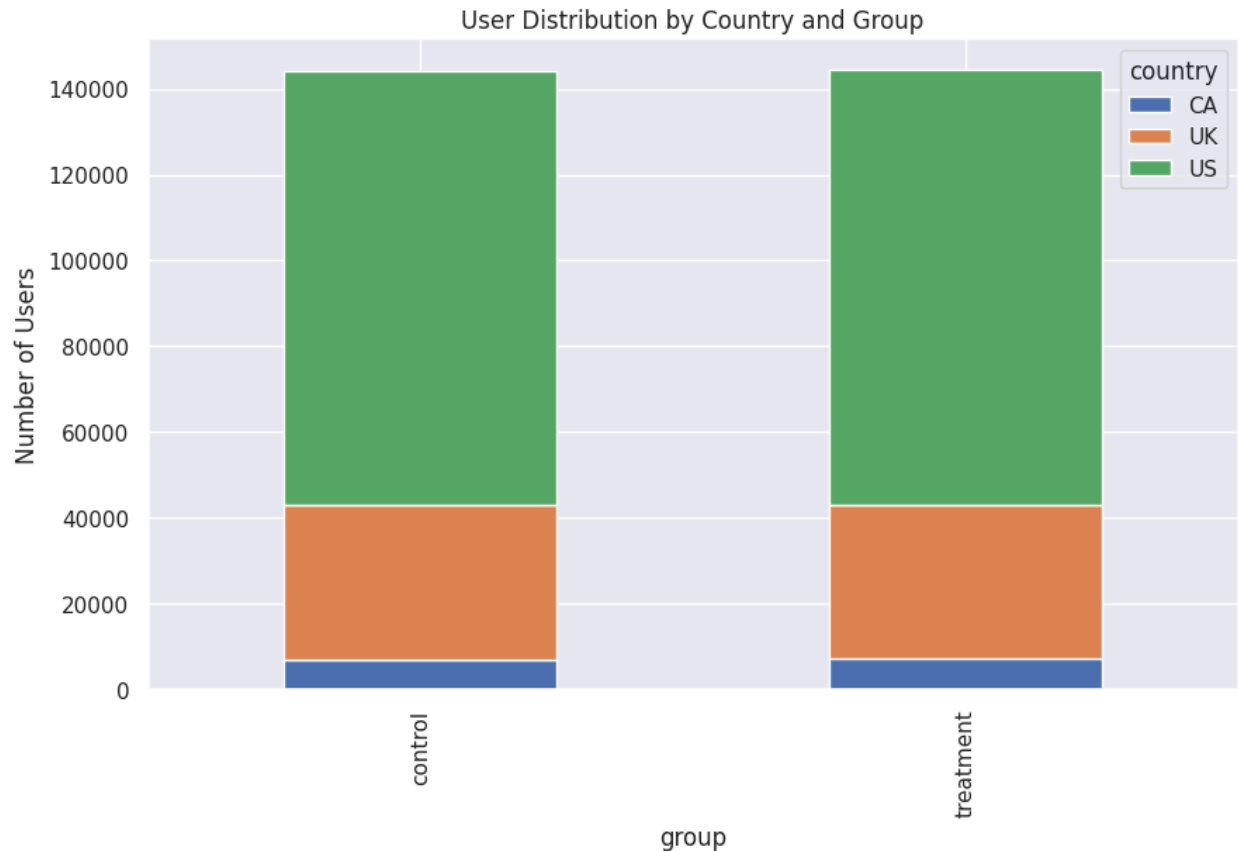
Observations:

- The distribution is **almost identical** between the control and treatment groups across all three countries (CA, UK, US).

- The US has the highest user count by a wide margin, followed by the UK and Canada.

- This balance reinforces the **randomization quality** of the experiment and rules out **geographic bias** in the results.

📐 Statistical Testing

Hypothesis Setup

- **Null Hypothesis (H_o):** There is no difference in conversion rates between the new and old landing pages.

- **Alternative Hypothesis (H$_1$):** There is a difference in conversion rates between the two pages.

Results of the Z-Test

Metric	Value
Z-statistic	-1.2942
P-value	0.1956
Significance Level (α)	0.05

Interpretation

- The **p-value of 0.1956** is **greater than 0.05**, meaning we **fail to reject the null hypothesis**.

- Statistically, there is **no significant difference** in conversion rates between the control group (12.02%) and the treatment group (11.87%).

- The **z-statistic of -1.2942** is not extreme enough to indicate a meaningful effect of the new landing page on conversions.

Although the control group had a slightly higher conversion rate, this difference is not **statistically significant**. The test suggests that the **new landing page does not outperform** the existing one in driving conversions.

💡 Business Implications

- The redesign **did not improve** the conversion rate and even showed a slight decrease.

- Deploying the new page may **not yield positive ROI**, especially considering the costs associated with design, engineering, and testing.

- Recommendation: **Retain the current landing page** and consider further user research or iterative design based on qualitative insights before additional testing.

✅ Conclusion

This A/B test demonstrates that the new landing page does **not lead to a statistically or practically significant improvement** in conversion rates. Based on the data, the new design should not be rolled out. Future experimentation might include testing multiple variants or focusing on other components of the user journey.

📚 References and Citations

- **Dataset Source:** A/B Testing Data
- **Python Libraries Used:** `pandas` , `numpy` , `matplotlib` , `seaborn` , `scipy` , `statsmodels`
- **Z-Test Methodology Reference:**
  - Two-Proportion Z-Test Explanation – Towards Data Science
  - Hypothesis Testing – Khan Academy
- **A/B Testing Concepts and Best Practices:**
  - Optimizely A/B Testing Guide

🧾 Code Documentation

- All analysis steps were executed in **Python** using a **Jupyter Notebook** environment.
- The notebook is structured and modular, with each section accompanied by clear **Markdown explanations** to enhance interpretability and traceability.
- The analysis flow follows the standard A/B Testing pipeline:
  1. **Data Loading & Inspection**
  2. **Data Cleaning & Preprocessing**
  3. **Exploratory Data Analysis (EDA)**
     - Conversion rate comparison
     - User distribution by group and country
  4. **Statistical Testing (Two-Proportion Z-Test)**
  5. **Result Interpretation & Business Recommendation**

💻 Environment & Setup

- **Python Version**: ≥3.7

- **Recommended Environment**: Jupyter Notebook / JupyterLab

📦 Required Packages

Install the necessary Python libraries using:

```
pip install pandas numpy matplotlib seaborn scipy statsmodels
```

Materials & Resources

IPYNB Notebook:
https://colab.research.google.com/drive/1FyxNydmLhS0dtioZpL7kIG8TwpoIQnSQ?usp=sharing

GitHub Link: https://github.com/Rudrajit12/Ecommerce-AB-Test-Case-Study

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