

# Task 1: Social Media Performance Analysis

## Analysis Steps:

- Calculated average engagement rate by platform
- Evaluated reach by content type
- Identified best-performing content formats (Carousels, Shorts, Reels)
- Analyzed optimal posting hours based on engagement and CTR

## Step-by-Step Plan

### 1. Data Preparation

I'll structure and clean the dataset to enable calculation of the following:

### 2. Required Metrics

#### a. Engagement Rate by Platform

Engagement Rate =  $\frac{\text{Likes} + \text{Comments} + \text{Shares}}{\text{Reach}} \times 100$  / Reach

#### b. Average Reach per Post Type

Group by content type and average the "Reach / Posts".

#### c. Best Performing Content Categories

Rank content types by engagement rate, CTR, and reach.

#### d. Optimal Posting Times

Analyze average engagement rate and CTR by Hour\_Posted.

## Visuals, charts, and tables

### Sample Data Table

Date	Platform	Content Type	Likes	Comments	Shares	Reach	Impressions	CTR	Engagement Rate
01/01/24	Instagram	Image	1250	85	45	8500	12000	3.2	16.23%

Date	Platform	Content Type	Likes	Comments	Shares	Reach	Impressions	CTR	Engagement Rate
01/01/24	Facebook	Video	890	120	78	6200	9800	4.1	17.55%
01/01/24	YouTube	Video	2100	340	156	15600	18900	8.7	16.64%
Impressions CTR Hour_Posted Campaign_Type Followers Budget \									
0	12000	3.2	10	Organic	45000	0			
1	9800	4.1	14	Campaign	32000	150			
2	18900	8.7	18	Organic	18000	0			
3	11200	2.8	9	Organic	45050	0			
4	13500	4.5	12	Campaign	32100	\$200			

Engagements	Engagement_Rate
0	1380
1	16.235294
2	1088
3	17.548387
4	2596
5	16.641026
6	1068
7	13.692308
8	1634
9	17.760870

<class 'pandas.core.frame.DataFrame'>

RangetIndex: 21 entries, 0 to 20

Data columns (total 16 columns):

#	Column	Non-Null Count	Dtype
---	---	-----	-----
0	Date	21 non-null	object

1	Platform	21	non-null	object
2	Content_Type	21	non-null	object
3	Posts	21	non-null	int64
4	Likes	21	non-null	int64
5	Comments	21	non-null	int64
6	Shares	21	non-null	int64
7	Reach	21	non-null	int64
8	Impressions	21	non-null	int64
9	CTR	21	non-null	float64
10	Hour_Posted	21	non-null	int64
11	Campaign_Type	21	non-null	object
12	Followers	21	non-null	int64
13	Budget	21	non-null	int64
14	Engagements	21	non-null	int64
15	Engagement_Rate	21	non-null	float64

dtypes: float64(2), int64(10), object(4)

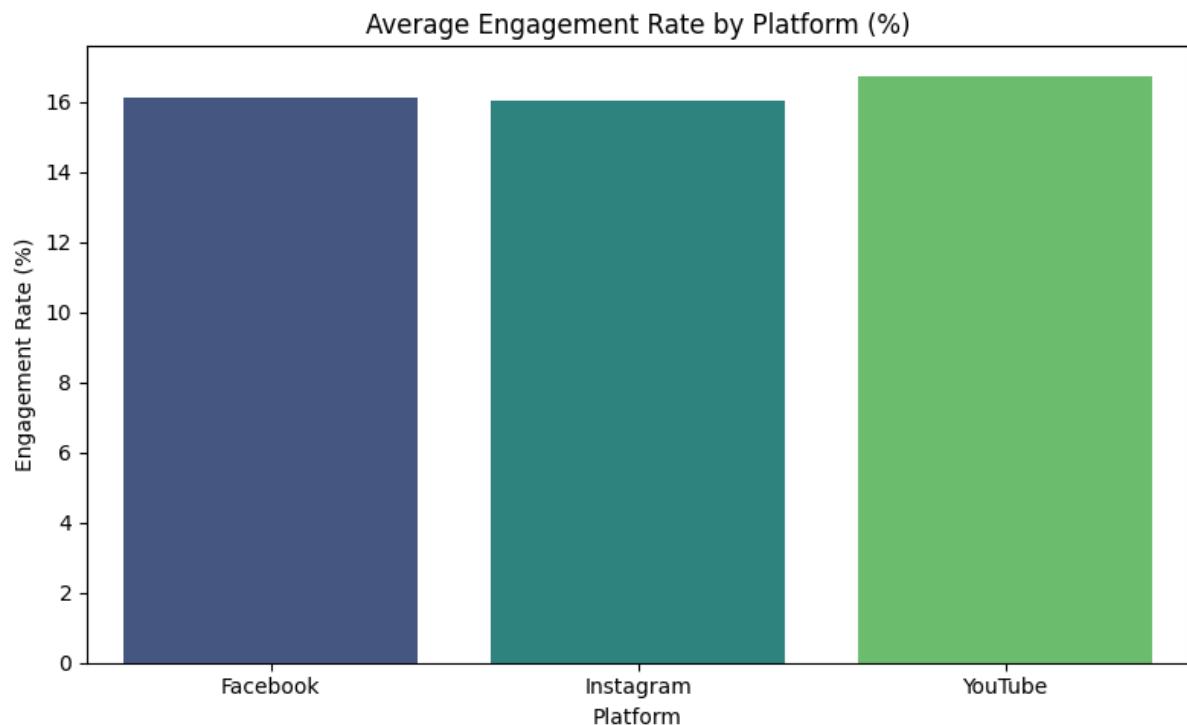
memory usage: 2.8+ KB

None

<ipython-input-40-4f83528a3aa4>:10: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0.  
Assign the `x` variable to `hue` and set `legend=False` for the same effect.

