

AB Test - Marketing Campaign Analysis

A/B Testing Analysis for Marketing Campaign

(Subtitle) — Evaluating Facebook vs Instagram Conversions

Note: This project uses a synthetic dataset generated using ChatGPT for educational and demonstration purposes.

Business Problem

As a marketing agency, our primary objective is to maximize the return on investment(ROI) for our clients' advertising campaigns. We have conducted two ad campaigns, one on Facebook and the other on Instagram, and we need to determine which platform yields better results in terms of clicks, conversions, and overall cost-effectiveness. By identifying the most effective platform, we can allocate our resources more efficiently and optimize our advertising strategies to deliver better outcomes for our clients.

Step1: Dataset Preparation

Import dataset

```
from google.colab import drive
drive.mount('/content/drive')

import pandas as pd

df = pd.read_csv('/content/drive/MyDrive/AB_Testing_Ad_Data_2025.csv')
```

df.head()

	Date	FB_Impressions	FB_Clicks	FB_CTR	FB_Conversions	FB_Conv_Rate	FB_Spend	FB_Revenue	FB_ROAS	IG_Impressions	IG_Clicks
0	2025-01-01	36902	396	0.0107	50	0.1263	195.21	635.88	3.26	29635	3250
1	2025-01-02	14073	166	0.0118	37	0.2229	158.86	401.51	2.53	12768	1420
2	2025-01-03	13821	642	0.0465	121	0.1885	191.87	735.04	3.83	13429	1480
3	2025-01-04	11123	233	0.0209	21	0.0901	186.48	367.57	1.97	8926	980
4	2025-01-05	12699	547	0.0431	59	0.1079	182.26	1325.02	7.27	8638	980

Next steps: [Generate code with df](#) [New interactive sheet](#)

Dataset Description

The dataset covers a Facebook Ad campaign and Instagram Ad campaign for a year. the dataset includes various performance metrics for each ad campaign, providing insights into their effectiveness and efficiency over time.

Impressions: How many times the ad was shown. Higher means better reach.

Clicks: How many people clicked the ad, showing engagement.

CTR (Click-Through Rate): Percentage of impressions that turned into clicks. Higher CTR means the ad is effective.

Conversions: Number of people who completed the target action (e.g., signup or purchase).

Conversion Rate (CVR): Percentage of clicks that turned into conversions. Shows how well the funnel works.

Spend: The total amount spent on ads.

Revenue: Money earned from the conversions.

ROAS (Return on Ad Spend): How much revenue was earned for every ₹1 spent. Main metric to evaluate success.

✓ Step 2: Exploratory Data Analysis

```
df.shape
```

```
(365, 17)
```

```
df.dtypes
```

	0
Date	object
FB_Impressions	int64
FB_Clicks	int64
FB_CTR	float64
FB_Conversions	int64
FB_Conv_Rate	float64
FB_Spend	float64
FB_Revenue	float64
FB_ROAS	float64
IG_Impressions	int64
IG_Clicks	int64
IG_CTR	float64
IG_Conversions	int64
IG_Conv_Rate	float64
IG_Spend	float64
IG_Revenue	float64
IG_ROAS	float64

```
dtype: object
```

```
# Convert Date datatype from object to datetime.  
df['Date'] = pd.to_datetime(df['Date'])
```

```
df.describe()
```

	Date	FB_Impressions	FB_Clicks	FB_CTR	FB_Conversions	FB_Conv_Rate	FB_Spend	FB_Revenue	FB_ROAS
count	365	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000	365.000000
mean	2025-07-01 23:59:59.99999744	14279.800000	434.750685	0.030309	64.808219	0.150112	142.137616	948.434027	7.1
min	2025-01-01 00:00:00	8481.000000	93.000000	0.010000	8.000000	0.046800	80.040000	48.430000	0.3
25%	2025-04-02 00:00:00	12734.000000	284.000000	0.020000	35.000000	0.100900	110.860000	442.690000	3.1
50%	2025-07-02 00:00:00	14451.000000	415.000000	0.030100	56.000000	0.149600	141.160000	711.970000	5.0
75%	2025-10-01 00:00:00	15785.000000	561.000000	0.040200	88.000000	0.204300	175.210000	1243.900000	9.8
max	2025-12-31 00:00:00	36902.000000	1659.000000	0.050000	319.000000	0.248700	199.980000	6380.600000	40.2
std	Nan	3166.218691	203.697904	0.011634	41.752692	0.058826	34.838398	760.940223	6.0

