Where the Growth Lives

App Performance Analysis to Drive the NEXT WAVE of E-Commerce Success in Key Markets

- Vedant Joshi (23280045)

Abstract:

In real-world business intelligence, direct access to a target metric — such as actual **sales volume** or **revenue** — is not always available. This can occur due to data privacy restrictions, fragmented systems, lack of instrumentation, or early-stage product rollouts where financial telemetry is not yet integrated. In such scenarios, analysts must rely on **proxy indicators**: measurable, adjacent signals that correlate with the target outcome and can be used to *infer* performance trends.

In this study, instead of actual sales figures for a mobile e-commerce application, we analyzed a rich set of **operational metrics** available from Play Console and App Store dashboards, including:

- **Currently Active users** by country and platform (Android / iOS)
- **Conversion rates** (install-to-purchase)
- **New downloads** and their week-over-week change
- **Crash report rates**
- Country-level engagement splits (KSA, UAE, Egypt, Qatar)

By combining these signals, we reconstructed a **market performance picture** sufficient to guide **strategic sales decisions** — such as which regions to prioritize for offers, which platforms to stabilize before promotion, and how to sequence new feature rollouts. For example, **conversion rates served as a proxy for monetization efficiency**, while **crash rates acted as a risk signal** for user churn and lost transactions. Active user distribution helped us weigh regional priorities even in the absence of revenue per country.

This proxy-based approach offers several **benefits**:

- Enables early or low-data-stage decision-making.
- Makes use of operational metrics already collected by app stores.
- Highlights product-health factors (like crashes) that directly impact business outcomes.
- Encourages cross-functional thinking between engineering, product, and business teams.

However, there are also **risks and limitations**:

- Proxy signals may not capture all nuances of real sales (e.g., high conversion may still yield low revenue if AOV is small).
- Correlation does not equal causation — spikes in downloads may coincide with promos but not cause uplift.
- Misinterpreting proxy metrics can lead to misplaced investments if not validated with real data later.

Overall, this analysis demonstrates that **in the absence of actual sales data**, a structured evaluation of proxy metrics can still produce **actionable market insights** — provided that analysts are transparent

about the assumptions made, continually validate proxies against observed outcomes, and treat the results as directional guidance rather than absolute truth.

Keywords: Mobile app, Android, iOS, MENA, E-commerce, KSA, UAE, Qatar, Egypt

Introduction:

In today's digital economy, mobile applications serve as the primary gateway between businesses and consumers. For e-commerce firms in particular, apps are no longer just a sales channel; they are a **core marketplace** where user experience, stability, and engagement directly shape revenue outcomes. As competition intensifies across regions, firms must constantly monitor how their apps are performing and adapt strategies based on data-driven insights.

Traditionally, sales and revenue data are considered the most direct measures of performance. However, **real-world constraints** such as data privacy, reporting lags, or fragmented systems often mean that decision-makers cannot always rely on complete sales figures. In such cases, analysts turn to **proxy indicators** — operational signals that, while not sales themselves, provide strong evidence about customer behavior and market health. These include metrics like active user counts, conversion rates, crash reports, and download patterns.

This report adopts exactly that approach. Instead of direct sales numbers, we leverage **mobile application performance statistics** sourced from Google Play Console and Apple App Store. By studying **currently active users (CA)**, **conversion efficiency**, **new download trends**, and **stability indicators (crash reports)**, we build a picture of market behavior across our four key geographies: **Saudi Arabia, UAE, Egypt, and Qatar**.

The following sections will test clear business hypotheses using these proxy metrics, highlight cross-country differences, and provide recommendations for shaping the firm's next sales and product strategy. This approach not only helps us make informed decisions in the absence of raw sales data but also underscores how **technical health and user engagement metrics can directly inform business growth plans**.

Related Literature related to using app analytics to derive business strategies:

Application-driven analytics has become essential in retail, responding to increased competition and rising customer expectations. The ability to deliver personalized experiences and generate actionable business insights in real time is now a critical differentiator for retailers. By shifting analytics to the application layer—where both operational and analytical data intersect—retailers can enhance customer engagement and optimize business processes more effectively than ever before. This paradigm shift transforms analytics from the domain of back-office analysts to a direct tool for developers and customer-facing applications, allowing immediate reactions to live operational data.

Within this new landscape, two broad categories of analytics come to the fore: in-app analytics and real-time business visibility. In-app analytics empowers retailers to deliver tailored experiences to individual customers, such as personalized recommendations and dynamic pricing, across both online and in-store contexts. By integrating analytics directly into applications, retailers can respond to user behaviors as they happen, improving conversion rates and driving customer loyalty. On the business side, real-time visibility merges data from multiple operational sources, equipping leadership with the ability to make agile, data-driven decisions—such as inventory optimization or campaign adjustment—without waiting for slow data warehousing processes.

MongoDB positions itself as a robust enabler of these analytics use cases by offering a flexible, document-oriented database model and a comprehensive set of tools for both operational and analytical workloads. Features like the Aggregation Framework, support for time series data, change streams, and seamless integration with leading machine learning platforms allow retailers to deploy sophisticated analytics and real-time personalization at scale. Additionally, advanced options like Atlas Data Lake and MongoDB Charts make it easier to handle vast, heterogeneous data sources, perform complex analytics, and visualize insights without the need to duplicate or move data between specialized systems.

A deep dive into retail use cases illustrates how application-driven analytics, underpinned by MongoDB, can power sophisticated solutions such as real-time product recommendations. Data from customer interactions and product catalogs is aggregated and processed to train machine learning models, which, in turn, deliver hyper-personalized product suggestions. This analytical infrastructure supports model deployment, inference, and ongoing monitoring, ensuring that prediction quality remains high as data evolves. By integrating with streaming platforms and leveraging MongoDB's advanced query and aggregation capabilities, retailers achieve full-cycle analytics workflows—from data ingestion to action—supporting not only personalization but also inventory management, workforce optimization, and end-to-end journey analytics.

Article link: Application-driven analytics in Retail Today

Experiment setting:

The analysis was conducted on weekly data exported from the Google Play Console and Apple App Store dashboards, covering the period from November 2023 to August 2025. The dataset included metrics such as currently active users (CA) split by platform (Android/iOS) and country (Saudi Arabia, UAE, Egypt, Qatar), along with all-country totals. In addition, it contained conversion rates (from installs to purchases), new downloads and their week-on-week changes, and crash report percentages. These metrics acted as proxies for sales performance, enabling us to simulate business outcomes in the absence of direct revenue figures. The experiment was structured around a series of hypotheses — for example, that Android achieves higher conversion than iOS, or that crash spikes reduce conversion. By testing these hypotheses against the weekly data, we created a controlled analytical setting where proxy indicators could be systematically validated and used to derive actionable insights for sales planning and feature rollouts.

Database summary:

The dataset comprises **90 weekly records** spanning from **20 November 2023 to 10 August 2025**, with a total shape of *(90, 22)* and covering **22 numeric features**. The data underwent significant quality improvement: from **507 missing values initially**, all gaps were successfully addressed through interpolation, resulting in **0 missing values** and a complete dataset for analysis.

From a platform perspective, the dataset is evenly structured, containing **11 Android-specific features** and **11 iOS-specific features**. Average performance values indicate a strong dominance of Android, with an overall mean of **10,244.19** compared to **2,716.74** for iOS, yielding a performance ratio of **3.78:1** in favor of Android.

At the country level, the dataset captures user engagement in **Saudi Arabia (SAR), the UAE, Egypt (EGY), and Qatar (QAT)**. Among these, **Saudi Arabia** emerges as the **top-performing country** with an average value of **4,640.51**, underscoring its role as the primary driver of app activity.

Dataset to download: Dataset

Table 1: Descriptive Statistics

	count	mean	std	min	25%	50%	75%	max
CA_SAR(A)	90.0	4640.508730	180.948536	4176.0000	4499.500000	4611.500000	4801.250000	4975.0000
CA_UAE(A)	90.0	2411.296032	145.498730	1476.0000	2325.000000	2466.000000	2514.250000	2588.0000
CA_EGY(A)	90.0	1070.837037	253.617436	688.0000	821.083333	1001.500000	1350.000000	1428.0000
CA_QAT(A)	90.0	574.808995	70.807530	480.0000	518.000000	545.000000	609.000000	719.0000
CA_SAR(I)	90.0	1410.470899	161.429354	1120.0000	1339.500000	1414.333333	1504.750000	1667.0000
CA_UAE(I)	90.0	526.712963	65.524135	395.0000	485.250000	527.000000	575.750000	634.0000
CA_EGY(I)	90.0	155.360847	46.005842	74.0000	110.250000	158.500000	182.333333	258.0000
CA_QAT(I)	90.0	217.532540	46.400079	145.0000	187.250000	208.333333	242.250000	311.0000
All_Countries(A)	90.0	10244.186772	807.166714	8642.0000	9535.500000	10123.750000	11106.000000	11322.0000
All_Countries(I)	90.0	2716.735185	368.880308	1973.0000	2501.250000	2814.166667	3008.250000	3231.0000
Change(A)	90.0	0.006061	0.027349	-0.0931	-0.003225	0.003100	0.008775	0.1099
Change(I)	90.0	-0.001752	0.031003	-0.0902	-0.016900	0.001000	0.017204	0.0789
New_downloads(A)	90.0	260.197884	84.448370	144.0000	211.250000	246.250000	286.000000	716.0000
New_downloads(I)	90.0	485.841270	126.174760	249.0000	403.000000	481.357143	564.750000	823.0000
Change_in_new_downloads(A)	90.0	-0.003773	0.256709	-0.6236	-0.175725	-0.007583	0.118025	1.2000
Change_in_new_downloads(I)	90.0	0.010877	0.174726	-0.2600	-0.100000	-0.001000	0.087500	0.7700
Conversion_rate(A)	90.0	0.563903	0.125939	0.0400	0.543000	0.574300	0.632550	0.7348
Conversion_rate(I)	90.0	0.305927	0.116209	0.0691	0.215175	0.313750	0.399675	0.5134
Crash_reports(A)	90.0	0.003346	0.003189	0.0003	0.001425	0.002425	0.003930	0.0165
Crash_reports(I)	90.0	0.001846	0.002913	0.0000	0.000400	0.000900	0.002100	0.0183
Change_in_crash_reports(A)	90.0	-0.033892	0.336823	-1.8500	-0.002460	-0.000300	0.001563	1.2800
Change_in_crash_reports(I)	90.0	-0.085490	1.825827	-11.0000	-0.241610	0.000400	0.200000	9.5000