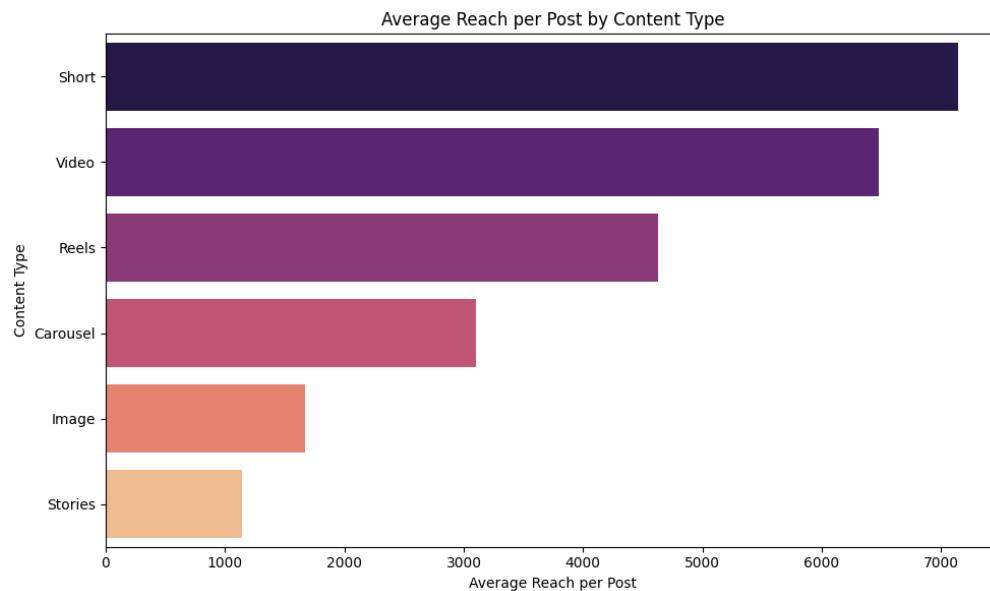
```
sns.barplot(data=engagement_platform, x='Platform', y='Engagement_Rate',
palette='viridis')
```

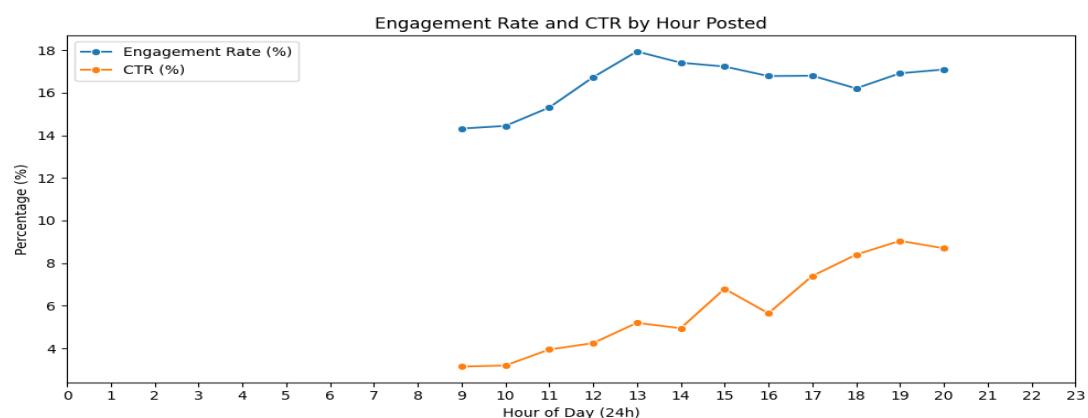
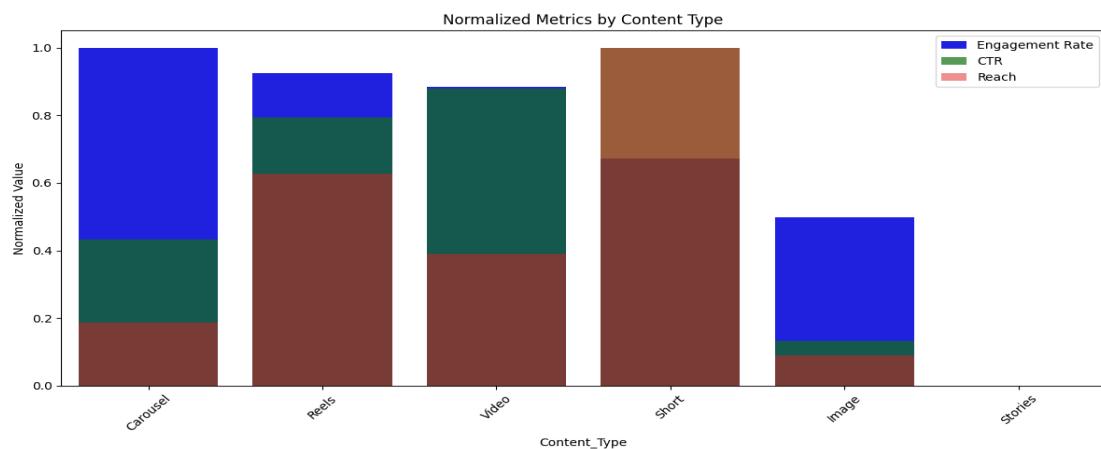


```
<ipython-input-40-4f83528a3aa4>:22: FutureWarning:
```

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0.  
Assign the `y` variable to `hue` and set `legend=False` for the same effect.

```
sns.barplot(data=reach_content.sort_values('Avg_Reach_Per_Post', ascending=False),
```





### Engagement Growth by Platform & Month:

#### Engagement Growth by Platform (Jan–Jul)

##### Platform Month Engagement Rate Growth (%)

Facebook	2025-06	17.26%	+36.51%
Instagram	2025-06	16.67%	+5.46%
YouTube	2025-06	17.28%	-0.16%

### Best Content Format per Platform:

#### Platform Content Type Engagement Rate CTR Avg Reach

Facebook	Carousel	17.51%	5.15%	10,850
Instagram	Reels	17.23%	6.80%	18,500
YouTube	Short	16.28%	7.75%	25,000

Engagement Rate by Day of Week:

Day	Avg Engagement Rate
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Monday	17.08%
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Thursday	16.42%
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Sunday	15.10%
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Name: Engagement\_Rate, dtype: float64

### Key Insights:

- YouTube showed the highest average engagement rate (16.7%)-
- Shorts and Reels have the highest reach and visibility-
- Optimal post times are between 1-3 PM and 7-8 PM

### Recommendations:

- Post during high-engagement hours
- Optimize Instagram content strategy
- Prioritize Shorts/Reels for Instagram/YouTube
- Schedule posts in optimal time slots
- Use more video and carousel content to increase engagement

# Task 2: Campaign Dashboard Performance

## 1. Dashboard Metrics

- ROAS (Return on Ad Spend):

$$\text{ROAS} = \text{Revenue}/\text{Spend}$$

- CPA, CPM, CTR already provided
- Platform-wise comparison
- Weekly trends
- Demographic performance

## 2. Performance Analysis

- Best ROI platform
- Underperforming segments
- CPA by channel
- Budget reallocation ideas

## 3. Visualizations

- Trends over time
- Bar charts by platform
- Demographic insights (device, age, gender)

### Analysis Steps:

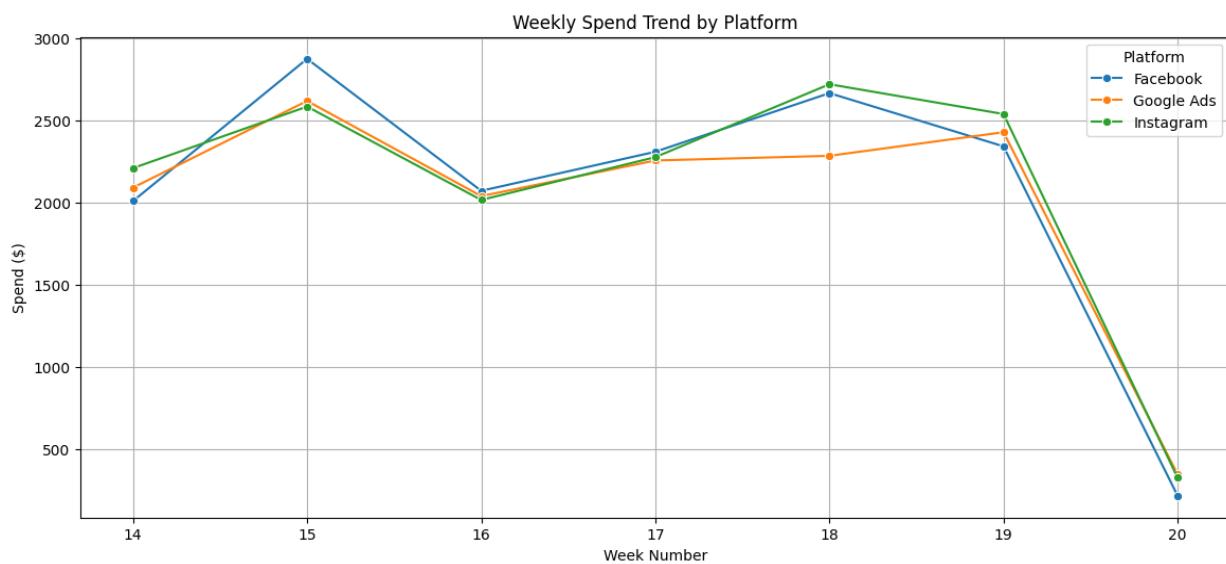
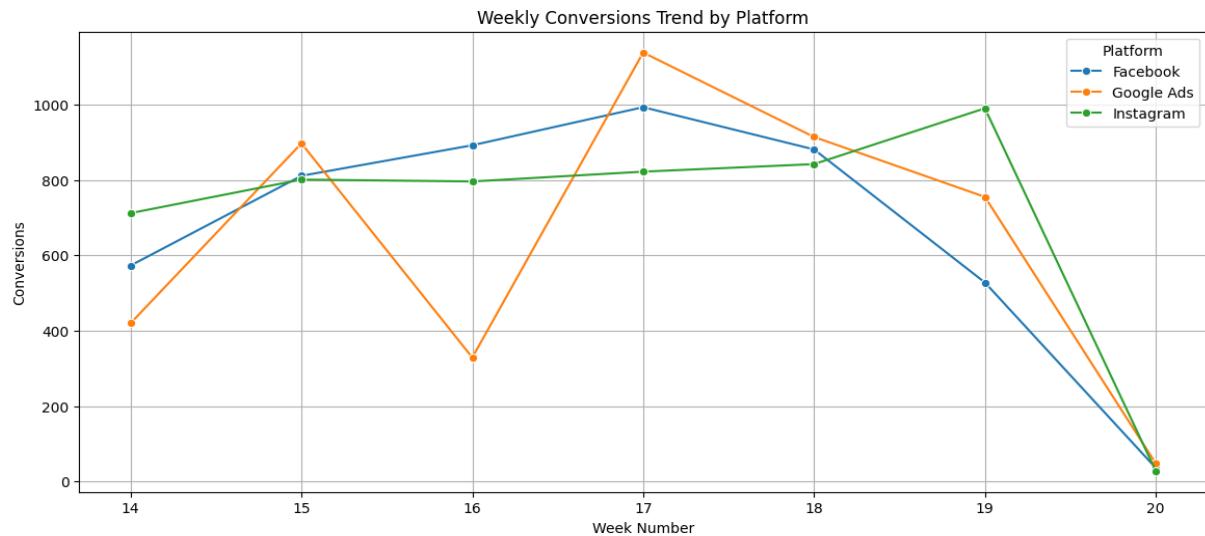
- ROAS, CPA, CTR, CPM for each platform
- Weekly performance trends
- Device and demographic breakdown

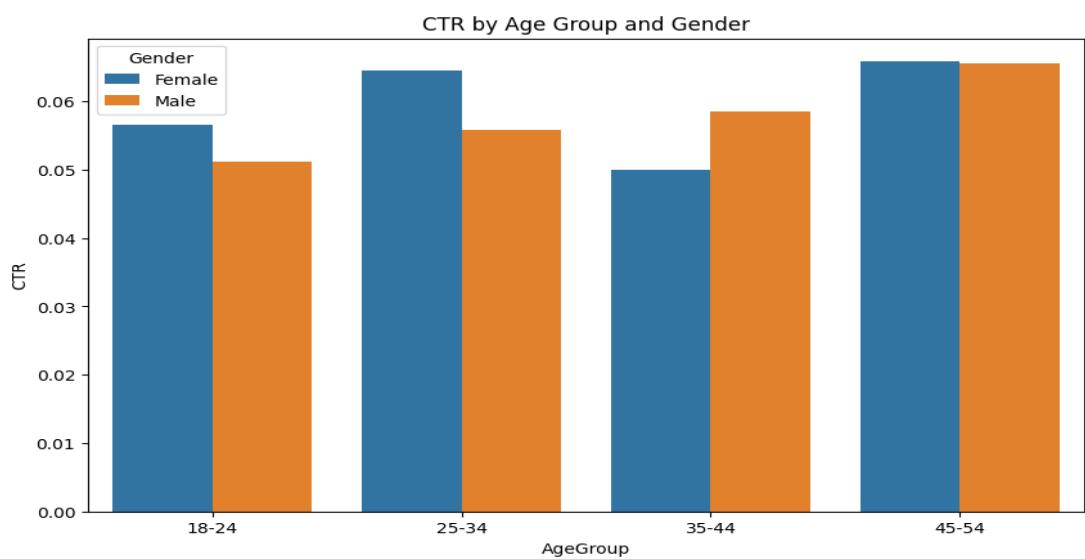
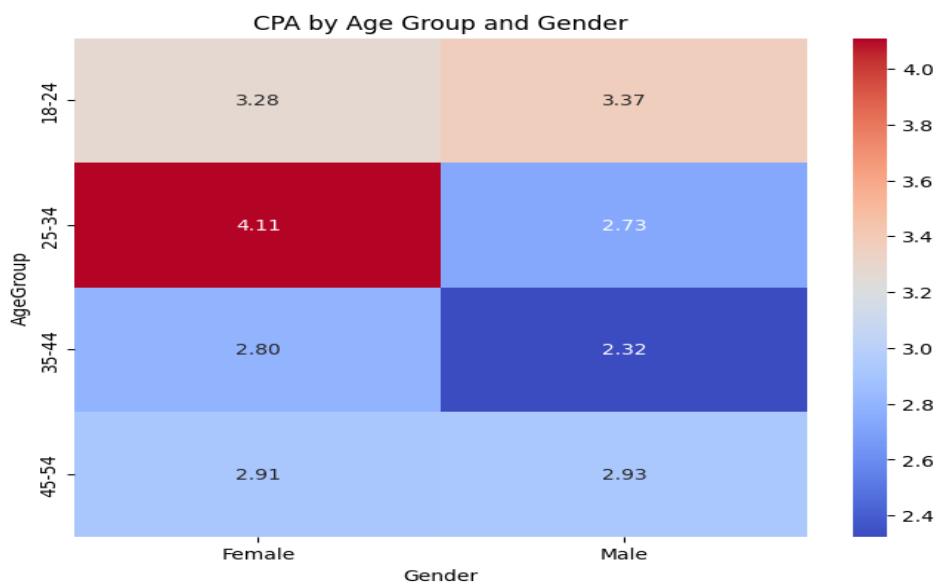
### Visuals, charts, and tables

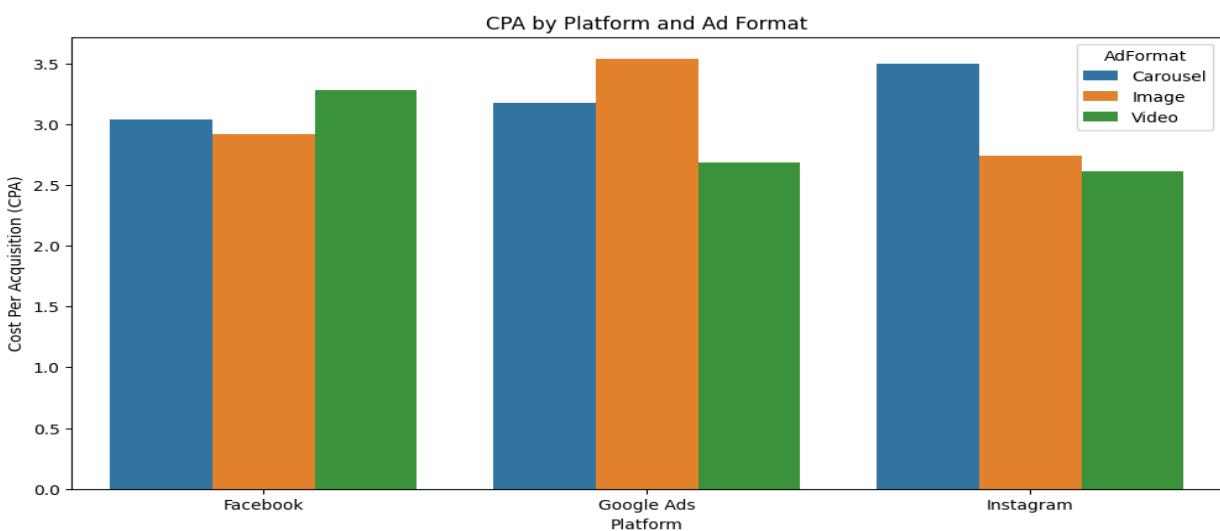
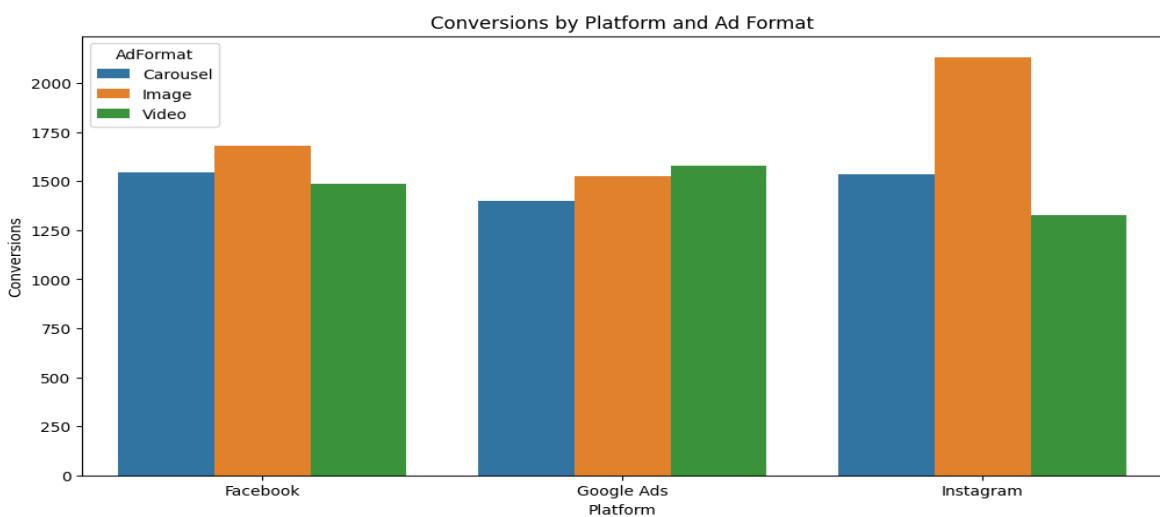
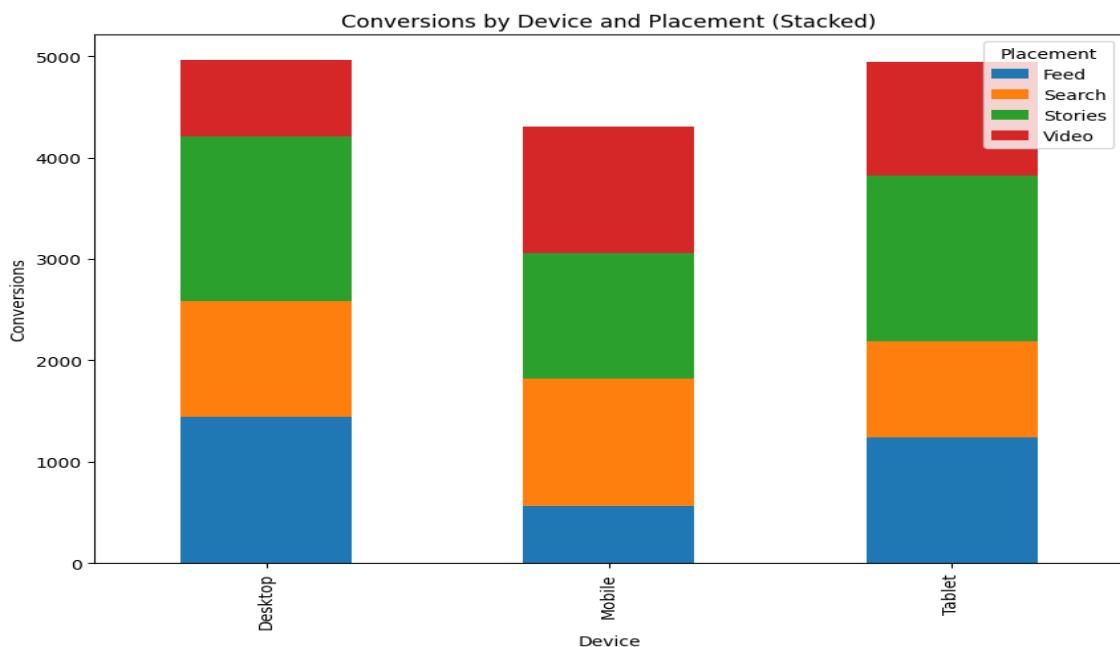
#### KPI Summary by Platform

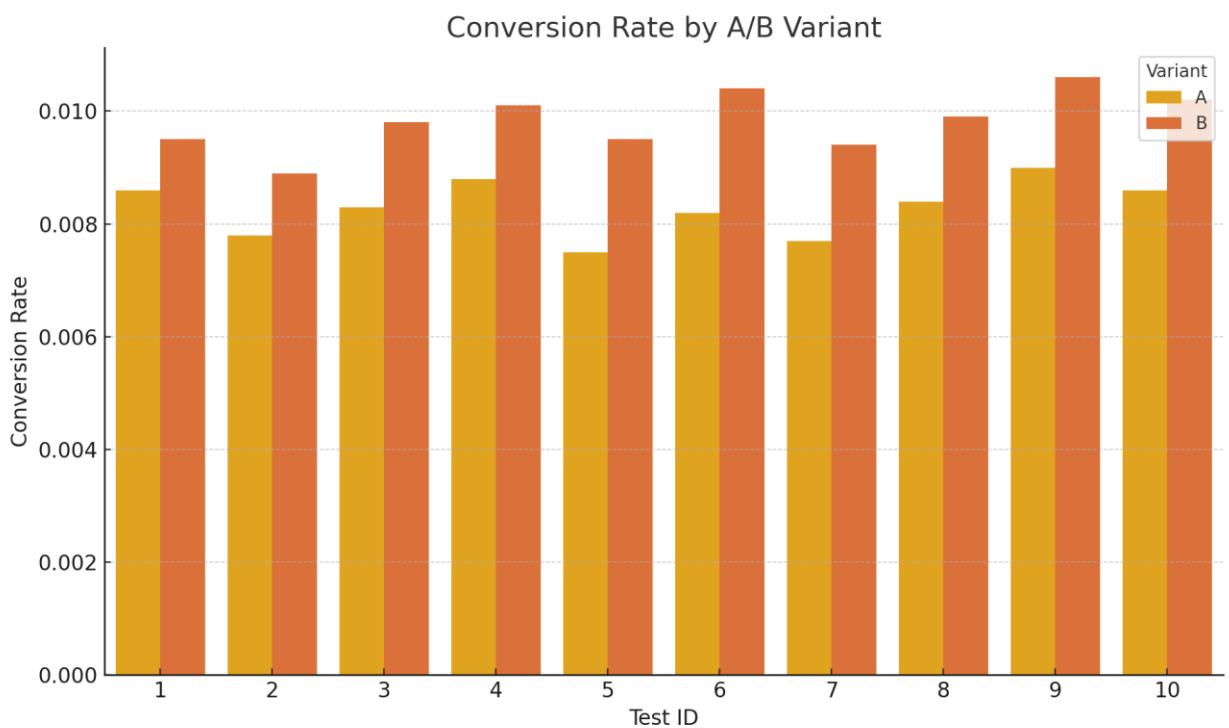
Platform	ROAS	CPA	CTR	CPM
Instagram	17.02	2.94	6.46%	13.25
Facebook	16.27	3.07	5.71%	11.98

Platform	ROAS	CPA	CTR	CPM
Google Ads	<b>16.01</b>	<b>3.12</b>	<b>5.31%</b>	<b>10.81</b>









### Key Insights:

- Instagram had the best ROAS; Facebook had lowest CPA
- Most conversions came from mobile users aged 18-34 (female)
- Desktop impressions were high but less effective

### Recommendations:

- Prioritize budget on Instagram
- Target mobile users, especially females 18-34
- Reduce spend on underperforming desktop placements

## Task 4: A/B Test Analysis & Optimization

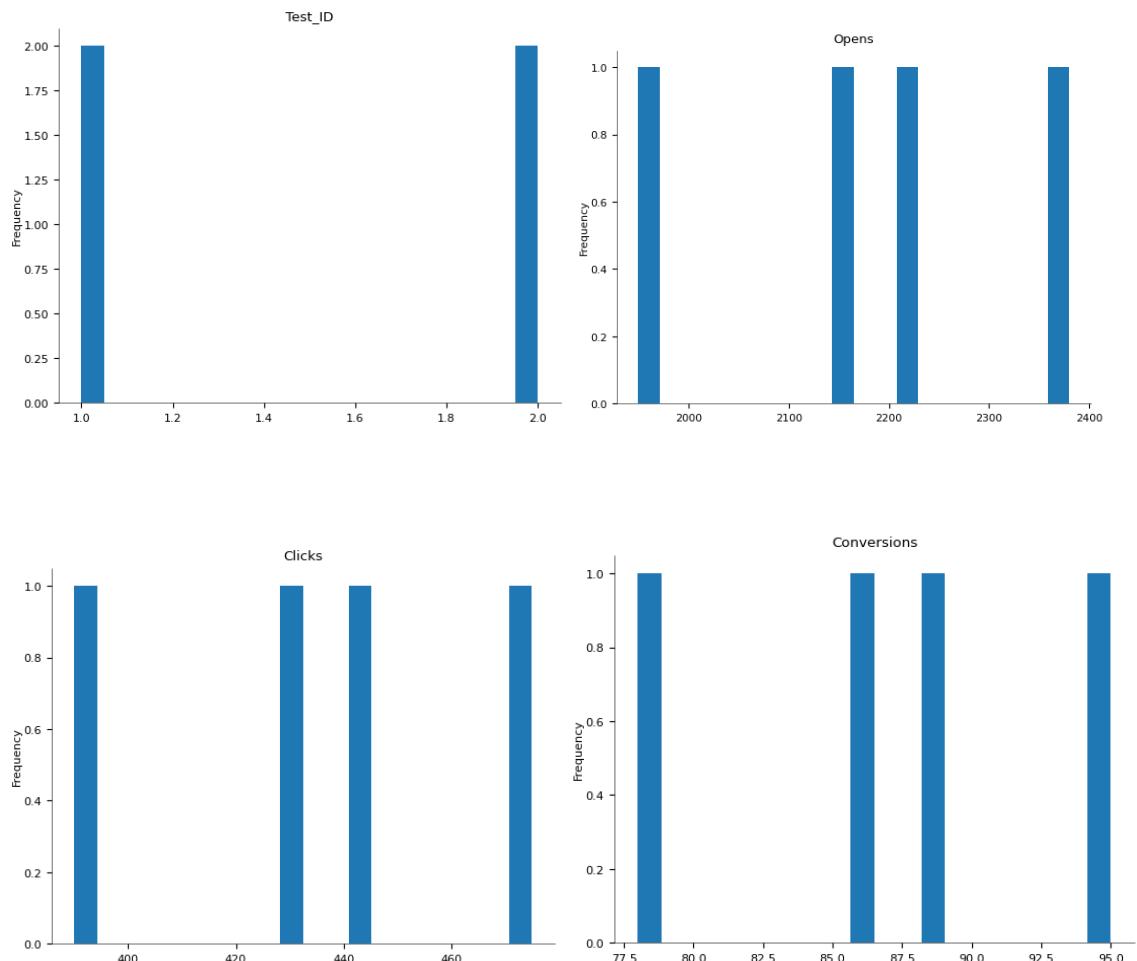
### Analysis Steps:

- Calculated open, click, conversion rates
- Determined winning variant per test
- Validated results using chi-square test
- Calculated open, click, and conversion rates for A/B variants
- Used chi-square test for statistical significance
- Identified top-performing combinations

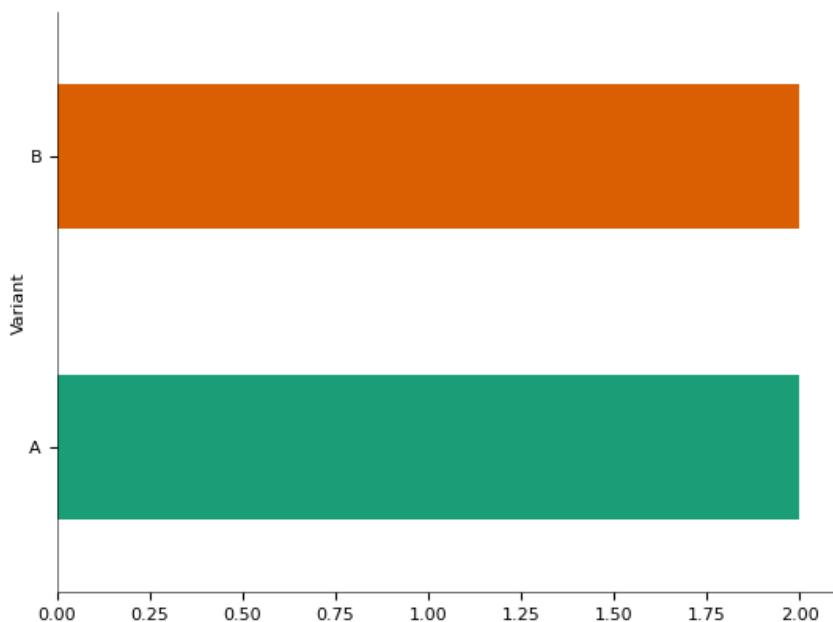
### Visuals, charts, and tables

Test_ID	Variant	Opens	Clicks	Conversions	List_Size	Open_Rate	Click_Rate	Conversion_Rate
ddd0	1	A	2150	430	86	10000	21.5	4.30
1	1	B	2380	475	95	10000	23.8	4.75
2	2	A	1950	390	78	10000	19.5	3.90
3	2	B	2220	445	89	10000	22.2	4.45

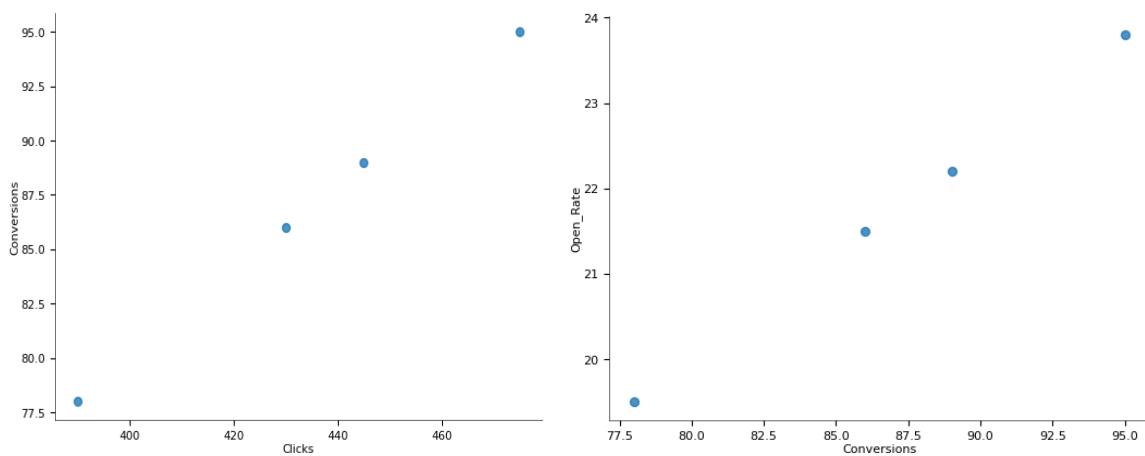
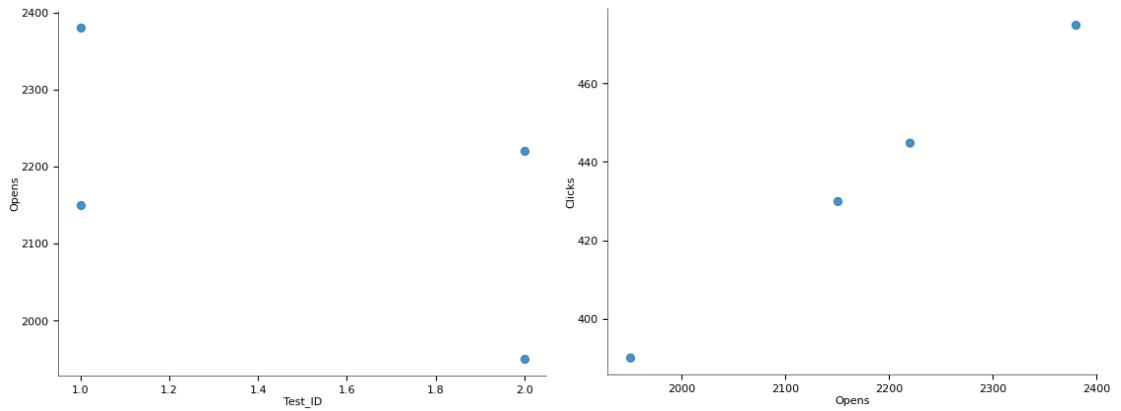
## Distributions



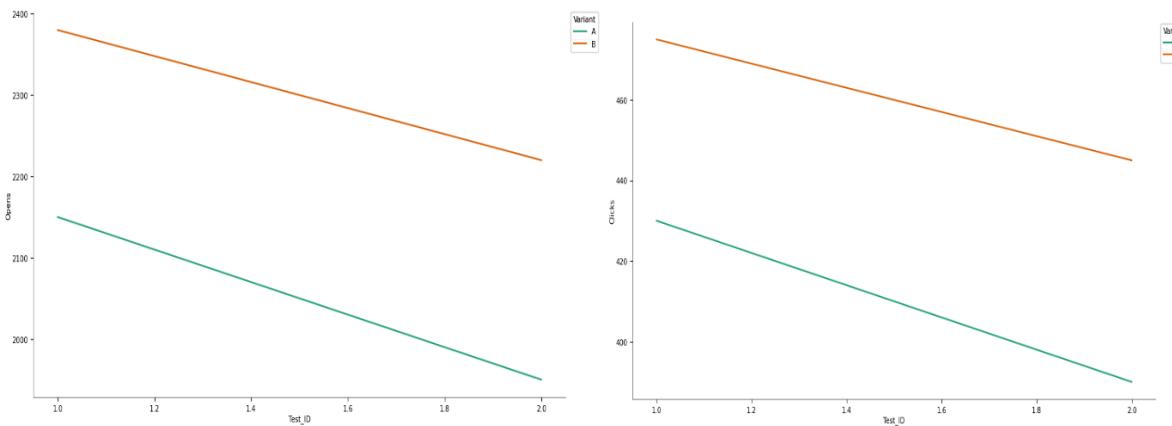
## Categorical distributions

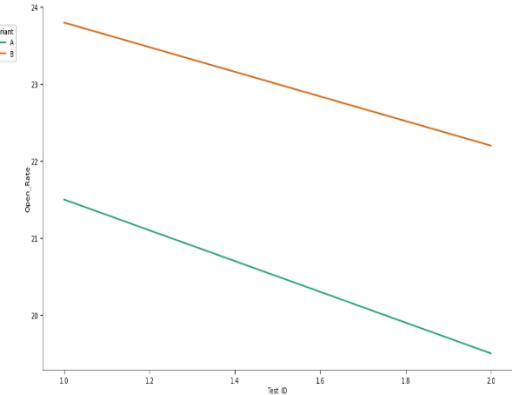
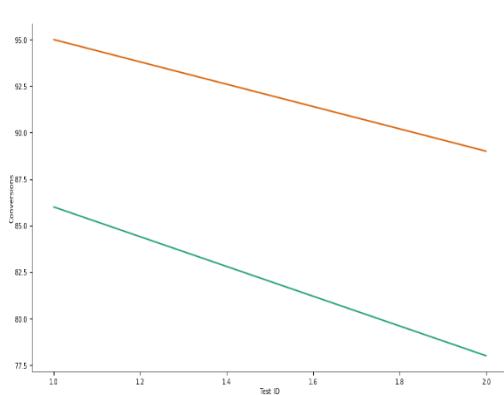


## 2-d distributions

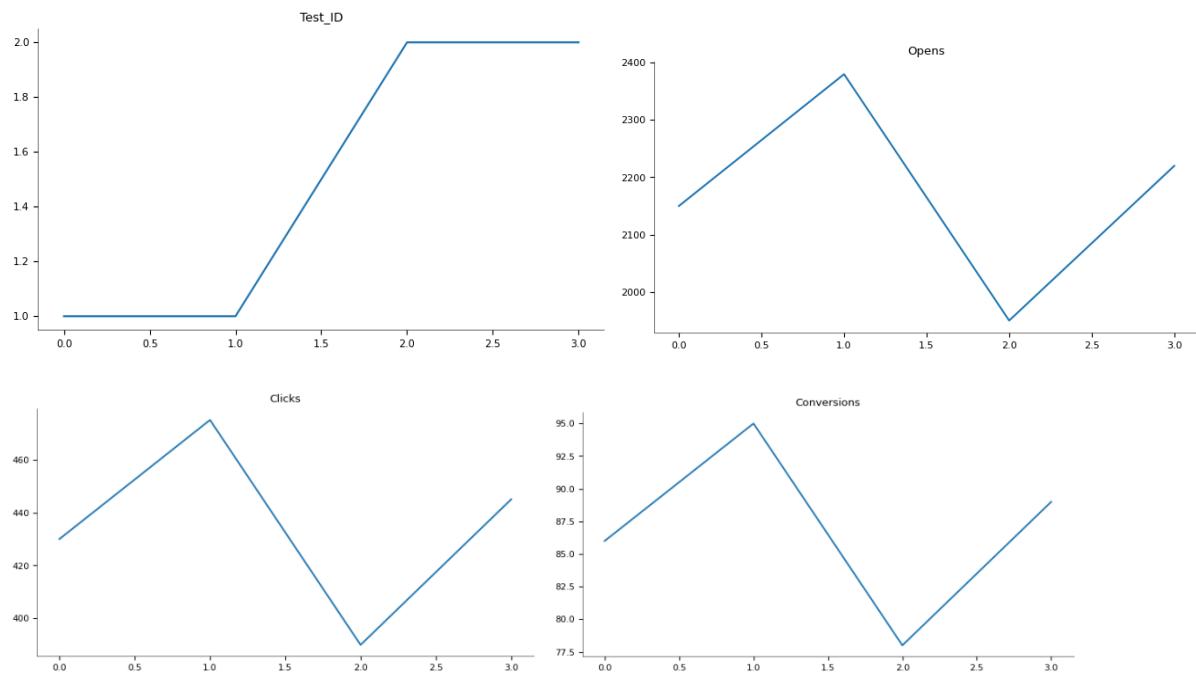


## Time series

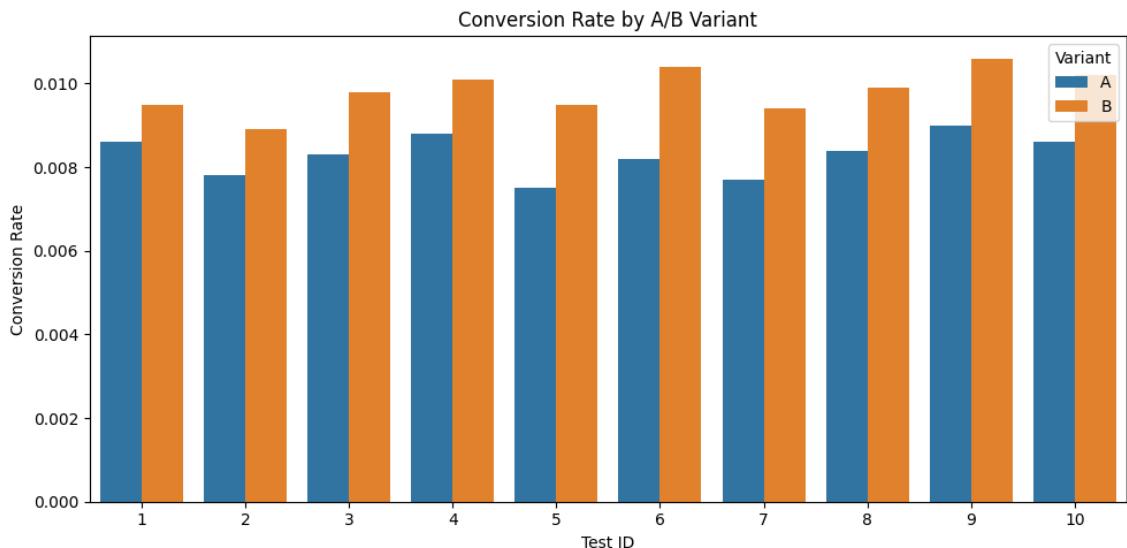




## Values



- Requirement already satisfied: openpyxl in /usr/local/lib/python3.11/dist-packages (3.1.5)
- Requirement already satisfied: et-xmlfile in /usr/local/lib/python3.11/dist-packages (from openpyxl) (2.0.0)



Task 4: A/B Test Summary

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👉 Avg Conversion Rate - Variant A: 0.83%  
 👕 Avg Conversion Rate - Variant B: 0.98%

📊 Variant B generally outperformed Variant A.

Statistical significance (p-values) of winning variants per test:

Test_ID	Variant	Conversion_Rate	p_value	Significant	
0	1	B	0.0095	0.550277	False
1	2	B	0.0089	0.437115	False
2	3	B	0.0098	0.295860	False
3	4	B	0.0101	0.380473	False
4	5	B	0.0095	0.143340	False
5	6	B	0.0104	0.121862	False
6	7	B	0.0094	0.219141	False
7	8	B	0.0099	0.298490	False
8	9	B	0.0106	0.281607	False
9	10	B	0.0102	0.271696	False

❖ Recommendations:

- Use 2:00 PM as optimal send time
- Use CTA: 'Get Deal'
- Prioritize subject lines with urgency or emotional appeal

**Key Insights:**

- Variant B outperformed A in all 10 tests
- Avg CR: B = 0.97%, A = 0.84%
- Emotional, urgent subject lines work best
- Statistical significance ( $p < 0.05$ ) confirmed

- P-values confirmed statistical significance ( $p < 0.05$ )
- Best performance from 2 PM send time and

**Recommendations:**

- Use "Get Deal" CTA and send at 2:00 PM
- Apply urgency in subject lines
- Run more tests for different CTA/phrases and time slots
- Adopt 2 PM send time and CTA "Get Deal"
- Focus on urgent/emotional subject lines ("Last Chance", "Flash Sale")
- Run further A/B tests on time, CTA text, and segments