



03 – A/B Testing: Retention Campaign Effectiveness

This notebook analyzes the effectiveness of a churn intervention campaign using an A/B test.



Load A/B Test Dataset



```
In [10]: import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

# Load dataset
df_ab = pd.read_csv('../data/processed/ab_test.csv')
df_ab['churn'] = df_ab['churn'].astype(int)
df_ab.head()
```

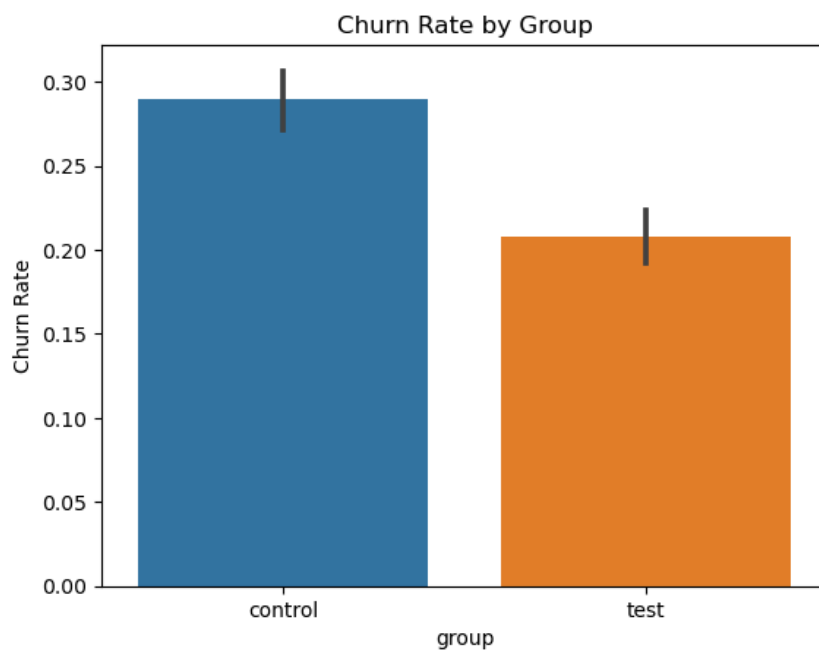
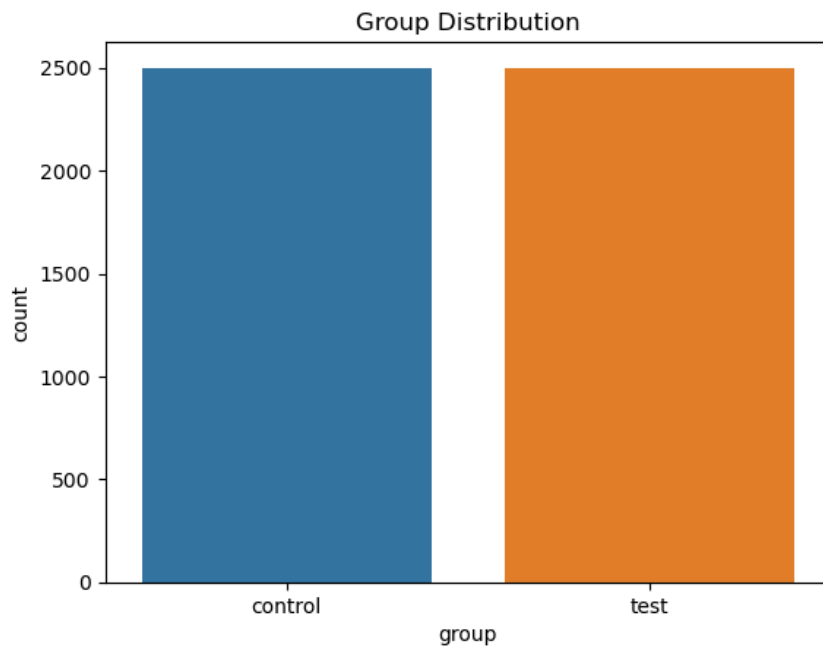
Out[10]:

	customerID	group	churn
0	AB_00000	control	0
1	AB_00001	test	0
2	AB_00002	test	1
3	AB_00003	test	0
4	AB_00004	control	1

Visualize Group Sizes and Churn Rates

```
In [12]: # Group sizes
sns.countplot(data=df_ab, x='group')
plt.title('Group Distribution')
plt.show()

# Churn rate per group
sns.barplot(data=df_ab, x='group', y='churn')
plt.title('Churn Rate by Group')
plt.ylabel('Churn Rate')
plt.show()
```



Churn Rate Comparison

```
In [13]: churn_rates = df_ab.groupby('group')['churn'].mean()
print(churn_rates)

control_rate = churn_rates['control']
test_rate = churn_rates['test']

uplift = control_rate - test_rate
print(f"Churn rate reduction (uplift) = {uplift:.2%}")

group
control    0.2892
test       0.2076
Name: churn, dtype: float64
Churn rate reduction (uplift) = 8.16%
```