✓ Distribution of clicks and conversion

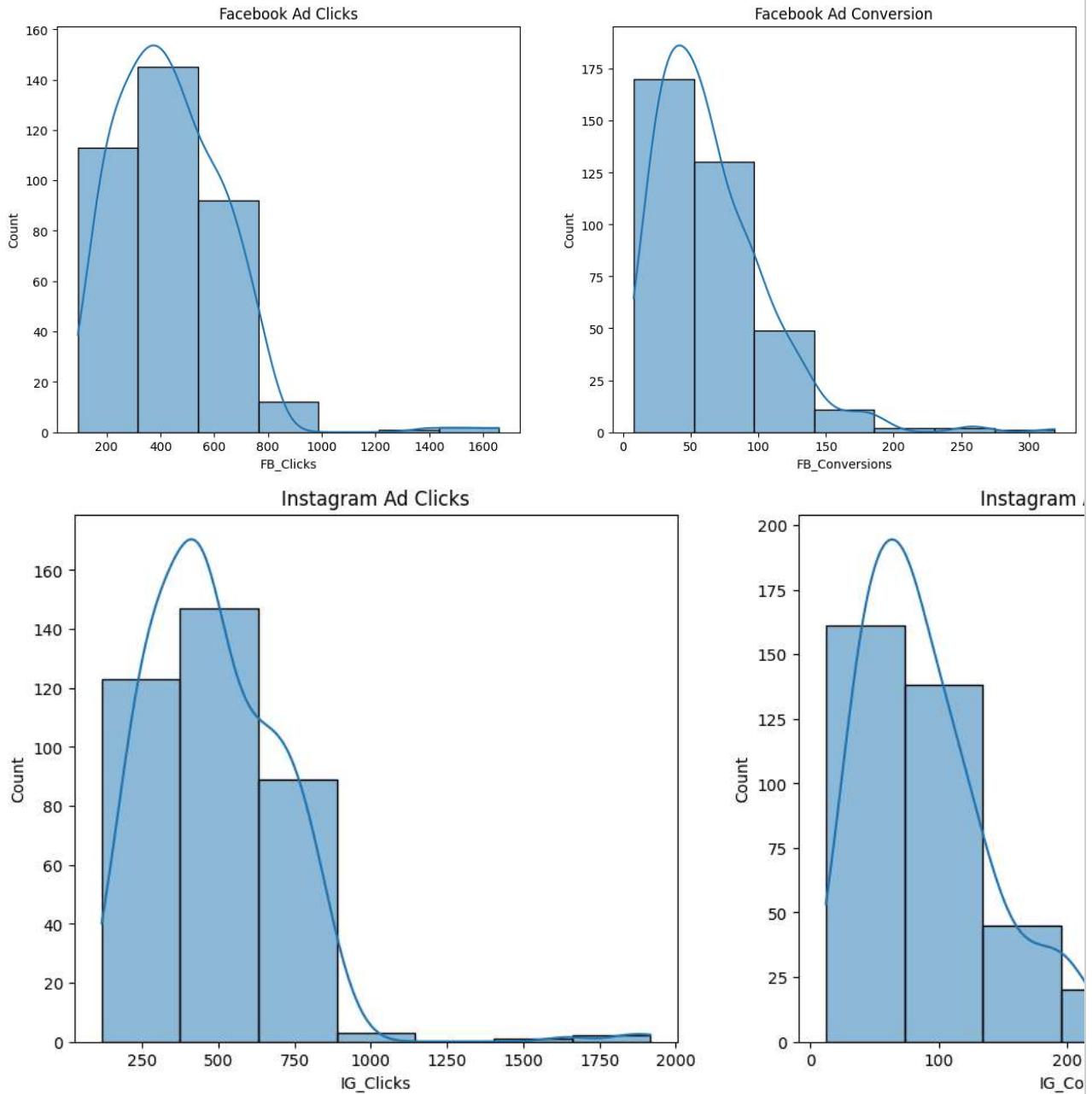
```
import matplotlib.pyplot as plt  
import seaborn as sns  
import numpy as np  
  
plt.figure(figsize = (15,6))
```

```

plt.subplot(1,2,1)
plt.title('Facebook Ad Clicks')
sns.histplot(df['FB_Clicks'],bins = 7, edgecolor = 'black', kde = True)
plt.subplot(1,2,2)
plt.title('Facebook Ad Conversion')
sns.histplot(df['FB_Conversions'],bins = 7, edgecolor = 'black',kde = True)

plt.figure(figsize = (15,6))
plt.subplot(1,2,1)
plt.title('Instagram Ad Clicks')
sns.histplot(df['IG_Clicks'],bins = 7, edgecolor= 'black',kde = True)
plt.subplot(1,2,2)
plt.title('Instagram Ad Conversion')
sns.histplot(df['IG_Conversions'],bins = 7, edgecolor = 'black',kde = True)
plt.savefig('compare_plot')