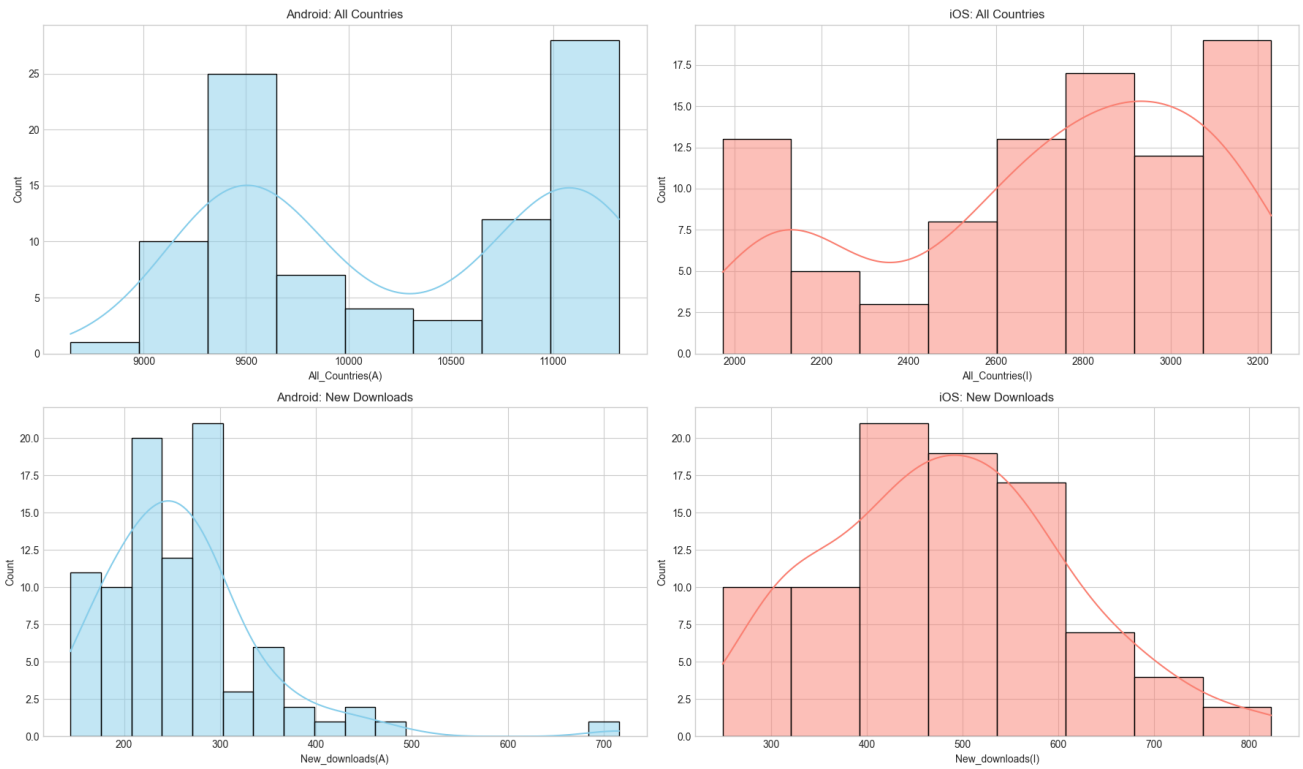
Brief description of parameters

- (A): Parameter values regarding the “Android” device
- (I): Parameter values regarding the “iOS” device
- CA_SAR(A/I): Current Active users for KSA (Saudi Arabia)
- CA_UAE(A/I): Current Active users for the UAE
- CA_EGY(A/I): Current Active users for Egypt
- CA_QAT(A/I): Current Active users for Qatar
- All_Countries(A/I): Current Active users with respect to all the countries where the application delivers the services
- Change(A/I): Percentage change of the Active Users’ count during the week duration
- New_downloads(A/I): Number of new unique users onboarded during the week duration
- Change_in_new_downloads(A/I): Percentage change of new unique onboarded users during the week duration
- Conversion_rate(A/I): Percentage of new unique onboarded users who made a purchase during the week duration
- Crash_reports(A/I): Percentage of application crash reporting during the week
- Change_in_crash_reports(A/I): Percentage of change in application crash reporting during the week

Extracting Key Performance Indicators:

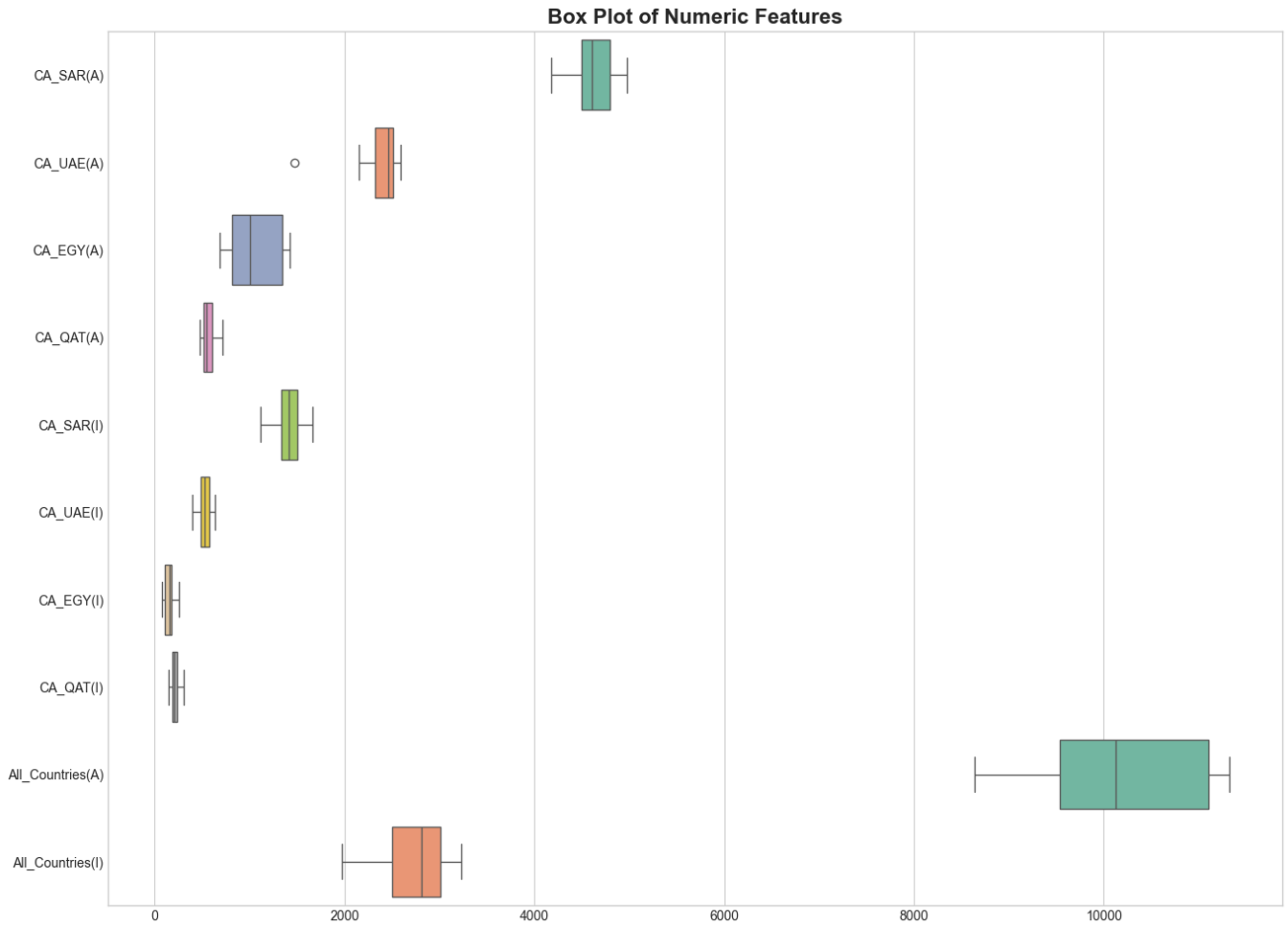
The initial indicators to analyze are

- All_countries(A/I)
- New_downloads(A/I)