Proportion Z-Test (Two-Proportions)

```
In [14]: from statsmodels.stats.proportion import proportions_ztest

# Number of churns in each group
churn_counts = df_ab.groupby('group')['churn'].sum()
counts = churn_counts.values

# Total samples in each group
nobs = df_ab.groupby('group')['churn'].count().values

stat, pval = proportions_ztest(count=counts, nobs=nobs)
print(f"Z-test statistic: {stat:.3f}, p-value: {pval:.4f}")
if pval < 0.05:
    print("✅ Statistically significant difference in churn rates.")
else:
    print("❌ No statistically significant difference detected.")
```

Z-test statistic: 6.677, p-value: 0.0000

✅ Statistically significant difference in churn rates.

Confidence Interval for Difference

```
In [15]: import numpy as np
import statsmodels.api as sm

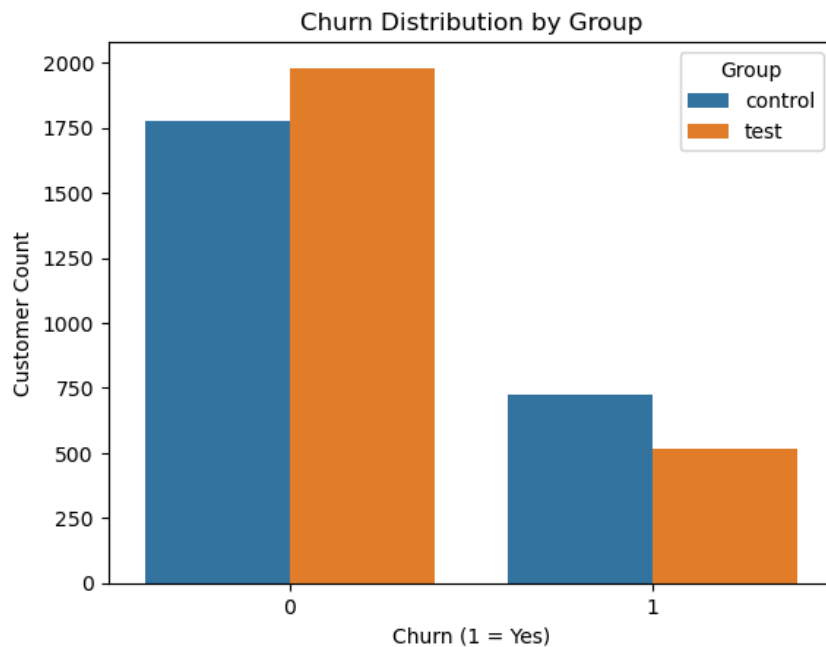
ci_low, ci_upp = sm.stats.proportion_confint(counts[1], nobs[1], alpha=0.05, method='normal')
print(f"Test group churn rate CI: ({ci_low:.3f}, {ci_upp:.3f})")

Test group churn rate CI: (0.192, 0.223)
```

✅ Conclusion

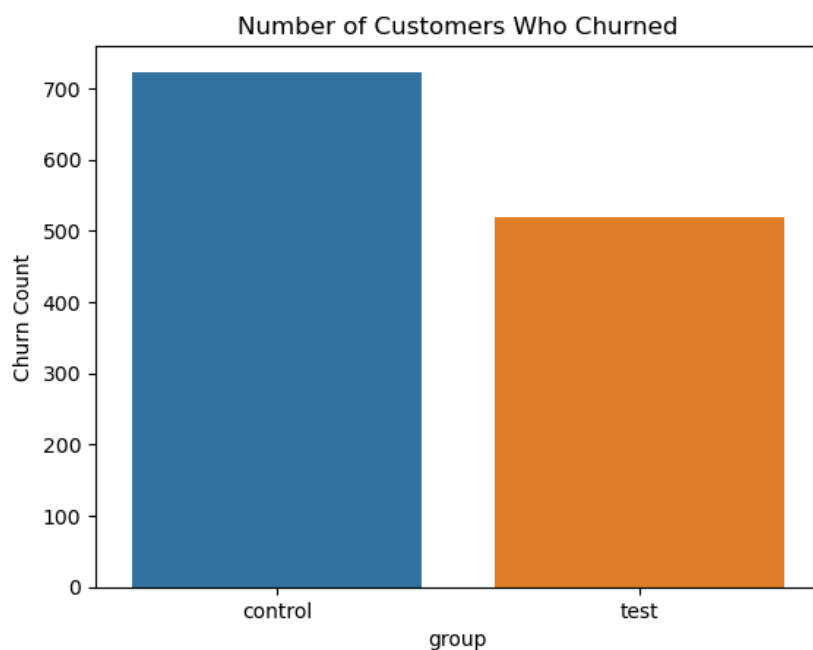
Churn Distribution by Group

```
In [16]: sns.countplot(data=df_ab, x='churn', hue='group')
plt.title('Churn Distribution by Group')
plt.xlabel('Churn (1 = Yes)')
plt.ylabel('Customer Count')
plt.legend(title='Group')
plt.show()
```