```



✓ Step 3: Comparison of Key Metrics

```

# categorize the data in three categories - holidays, weekends, weekdays
import holidays
india_holidays = holidays.India()

# define a function
def classify_day(date):

```

```

if date in india_holidays:
    return "Holiday"
elif date.weekday() >= 5:
    return "Weekend"
else:
    return "weekday"
df['date_category'] = df['Date'].apply(classify_day)

```

```

fb_IG_conversion = df.groupby('date_category')[['FB_Conversions','IG_Conversions']].sum().reset_index()
fb_IG_conversion

```

date_category	FB_Conversions	IG_Conversions	
0 Holiday	1420	1866	
1 Weekend	4749	7165	
2 weekday	17486	23932	

Next steps: [Generate code with fb_IG_conversion](#) [New interactive sheet](#)

```
# Difference between conversion of both versions
```

```

fb_IG_conversion['Diff'] = (fb_IG_conversion['IG_Conversions'] - fb_IG_conversion['FB_Conversions'])/fb_IG_conversion['FB_Conversions']
fb_IG_conversion

```

date_category	FB_Conversions	IG_Conversions	Diff	
0 Holiday	1420	1866	31.408451	
1 Weekend	4749	7165	50.873868	
2 weekday	17486	23932	36.863777	

Next steps: [Generate code with fb_IG_conversion](#) [New interactive sheet](#)

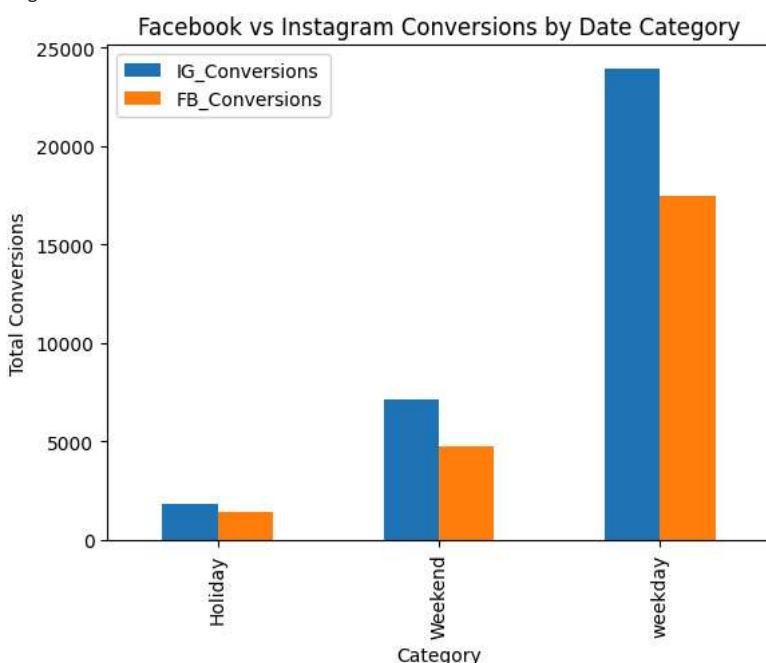
```

plt.figure(figsize = (8,5))
ax = fb_IG_conversion.plot(
    x = 'date_category',
    y = ['IG_Conversions', 'FB_Conversions'],
    kind = 'bar'
)

plt.title("Facebook vs Instagram Conversions by Date Category")
plt.ylabel("Total Conversions")
plt.xlabel("Category")
plt.show()