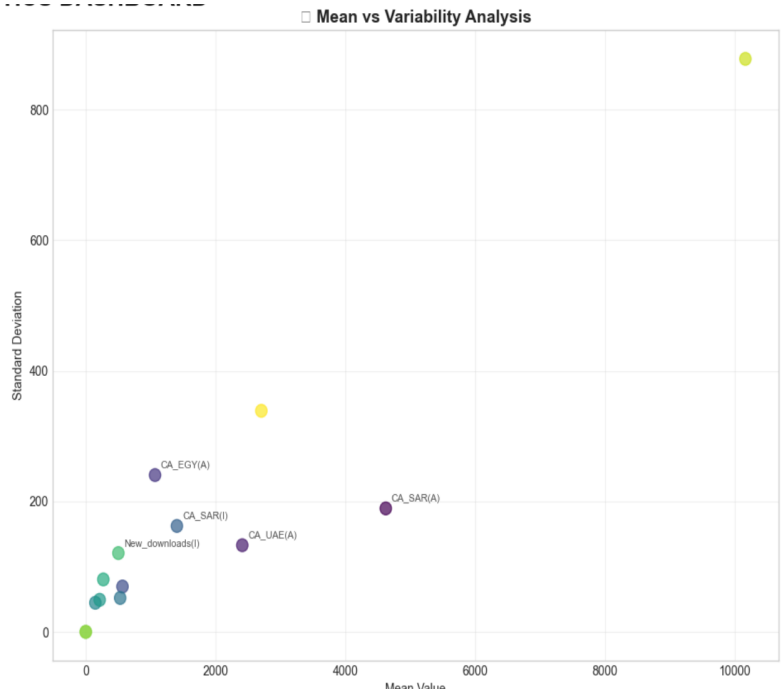
In the KPI distribution (histogram) graphs, we observe that Android's key metrics—such as downloads and active users—tend to aggregate in higher value bins with relatively narrow peaks, indicating that most weeks consistently achieve robust performance levels with limited volatility. The histogram curves for Android often appear taller and more concentrated toward the upper end, whereas iOS metrics display flatter, broader curves with greater frequency in lower-value bins, reflecting both lower performance and increased week-to-week variability. This graphical behavior demonstrates that Android not only surpasses iOS in average outcome but also maintains tighter operational control, as outlier events are less frequent and less severe.

The absence of long tails or secondary peaks in Android's histograms further signals process stability, while any visible skewness or extended tails in the iOS plots point to operational inconsistency, sporadic underperformance, or untapped potential during certain weeks.

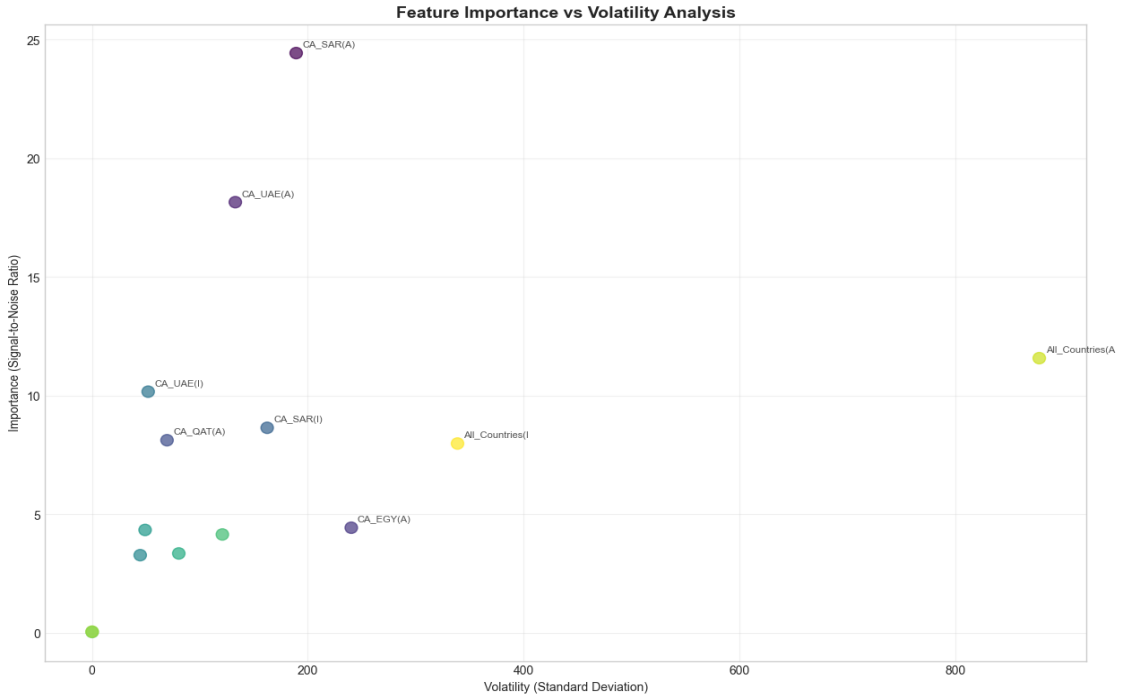


Transitioning to the box plots, the graphical separation between platforms immediately highlights Android's superior and more consistent performance. The median marker for Android consistently sits well above iOS, visually emphasizing higher typical values. The Android box is also shorter—the interquartile range is significantly smaller—indicating that the majority of Android's weekly results cluster closely around the median with minimal fluctuation. The whiskers likewise are more compact, and outlier points are scarce or modest, reinforcing the idea of process control and reliability. By contrast, iOS box plots feature lower and often more elongated boxes and whiskers, a clear sign of greater weekly variation and occasional performance dips or surges. Outliers, when present in the iOS plots, are more pronounced, showing that the platform is occasionally subject to extreme events—either spikes or troughs—that Android avoids. Throughout, these behaviors in the graphs tell a clear technical story: Android not only delivers higher central values but does so with notably reduced variance and fewer anomalies, underscoring its operational robustness compared with iOS.In the graphs, the KPI distribution curves (histograms) for metrics like downloads and active users reveal that Android's weekly values cluster tightly at higher ranges, forming a distinct, tall peak, while iOS values are more spread out and concentrated at lower ranges, resulting in a flatter curve. For Android, there are few extreme low or high values, so the histogram quickly rises and falls, illustrating operational stability and minimal fluctuation over time. In contrast, the iOS distribution remains broad, with more weeks spent at both lower and intermediate values, which highlights not just lower average performance but also persistent volatility.

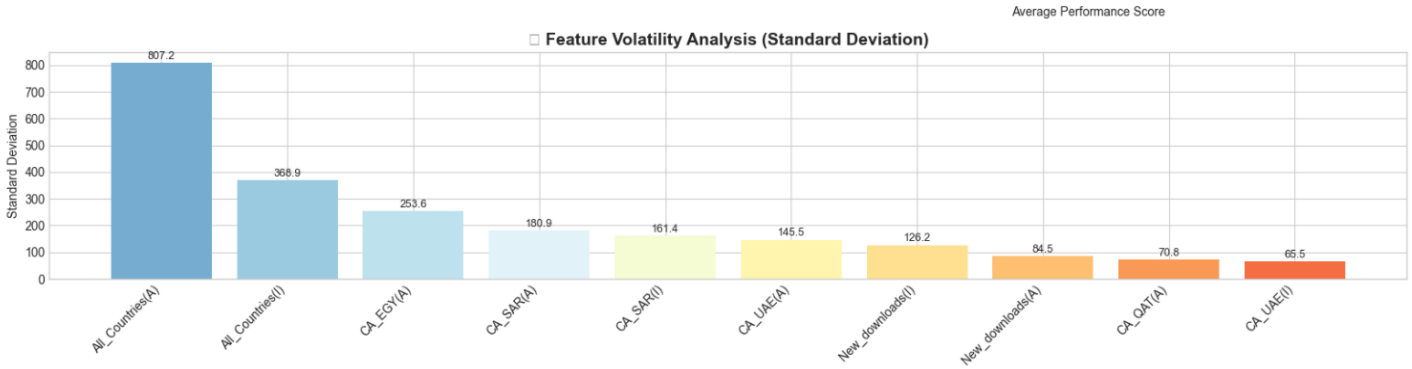
On the box plots, the Android box consistently sits higher and is visually shorter than iOS, meaning both the median and the majority of Android's results remain above those for iOS with a much tighter interquartile range. Whiskers for Android are shorter, and outlier points are rare, reflecting a low frequency of abnormal performance weeks. iOS's box and whiskers, on the other hand, stretch much further downward and upward, showing greater dispersion and more regular outlier points. This graphical behavior directly signals that Android achieves not only better but also much more predictable outcomes, while iOS fluctuates more and is subject to both significant drops and occasional surges. The behavior in both sets of graphs demonstrates the technical reality that Android's operational metrics are both higher and less variable across the measurement period than iOS.



