A/B TEST ANALYSIS: AD VS. PSA CAMPAIGN (SYNTHETIC DATASET)
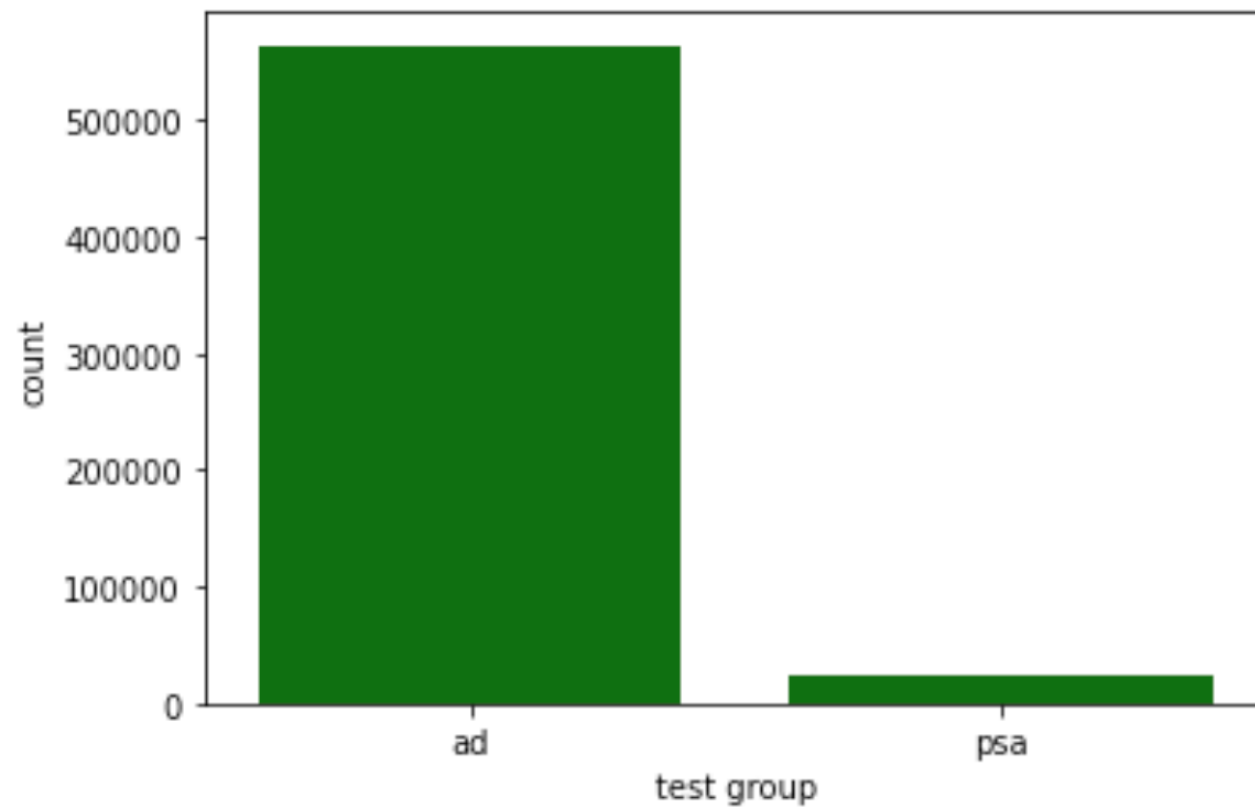
- Conversion Analysis with Statistical Testing & Business Insight

- Joe Lam

- 🔗 https://github.com/joelam21/marketing-ab-test-ad-vs-psa

OBJECTIVE & BUSINESS CONTEXT

Test Goal: Which marketing approach drives more conversions — an ad or a PSA?

Outcome Metric: Binary (converted or not)

Dataset: Synthetic data from Kaggle (for demonstration purposes)

EXPERIMENTAL DESIGN

Two groups: Ad group vs. PSA group

Group sizes were imbalanced (ad group was larger)

Random assignment used; stratification not applied (no user metadata)

HYPOTHESES & SIGNIFICANCE

Defining the question and the statistical tools used to answer it

- **H_0**: No difference in conversion rate between groups
- **H_1**: Ad group has a higher conversion rate than PSA group
- **Significance level (α):** 0.05
- Test: Two-Proportion Z-Test
- **One-tailed (right-tailed) test**: We're testing for improvement, not just any difference

- 💡 Why we chose this test:
- We're comparing two groups, ad vs. PSA to see if one has a higher conversion rate. Because of the large sample size, the Two-Proportion Z-Test is appropriate and statistically reliable.

RESULTS — CONVERSION RATES & LIFT

📌 **Statistical Result:**

- Two-Proportion Z-Test
- p-value < 0.001, well below the significance level (α = 0.05)
- ✅ **Null hypothesis rejected** — ad group significantly outperformed PSA

📊 **Highlights:**

- Ad group conversion rate: e.g., 2.55%
- PSA group conversion rate: e.g., 1.78%
- Absolute Lift: 0.77 percentage points
    - 0.0255 - 0.0179 = 0.0077
- Relative Lift: 43.09% improvement
    - (0.0077 / 0.0179) * 100 = 43.09%

➡️ **Takeaway:**

- The ad group drove **43% more conversions** than PSA — a meaningful lift that justifies continued investment in ad-based campaigns

Bootstrap Distribution of Conversion Rates (95% CI)
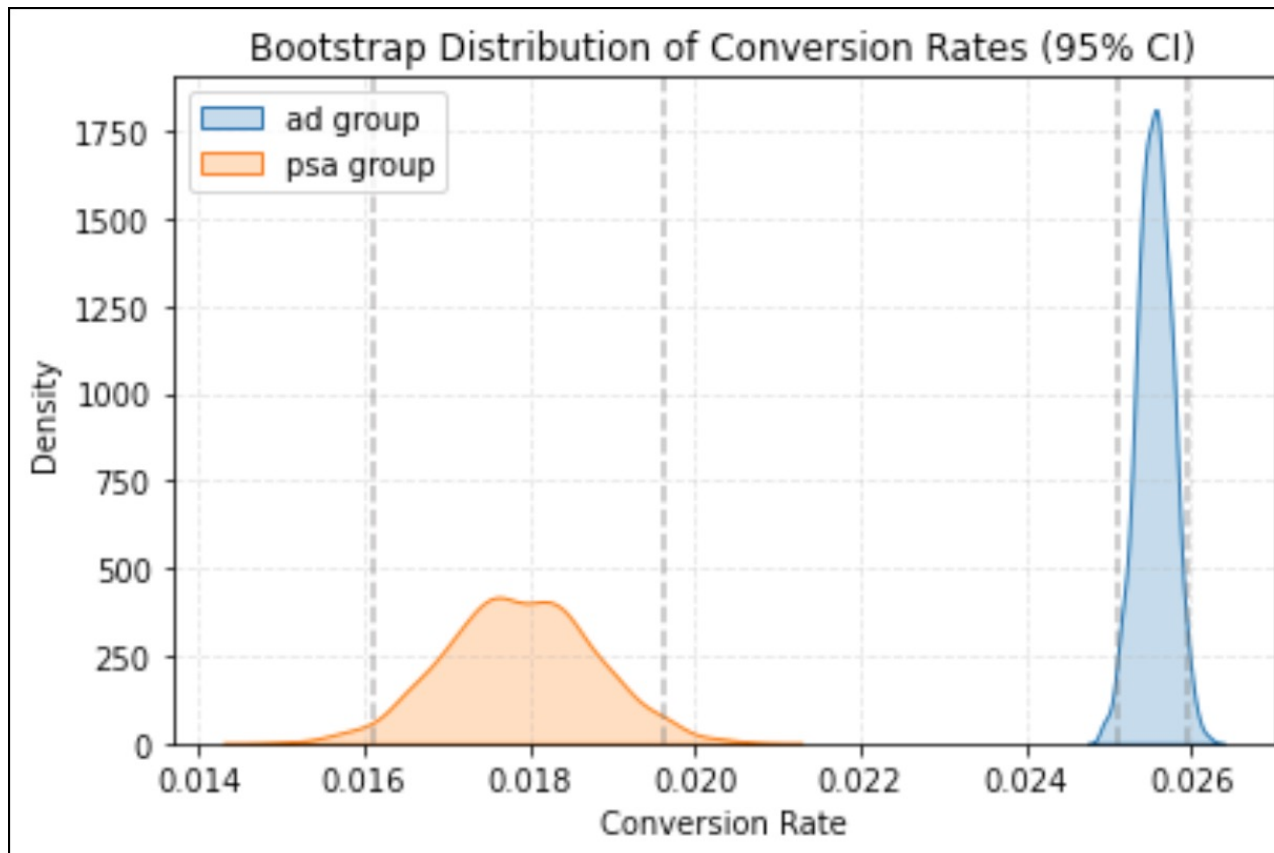
CONFIDENCE & BOOTSTRAPPING

The ad group outperformed PSA with high confidence

Bootstrapped 1,000 samples per group to visualize uncertainty

95% Confidence Intervals show no overlap

Ad group shows higher and more consistent performance

The visual clearly shows a clear separation between the two groups – there's no ambiguity

FINAL TAKEAWAYS & RECOMMENDATION

✅ **Ad strategy is a clear winner**

- Ad group achieved a **43% higher conversion rate** than PSA
- Lift is both **statistically significant** and **business meaningful**

📊 **Backed by strong evidence**

- Two-Proportion Z-Test confirms significance
- Bootstrapped confidence intervals show **no overlap**

💡 **Actionable next steps**

- Move forward with **ad-based campaigns**
- Test **ad variations** and **targeted segmentation** strategies

APPENDIX / ADDITIONAL NOTES

- Group imbalance noted; PSA group still exceeded power threshold

- No stratification applied due to lack of user-level metadata

- Synthetic data used — reflects structure of real A/B test

- Dataset: Synthetic data from Kaggle – Marketing A/B Test