```

<Figure size 800x500 with 0 Axes>

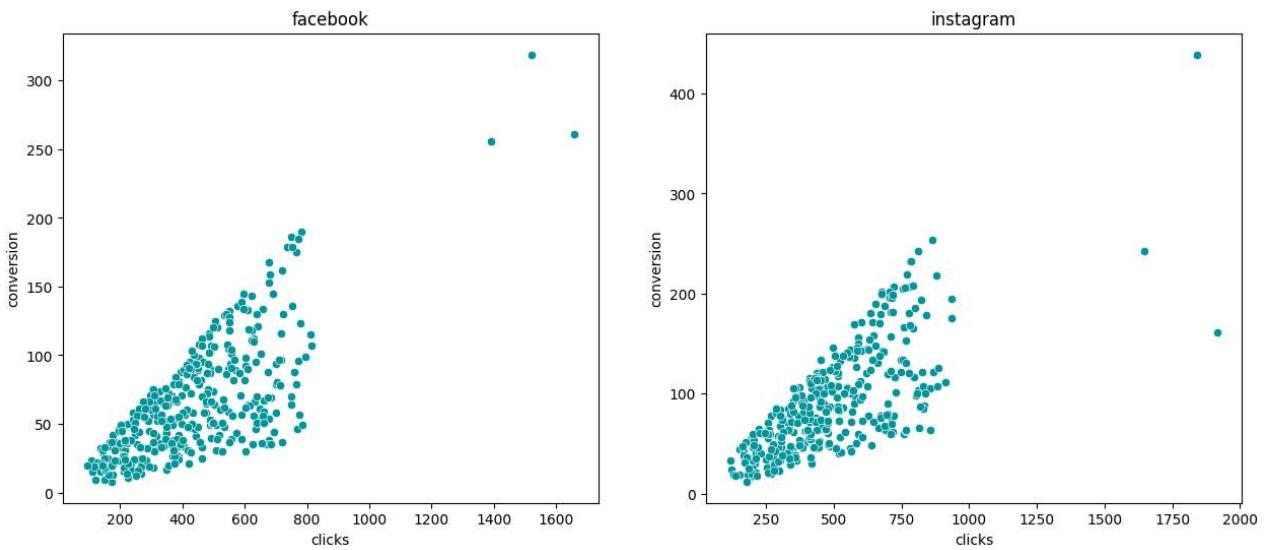


The data suggests Instagram had more frequent higher conversion days than Facebook. There is significant variance in the number of high-conversion days between two different campaigns.

✓ Step 4: Behaviour and Relationship Check

Check weather more clicks cause more conversion

```
plt.figure(figsize = (15,6))
plt.subplot(1,2,1)
plt.title('facebook')
sns.scatterplot(x = df['FB_Clicks'],y =df['FB_Conversions'],color = '#03989E')
plt.xlabel('clicks')
plt.ylabel('conversion')
plt.subplot(1,2,2)
plt.title('instagram')
sns.scatterplot(x = df['IG_Clicks'],y =df['IG_Conversions'],color = '#03989E')
plt.xlabel('clicks')
plt.ylabel('conversion')
plt.show()
```



Find Correlation between clicks and conversion

```
Facebook_corr = df[['FB_Clicks','FB_Conversions']].corr()
Instagram_corr = df[['IG_Clicks','IG_Conversions']].corr()

print('facebook :',round(Facebook_corr.values[0,1],2))
print('Instagram :',round(Instagram_corr.values[0,1],2))

facebook : 0.74
Instagram : 0.73
```

Based on Corr between clicks and conversion, both are looking near about similar, in this condition we can decide which one is performing best so we will move towards hypothesis testing

Note: Correlation does NOT measure volume or cost-effectiveness — only the strength of relationship.

✓ Step 5: Statistical(Hypothesis) Testing

Hypothesis: Advertising on Instagram will result in greater number of conversion compared to Facebook conversion

- H₀: There is no difference in number of conversion of Instagram and Facebook
- Null Hypothesis(H₀): $\mu_{IG}=\mu_{FB}$
- Alternat Hypothesis(H₁):The number of conversion from Instagram is greater than the number of coversion of facebook.
- H₁: $\mu_{IG}>\mu_{FB}$

```
print('Mean Convrision \n-----')
print('facebook :',round(df['FB_Conversions'].mean(),2))
print('Instagram :',round(df['IG_Conversions'].mean(),2))
```

```
from scipy.stats import ttest_ind
t_stat,p_value = ttest_ind(df['IG_Conversions'],df['FB_Conversions'],equal_var = False)
print('T_static :',round(t_stat,2))
print('P_value :',round(p_value,4))

Mean Convrson
-----
facebook : 64.81
Instagram : 90.31
T_static : 7.21
P_value : 0.0
```

Based on Mean Of Conversion Instagram is generating ~39% more conversions per day than Facebook.

Since the p-value is < 0.05 (in fact, ~0), the result is highly statistically significant.

Based on the t-test results, we reject the null hypothesis.

There is a statistically significant difference in conversions between Facebook and Instagram, with Instagram performing substantially better.

```
# With mannwhitneyU test
from scipy.stats import mannwhitneyu

stats,p = mannwhitneyu(df['IG_Conversions'],df['FB_Conversions'],alternative = 'greater')
print('Static :',round(stats,2))
print('P_value :',round(p,8))

Static : 87567.5
P_value : 0.0
```

results are consistent: IG_Conversions and FB_Conversions are significantly different.

▼ Step 6: Insights and Recommendation

Instagram clearly outperforms Facebook in terms of conversions. The difference in mean conversions is substantial (90.31 vs. 64.81), and both statistical tests support that this gap is highly significant. Since the p-value is effectively zero, the results are unlikely due to chance.

Based on the findings, Instagram should be prioritized for future campaigns, as it delivers better conversion performance. Facebook can still be part of the strategy, but it may require adjustments in targeting, creative, or budget allocation to improve outcomes.