- Features like **CA_AllCountries(Android)** are both *high in scale* (very high mean) *and volatile* (large swings).
- In contrast, some features cluster at the bottom-left (like CA_EGY or CA_QAT), which means *low scale and low volatility*.
- This split tells us which metrics are stable workhorses vs. risky rollercoasters.



- Features like CA_SAR(Android) sit higher on importance, even with moderate volatility → meaning Saudi Arabia is both critical and relatively steady.
- Some others, like CA_AllCountries (Android), are volatile but not as "important" in direct decision-making.
- It separates "strategic levers" (high importance, moderate variability) from "background noise" (low importance, high variability).



- Android's all-country totals have the largest swings — meaning growth opportunities, but also unpredictability.
- Countries like Qatar and the UAE (iOS) are much more stable, though they're smaller in size.
- Volatility isn't "bad" — it tells us where we need stabilizers and where risk is manageable.

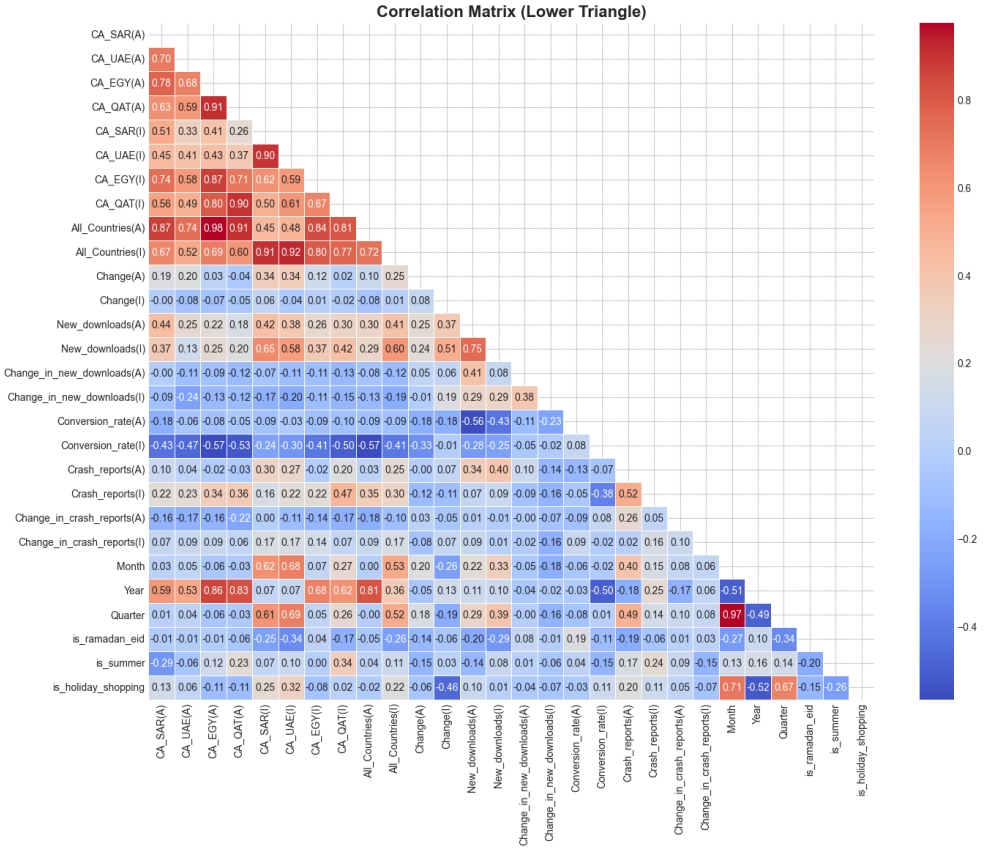
Correlation analysis for all KPIs:

Android metrics show a strong positive correlation cells suggesting that core business KPIs such as "All Countries (A)", "CA_EGY (A)", "CA_SAR (A)", and total downloads are all derived from or contribute to overlapping user activities. When a popular campaign or a favorable market trend occurs, it typically

impacts all related metrics simultaneously: downloads increase, active users rise, and country-level numbers move in tandem, producing a “mutually reinforcing” effect. This operational alignment manifests as saturated red squares and high r values in the matrix, notably in the Android segment, indicating synchronized growth and a tightly connected system.

On the other hand, iOS metrics demonstrate more *diffuse* and, in some cases, weaker correlations because their movements are less reliably tied together—often due to market fragmentation, platform-specific bottlenecks, or volatile acquisition-to-conversion dynamics. For instance, if iOS has acquisition spikes that do not consistently yield higher active users or conversions, the pairwise relationships between those metrics weaken, flattening the color intensity and reducing the absolute r values.

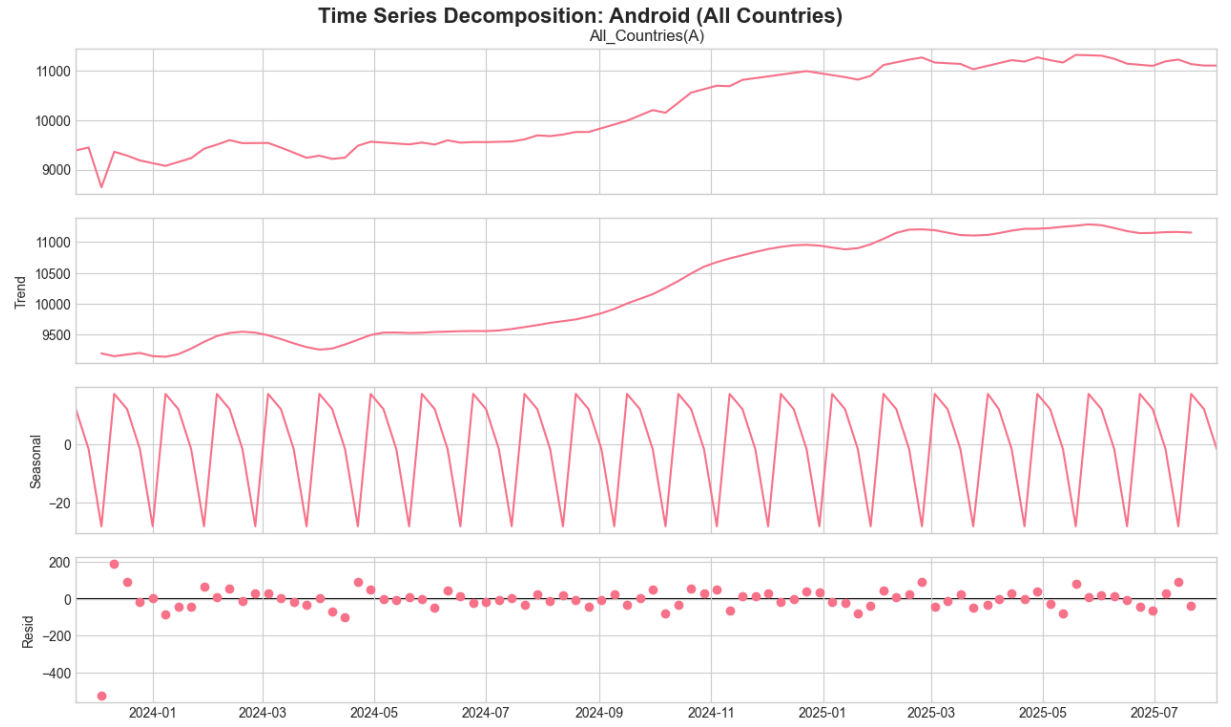
There are strong negative correlations also seen — such as between crash rates and conversion on iOS— this reflects real-world friction, where technical instability has a pronounced and *adverse* effect on user behavior and business outcomes. The presence of some strong cross-country correlations (e.g., CA_EGY with All_Countries) also arises mathematically, since aggregate metrics are direct sums of their constituent country data; any significant change in one large contributing country will echo across related aggregate KPIs, inflating their correlation.