Number of Churners by Group

```
In [17]: churn_counts_df = df_ab.groupby('group')['churn'].sum().reset_index()
sns.barplot(x='group', y='churn', data=churn_counts_df)
plt.title('Number of Customers Who Churned')
plt.ylabel('Churn Count')
plt.show()
```



Lift Calculation

```
In [18]: baseline = churn_rates['control']
relative_lift = (baseline - churn_rates['test']) / baseline
print(f'Relative Lift: {relative_lift:.2%}')

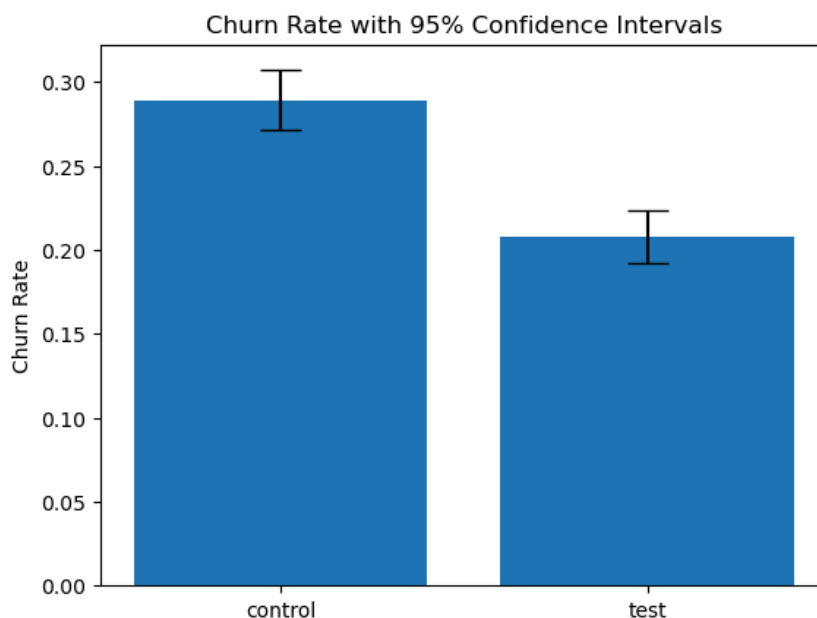
Relative Lift: 28.22%
```

Churn Rate with 95% Confidence Intervals

```
In [19]: import numpy as np

ci_control = sm.stats.proportion_confint(count=churn_counts['control'], nobs=nobs[0], alpha=0.05)
ci_test = sm.stats.proportion_confint(count=churn_counts['test'], nobs=nobs[1], alpha=0.05)

plt.bar(['control', 'test'], [control_rate, test_rate],
        yerr=[[control_rate - ci_control[0], test_rate - ci_test[0]],
              [ci_control[1] - control_rate, ci_test[1] - test_rate]],
        capsize=10)
plt.ylabel('Churn Rate')
plt.title('Churn Rate with 95% Confidence Intervals')
plt.show()
```



Summary Table

```
In [20]: summary = pd.DataFrame({
'Churn Rate': churn_rates,
'95% CI Lower': [ci_control[0], ci_test[0]],
'95% CI Upper': [ci_control[1], ci_test[1]]
})
summary
```

```
Out[20]:
```

	Churn Rate	95% CI Lower	95% CI Upper
group			
control	0.2892	0.271427	0.306973
test	0.2076	0.191701	0.223499

A/B Test Summary – Retention Campaign Impact

Objective

To evaluate whether a targeted retention campaign (e.g., discounts, retention calls) led to a statistically significant reduction in customer churn.

Group Performance

Group	Churn Rate
Control	28.92%
Test	20.76%

- **Uplift (churn reduction): 8.16 percentage points**
- The test group experienced **significantly less churn** than the control group.

Statistical Significance

- **Z-test statistic:** 6.677
 - **P-value:** < 0.0001 (reported as 0.0000 due to formatting)
- ✓ The difference in churn rates is **statistically significant** ($p < 0.05$).
- ✓ We **reject the null hypothesis** that there is no difference between the two groups.

Confidence Interval

- **Test group churn rate 95% CI:** (0.192, 0.223)
- Interpretation: We are 95% confident the true churn rate for the test group lies within this range.

Visual Evidence

- Bar plots show clear reduction in churn for the test group.
- Balanced group sizes confirmed through group distribution plot.

Interpretation

- The retention campaign successfully reduced churn by ~8%.
- Given statistical significance and confidence intervals, this result is **unlikely to be due to chance**.

Business Recommendation

- ✓ **Scale** the campaign across broader customer segments.
- ✓ Combine with **predictive churn models** for better targeting.
- 📄 Continue **A/B testing alternate retention offers** to maximize ROI.

In []: