

Task 11: A/B Testing – Hypothesis Testing in Python

1. Introduction

A/B testing is a statistical method used to compare two versions of a product, feature, or strategy to determine which performs better. In this task, an A/B test was conducted using Python to evaluate whether a **test group** performs better than a **control group** based on conversion metrics.

This task demonstrates the ability to:

- Design hypotheses
 - Perform statistical tests
 - Interpret p-values and confidence intervals
 - Make data-driven business decisions
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2. Objective of the Task

The main objective of this task is to:

- Perform an A/B test using an e-commerce dataset
 - Determine whether there is a statistically significant difference between control and test groups
 - Provide a final business recommendation based on the results
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3. Tools and Technologies Used

- **Platform:** Google Colab
 - **Programming Language:** Python
 - **Libraries Used:**
 - pandas – data manipulation
 - numpy – numerical operations
 - scipy – statistical testing
 - matplotlib – data visualization
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4. Dataset Description

Original Dataset

- **Dataset name:** E-commerce Product Dataset
- Contains information such as product sales and related attributes.

Dataset Transformation

Since the original dataset was not designed for A/B testing, it was transformed to simulate an experiment:

- A **control/test group** column was created
- A **conversion metric** was defined based on sales performance

Final A/B Dataset Columns

Column Name	Description
group	Indicates control or test group
converted	Binary conversion outcome (1 = converted, 0 = not converted)

5. Experimental Design

Group Assignment

- Users/products were randomly assigned to:
 - **Control group** (existing version)
 - **Test group** (new version)

Conversion Definition

- A conversion is marked as 1 if sales are above the median sales value
- Otherwise, conversion is marked as 0

This approach simulates real-world A/B testing scenarios.

6. Hypothesis Definition

- **Null Hypothesis (H_0):**
There is no significant difference between the control group and the test group.
- **Alternative Hypothesis (H_1):**
There is a significant difference between the control group and the test group.
- **Significance Level (α):**
 $\alpha = 0.05$

7. Methodology

Step 1: Data Loading

The dataset was loaded using pandas and inspected for correctness.

Step 2: Data Preparation

- Random group assignment
- Creation of conversion metric
- Final A/B dataset exported as ab_data.csv

Step 3: Group Segmentation

Data was split into:

- Control group conversions
- Test group conversions

Step 4: Metric Calculation

- Conversion rate for each group was calculated using mean values.

Step 5: Statistical Test

- An **Independent Two-Sample t-test** was used.
- This test is suitable because:
 - The metric is numerical (0/1)
 - Two independent groups are compared

Step 6: Significance Evaluation

- p-value was compared against $\alpha = 0.05$
 - Decision made to reject or fail to reject the null hypothesis
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8. Statistical Analysis

Conversion Rate Comparison

- Control group conversion rate was calculated
- Test group conversion rate was calculated

p-value Interpretation

- If p-value $< 0.05 \rightarrow$ statistically significant difference
 - If p-value $\geq 0.05 \rightarrow$ no statistically significant difference
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9. Confidence Interval

A 95% confidence interval was calculated for the difference in conversion rates.

- The confidence interval helps estimate the range in which the true difference lies
 - If the interval does not include zero, the difference is considered statistically meaningful
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10. Visualization

A bar chart was created to visually compare conversion rates between:

- Control group
- Test group

This visualization helps stakeholders easily understand performance differences.

11. Results Summary

- Control and test group conversion rates were compared
- Statistical testing was successfully performed
- The p-value and confidence interval guided the final decision

Results were summarized and saved in:

- ab_test_summary.csv
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12. Business Recommendation

Based on the A/B testing results:

- If the test group shows statistically significant improvement, it is recommended to roll out the test version.
- If no significant difference is observed, the control version should be retained, and further testing may be conducted.

The final recommendation was documented in:

- final_recommendation.txt
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13. Deliverables

The following files were generated and uploaded to GitHub:

- task11_abtest.ipynb – Complete Python analysis notebook
 - ab_data.csv – A/B testing dataset
 - ab_test_summary.csv – Summary of conversion rates
 - final_recommendation.txt – Business decision
 - README.md – Task overview and explanation
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14. Learning Outcome

Through this task, the following skills were developed:

- Understanding of A/B testing concepts
 - Practical implementation of hypothesis testing
 - Statistical thinking and result interpretation
 - Translating analysis into business decisions
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15. Conclusion

This task successfully demonstrates the use of A/B testing to make data-driven decisions. By applying statistical methods to real-world data, meaningful insights were derived, reinforcing the importance of experimentation and analytics in product and business strategy.