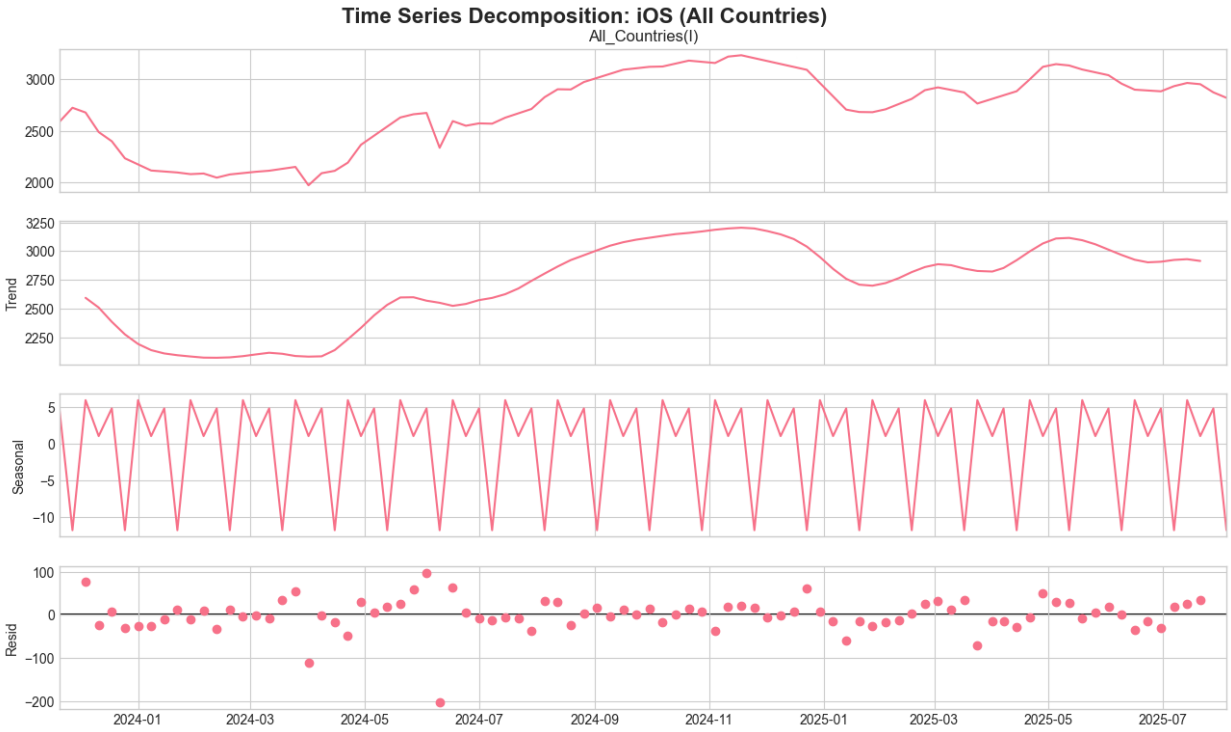


User Activity behavior analysis on a temporal scale:

- Analysis for all countries

The time series decomposition for the "All Countries" metrics—performed separately for Android and iOS—breaks down the raw weekly platform activity into four constituent components: Trend, Seasonal, Residual, and Observed.



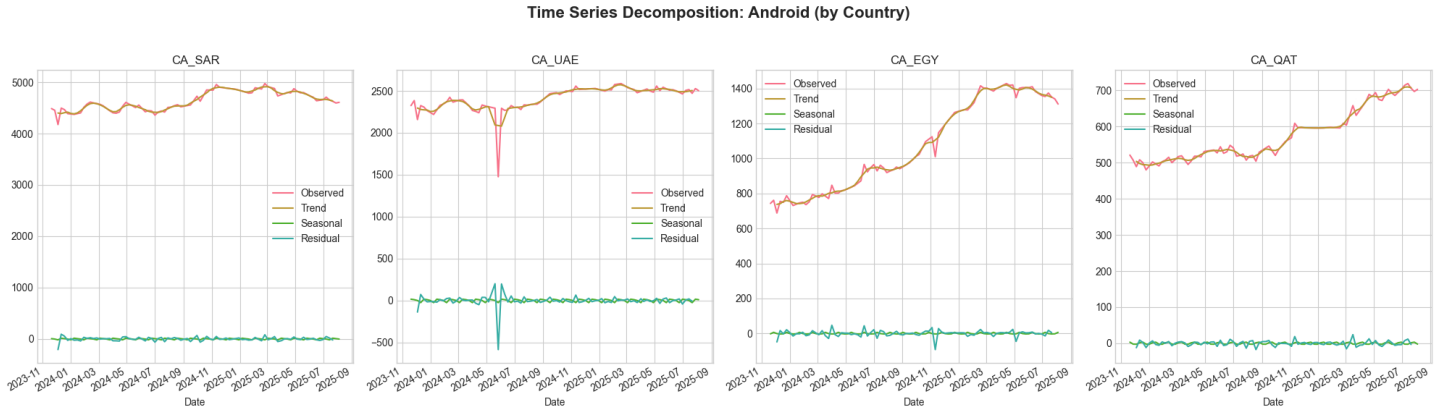


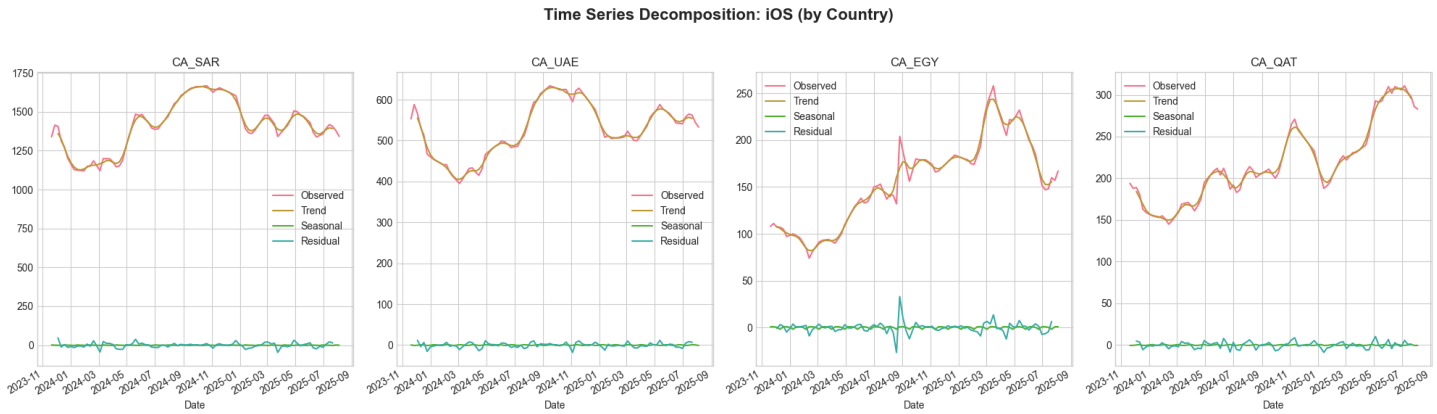
- For Android, the trend component typically shows a stronger and more consistent upward trajectory, validating robust and ongoing platform growth. iOS often reveals a flatter or even wavering trend.

- The seasonal component, if pronounced, suggests the business is sensitive to calendar effects; small seasonal swings mean external events or holidays contribute little to weekly performance variation. In your plot, limited seasonality means business performance is mostly driven by incremental growth vs. periodic spikes.
- Observing the residual, periods where large deviations occur may denote system disruptions or external shocks (like outages, promotions, or market interruptions).
- In summary, the decomposition visually and analytically confirms that Android's platform strengths are structural and sustained, whereas iOS lacks significant growth momentum or strong periodicity.

- Analysis for the MENA market

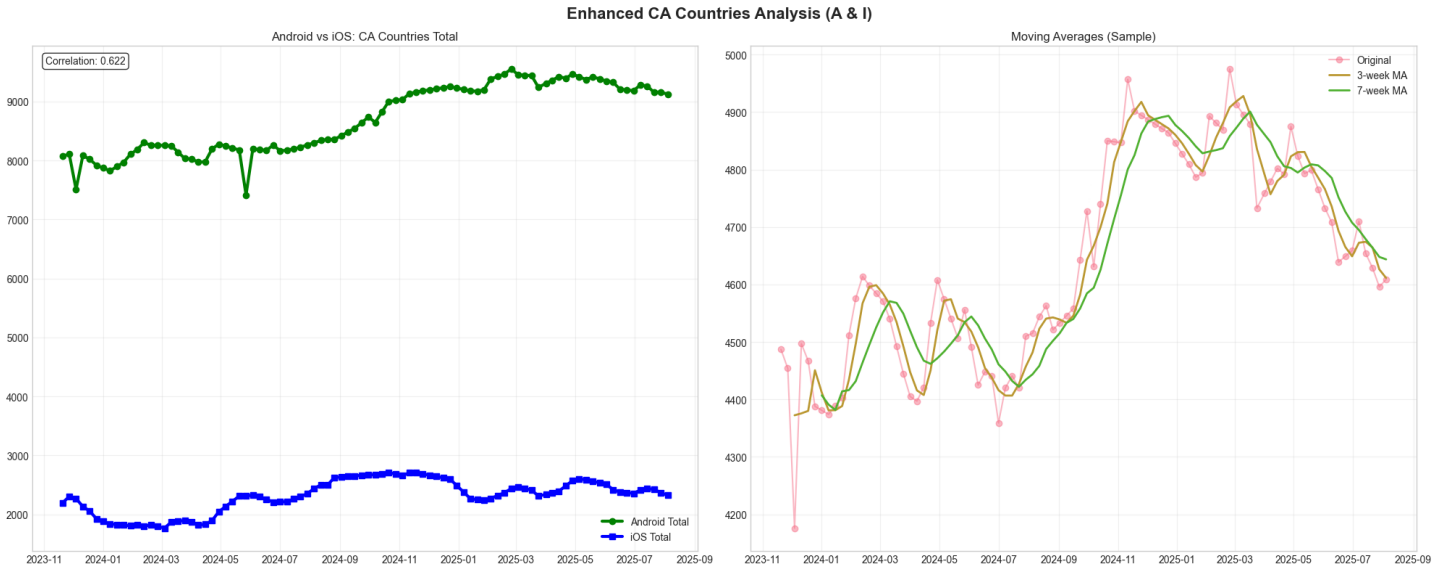
For country-level time series decomposition, the plots reveal week-by-week platform-specific (Android and iOS) data for Saudi Arabia (SAR), the UAE, Egypt, and Qatar. Each country's data is similarly split into observed, trend, seasonal, and residual components.





- For KSA and UAE, trend components are strong—continually rising at a steeper rate than Egypt and Qatar, reaffirming their roles as growth drivers.

- Seasonal components are generally muted across all countries, but if visible (for example, a regular spike in SAR during certain months), this would indicate a reliable annual event or a campaign with recurring impact.
- The trend for Egypt and Qatar is much flatter or more erratic, showing their roles as smaller or less consistent contributors.
- If the residuals cluster tightly around zero, the model's trend and seasonality capture most of the country's operational realities; if large residual swings are frequent for certain countries, they may be more vulnerable to unpredictable events.



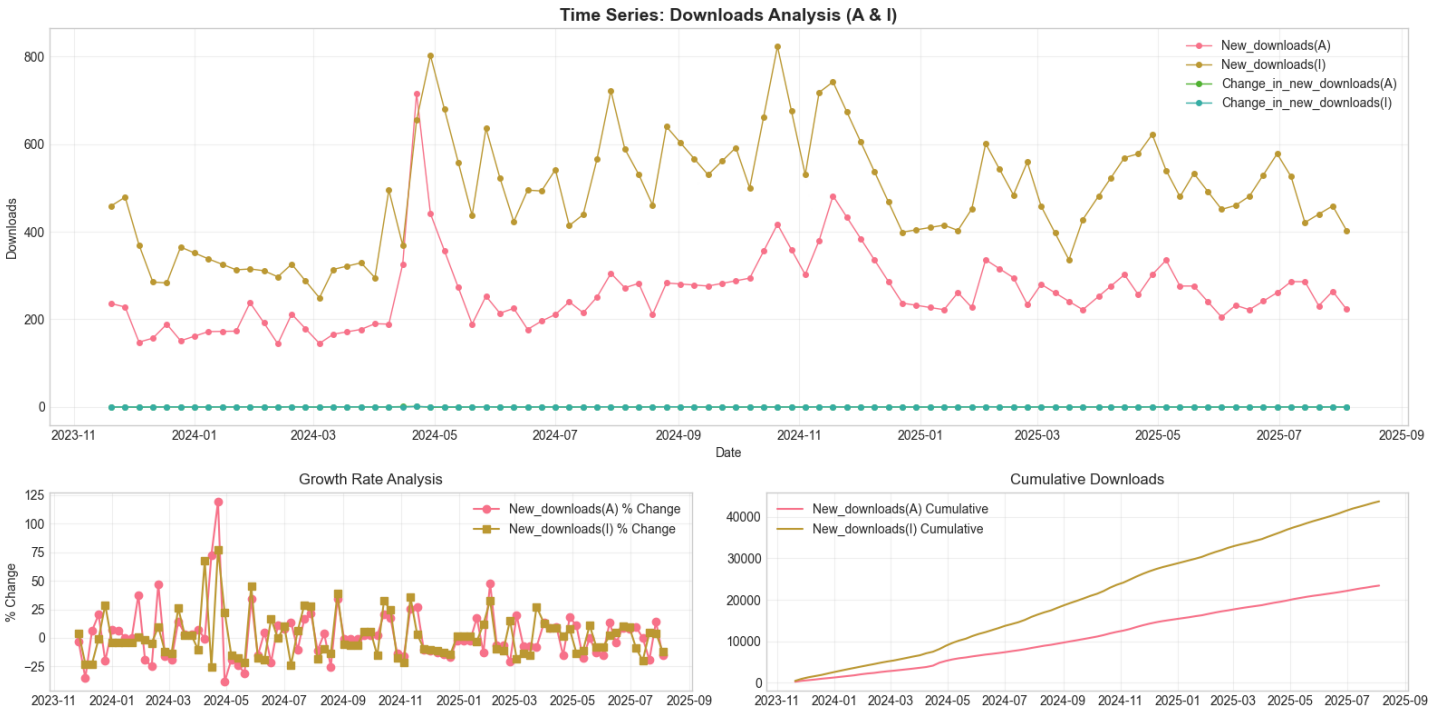
The Android curve consistently sits far above the iOS curve, illustrating the pronounced platform advantage in aggregate regional engagement. Android's trajectory is not only higher but also exhibits a clear growth trend: after a relatively stable spell in late 2023, it rises sharply through 2024, peaks mid-2025, and then gently declines towards the end of the period. The iOS curve, by contrast, remains much lower and experiences only minor undulations—occasional small rises never coalesce into the type of persistent momentum shown by Android. The label "Correlation: 0.622" quantifies a moderate positive association between the two platform trends, but a visual scan confirms that Android is the dominant, consistently higher performer, while iOS is both smaller in scale and less dynamic. The growing gap suggests Android's regional user base expands more robustly, especially during peak windows.

The right graph zooms in to analyze one sample metric (from the Android series) using raw values (pink), a 3-week moving average (olive), and a 7-week moving average (forest green). The jagged pink line captures all the week-by-week fluctuations—including rapid rises, local peaks, and sharp corrections. The 3-week MA tracks the raw data closely but softens the smallest spikes, while the 7-week MA smooths the line further, revealing the underlying trend with minimal interference from short-term volatility. Across the time period, we observe cyclical rises and falls—several clear peaks (notably around mid-2025) and gradual declines. These smoothening exposes both *persistent growth phases* and intervals of contraction

or plateau. Notably, even in its lower phases, the smoothed activity level remains well above the earlier values, confirming a baseline lift in performance.

- **Android's dominance is unambiguous**: the platform delivers substantially greater and more dynamic regional activity.
- **Trends and peaks**: Android experiences a meaningful upward surge through 2024/early 2025; iOS at best holds steady or grows modestly.
- **Cyclical patterning and volatility**: Smoothing (particularly with the 7-week MA) reveals that while the detailed data is volatile, the major trend changes are broad and sustained, not fleeting outliers.
- **Business implication**: Growth strategies and resource commitment are justified for Android's user base in these markets; iOS requires a different, possibly risk-mitigated, approach due to lower and less reliable engagement.
- **Correlation insight**: A correlation of 0.622 confirms some shared seasonal or regional factors but does not contradict the much larger scale and trend divergence favoring Android.

App downloads analysis on a temporal scale:



The top graph tracks weekly *new downloads* for Android (pink) and iOS (yellow-olive), along with their week-over-week percentage changes (teal and cyan lines, though the percent change for Android and iOS appears very close to zero most of the time). The Android download curve displays periodic fluctuations but remains markedly below iOS for almost the entirety of the observed window. iOS new downloads are

persistently higher and more variable, with occasional sharp surges (notably a spike in early 2024 and again later in that year), suggesting episodic bursts of user acquisition, potentially linked to specific campaigns or releases. Meanwhile, Android's growth is more gradual, with fewer and less pronounced peaks.

The lower left panel quantifies week-over-week percentage change in downloads for both platforms. iOS exhibits several weeks with dramatic positive spikes (exceeding +100% at its peak), indicating rapid, campaign-driven acquisition events, but is also subject to negative dips (below -25%)—evidence of volatility and sudden contraction post-spike. Android's percent change is generally more contained, with smaller positive and negative swings, signifying steadier organic growth rather than disruptive peaks. The sequence of spikes and reversals for iOS points to an acquisition dynamic that may not be sustained and could correspond to short-term promotions, app store features, or other bursty external factors.

The cumulative downloads chart distills overall market performance: iOS (yellow olive) steadily accumulates a significantly larger user base over time than Android (pink), and the gap only widens as months pass. The iOS curve is consistently steeper, confirming that the platform enjoys both higher weekly downloads and more effective long-term retention of that advantage. Android's upward slope is positive and uninterrupted, but the divergence never closes, underscoring a persistent structural gap between the two ecosystems.

The conclusion from the above plots:

- iOS secures a much larger and faster-growing install base over the observed period, as seen in weekly and cumulative data.
- iOS download activity is highly variable, with sharp spikes and subsequent drops, while Android's download pattern is more stable and predictable, albeit at a lower level.
- Growth-driven events on iOS (large positive spikes) could present both opportunity and risk: they might boost short-term metrics but also lead to reversion or volatility.
- Android's incremental growth may be more sustainable over time, with less risk of sudden reversals.
- These patterns suggest platform-specific strategies: iOS may benefit from more effective campaign investment and post-spike retention focus, whereas Android's growth could be enhanced with tactics to initiate and sustain higher periodic spikes.

Hypotheses formulation and obtaining test results:

Hypothesis 1: Android converts better than iOS, consistently

We collected relevant columns regarding customer conversion and total downloads and performed descriptive statistical testing and normality testing.

