Summary Report: Optimizing Ad Engagement with A/B Testing

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Tools Used: Python (Colab), Tableau, Pandas, Plotly, Seaborn

Objective

The goal of this project was to analyze digital ad engagement through A/B testing to determine which combinations of ad format and personalization techniques lead to the highest user engagement and conversions. Using simulated user interaction data, we explored:
- Which ad strategies drive better Click-Through Rate (CTR)
- When users are most likely to engage (time-based analysis)
- How different demographics respond to ads
- Where users drop off in the conversion funnel

Data Overview

The dataset included the following features:

- Ad Characteristics: Ad_Format (Banner, Video), Personalization (Static, Dynamic)
- User Data: Age, Gender, Device_Type, Location
- Performance Metrics: Impressions, Clicks, Conversions, Engagement_Duration
- Time: Timestamps of ad exposure

Derived features included:
- CTR = Clicks / Impressions
- Conversion Rate = Conversions / Clicks
- Engagement Bins = Categorized session durations (0–1, 1–2, etc.)

Key Analyses & Insights

1. KPI Highlights (All Users)
Average CTR: 0.084
Average Engagement: 2.8 minutes
Conversion Rate: 0.116
Total Impressions: 85,000
Total Clicks: 7,140
Total Conversions: 830

Color indicators used in the dashboard highlight performance thresholds (Green / Yellow / Red).

2. Time-of-Day Analysis
Peak engagement occurred between 10 AM and 1 PM on weekdays. Heatmap analysis revealed strong midday performance.

3. Session Length Distribution
Majority of users exited within the first 2 minutes. Only ~15% stayed longer than 5 minutes, suggesting retention improvements are needed.

4. A/B Test Results
Dynamic Video outperformed all combinations:
- Static Banner: CTR 0.045, Conversion Rate 0.058, Engagement 1.6 min
- Static Video: CTR 0.067, Conversion Rate 0.091, Engagement 2.1 min
- Dynamic Banner: CTR 0.072, Conversion Rate 0.102, Engagement 2.5 min
- Dynamic Video: CTR 0.089, Conversion Rate 0.136, Engagement 3.3 min

5. Demographic Performance
Highest CTR seen in 25–34 and 35–44 age groups, especially among females using mobile devices. Under 25s showed lower conversions.

6. Conversion Funnel
Drop-off stages:
- Impressions → Clicks: ~92% drop-off
- Clicks → Conversions: ~88% drop-off

Recommendation: Improve ad relevance and optimize landing pages.

Recommendations
- Prioritize Dynamic Video ads in future campaigns
- Deploy ads during late mornings and early afternoons
- Tailor creative for top-performing age/gender/device segments
- A/B test landing pages to improve conversion
- Retire underperforming static banners

Deliverables
- Google Colab Notebook: Preprocessing, KPIs, visual analysis
- Interactive Tableau Dashboard
- GitHub Repository (linked)
- Tableau Public (optional)