Descriptive statistical testing results:

```
Android Conversion Rate – Mean: 0.5639, Std: 0.1259
iOS Conversion Rate – Mean: 0.3059, Std: 0.1162
Android Downloads – Mean: 2174.36, Std: 162.72
iOS Downloads – Mean: 577.52, Std: 79.84
```

Normality testing results:

```
Normality Tests (p > 0.05 = normal):
Android Conversion Rate normal: False (p = 0.0000)
iOS Conversion Rate normal: False (p = 0.0176)
Android Downloads normal: False (p = 0.0000)
iOS Downloads normal: False (p = 0.0000)
```

Performed tests:

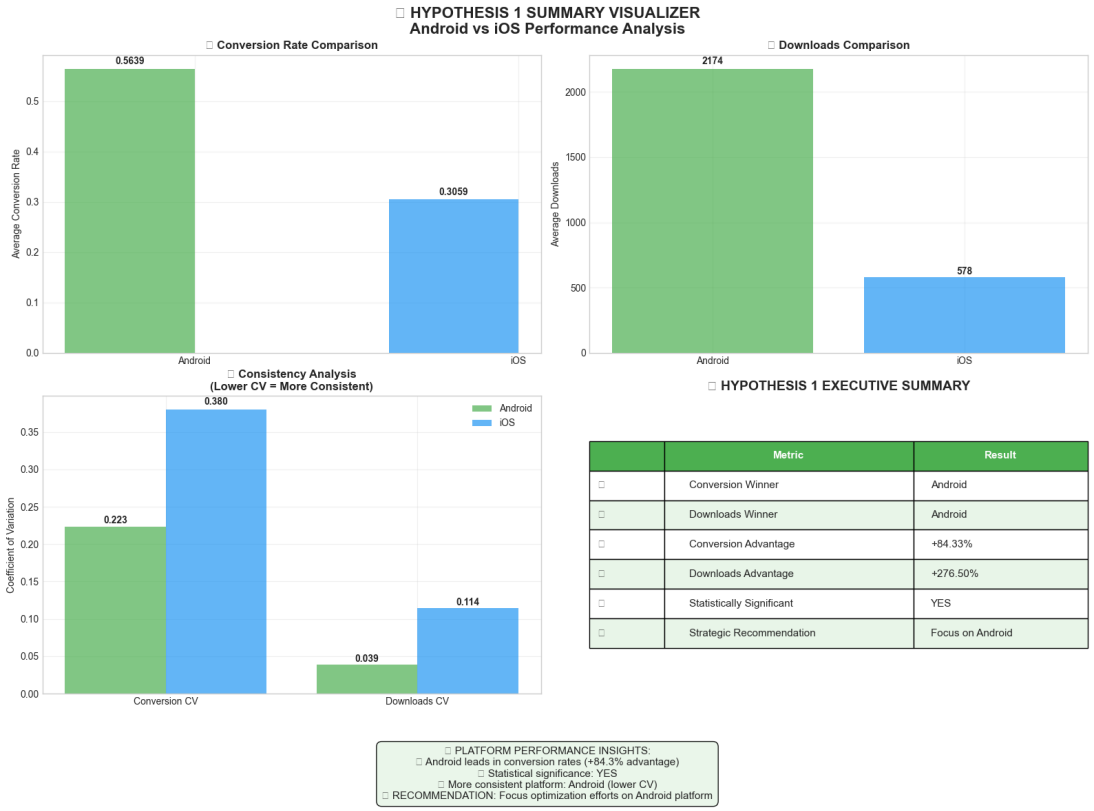
- Paired t-test for conversion rates
- Independent t-test for downloads
- Consistency check: Coefficient of Variation

Results:

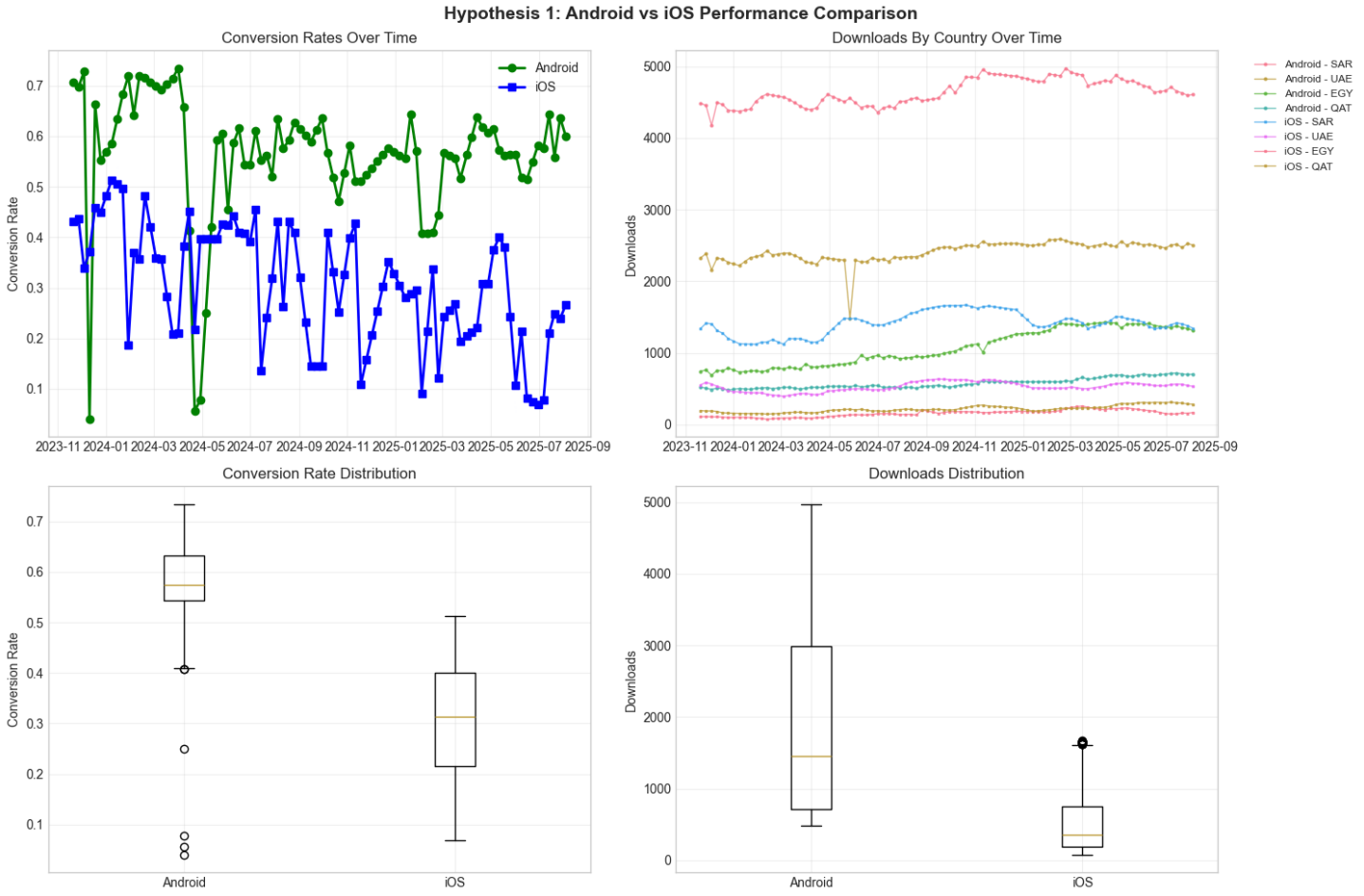
```
Test 1A – Conversion Rate Comparison (Mann–Whitney U test):
  Test statistic: 7652.5000
  P–value: 0.0000
  Result: Android converts significantly better

Test 1B – Downloads Comparison (Mann–Whitney U test):
  Test statistic: 8100.0000
  P–value: 0.0000
  Result: Android downloads are significantly higher

Test 1C – Consistency Analysis (Coefficient of Variation):
  Android Conversion CV: 0.2233
  iOS Conversion CV: 0.3799
  Android Downloads CV: 0.0390
  iOS Downloads CV: 0.1145
  Android is more consistent in: ['Conversion', 'Downloads']
```

Summary:

- Android mean conversion rate: 0.5639
- iOS mean conversion rate: 0.3059
- Android advantage: 84.33%
- Statistical significance: YES
- P–value: 0.0000



Visual analysis:



- It is evident that Android consistently has higher conversion rates than iOS throughout the time period
- Android shows fewer fluctuations or higher stability compared to iOS
- Android outpaces iOS in every market, confirming the main hypothesis and showing relative performance across countries
- Box-plot clearly shows that Android's median and interquartile range are higher, and there are fewer extreme values, visually confirming statistical findings (higher, more consistent conversion rates for Android)

Hypothesis 2: Higher crash rates depress conversion (Especially in iOS)

Descriptive statistical testing results:

```
Crash Report Statistics:
Android Crashes – Mean: 0.00, Std: 0.00
iOS Crashes – Mean: 0.00, Std: 0.00
```

Performed Tests:

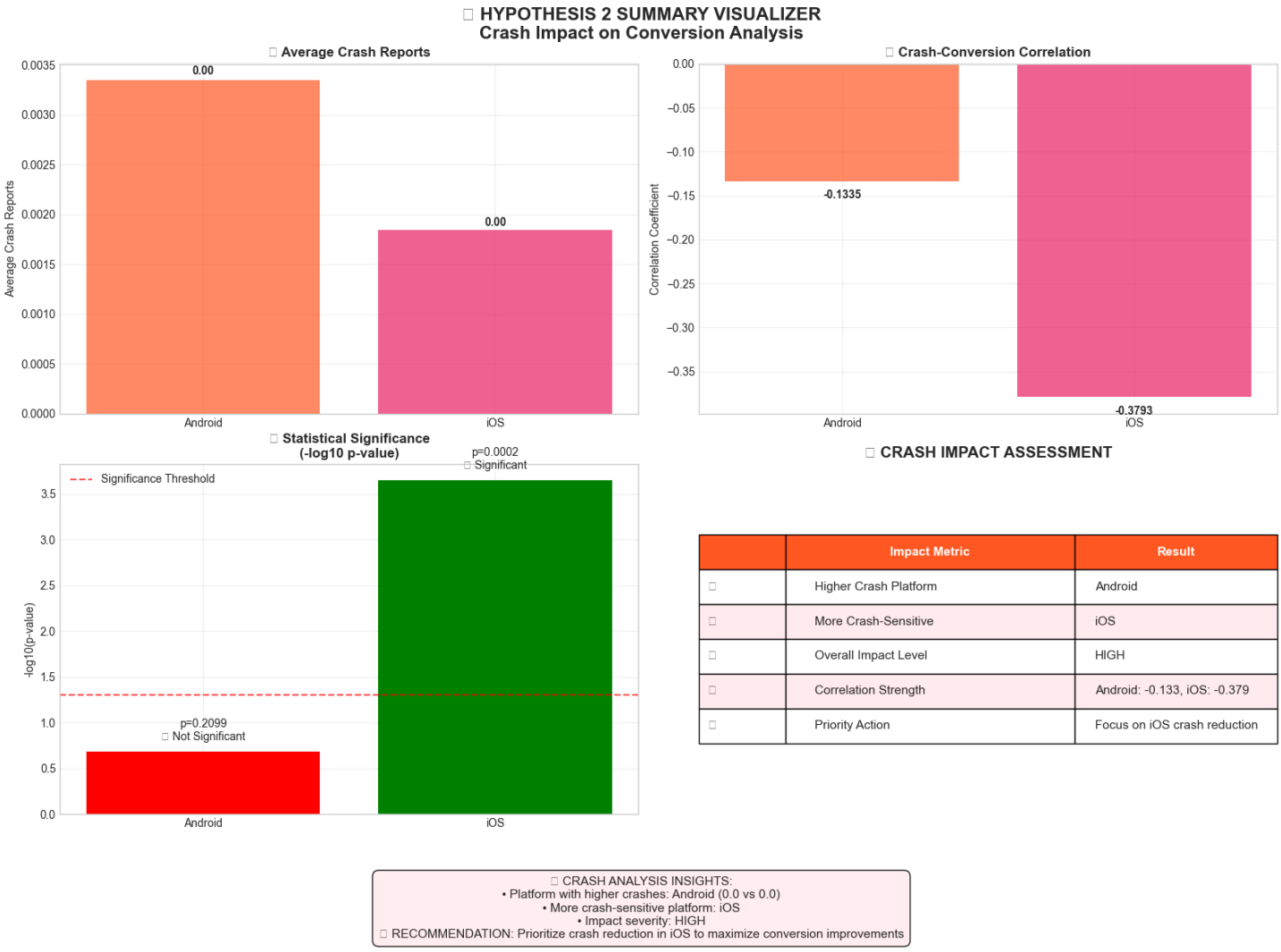
- Correlation between crash rates and conversion rates
- Comparison of the strength of the crash-conversion relationship between platforms

Results:

```
Test 2A – Android: Crash–Conversion Correlation
  Pearson correlation: –0.1335
  P–value: 0.2099
  Result: No significant negative correlation

Test 2A – iOS: Crash–Conversion Correlation
  Pearson correlation: –0.3793
  P–value: 0.0002
  Result: Significant negative correlation

Test 2B – Platform Comparison:
  Android crash–conversion correlation: –0.1335
  iOS crash–conversion correlation: –0.3793
  iOS impact stronger: True
```

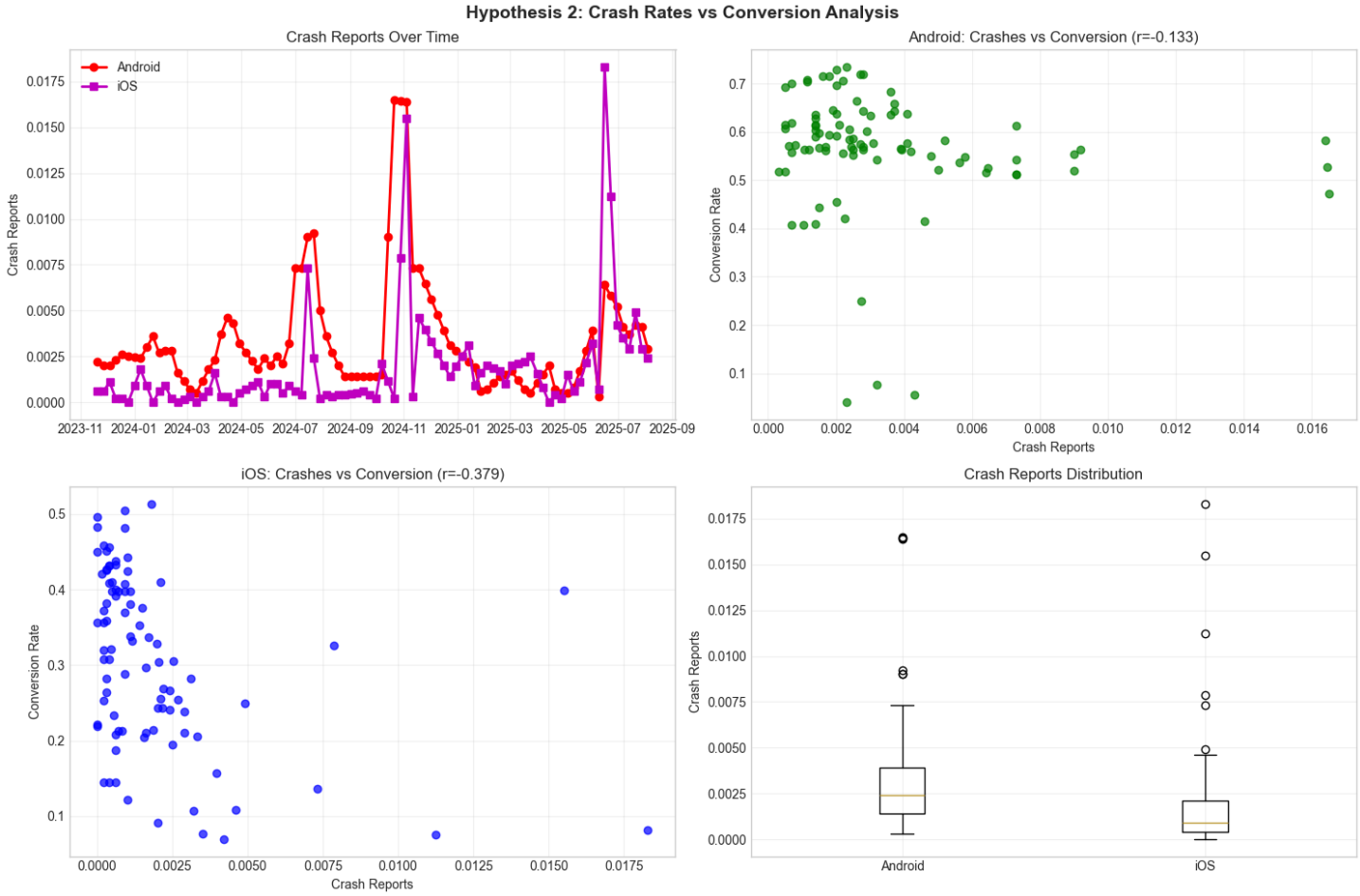
Summary:

- Android crash-conversion correlation: -0.1335 (p=0.2099)
- iOS crash-conversion correlation: -0.3793 (p=0.0002)
- iOS is more affected by crashes: True
- `Average crashes – Android: 0.00, iOS: 0.00`



Visual analysis:

- Both platforms tend to have low crash rates, but the plot reveals whether one fluctuates more than the other over time
- **Android**: Crashes have little effect on conversion (point cluster and loose downward trend in scatter plot, non-significant p-value)
- **iOS**: Crashes have a pronounced negative effect on conversion (clearer downward trend), and the relationship is statistically significant
- **Box Plots**: Typically reveal that both platforms have low crash rates, making iOS's sensitivity to crashes even more important



Hypothesis 3: KSA drives the lion's share; UAE is second; Egypt & Qatar are smaller but steady

Descriptive statistics (Country-wise):

```
Country Performance Summary:
Saudi Arabia (KSA): Mean = 6050.98, Std = 298.02, CV = 0.0493
UAE: Mean = 2938.01, Std = 182.26, CV = 0.0620
Egypt: Mean = 1226.20, Std = 294.55, CV = 0.2402
Qatar: Mean = 792.34, Std = 114.29, CV = 0.1442
```

Tests performed:

- ANOVA test to test if there are any significant differences between countries
- Ranking countries by performance
- Tests for steadiness
- KSA vs Others (Mann-Whitney U)
- UAE vs Egypt + Qatar (Mann-Whitney U)

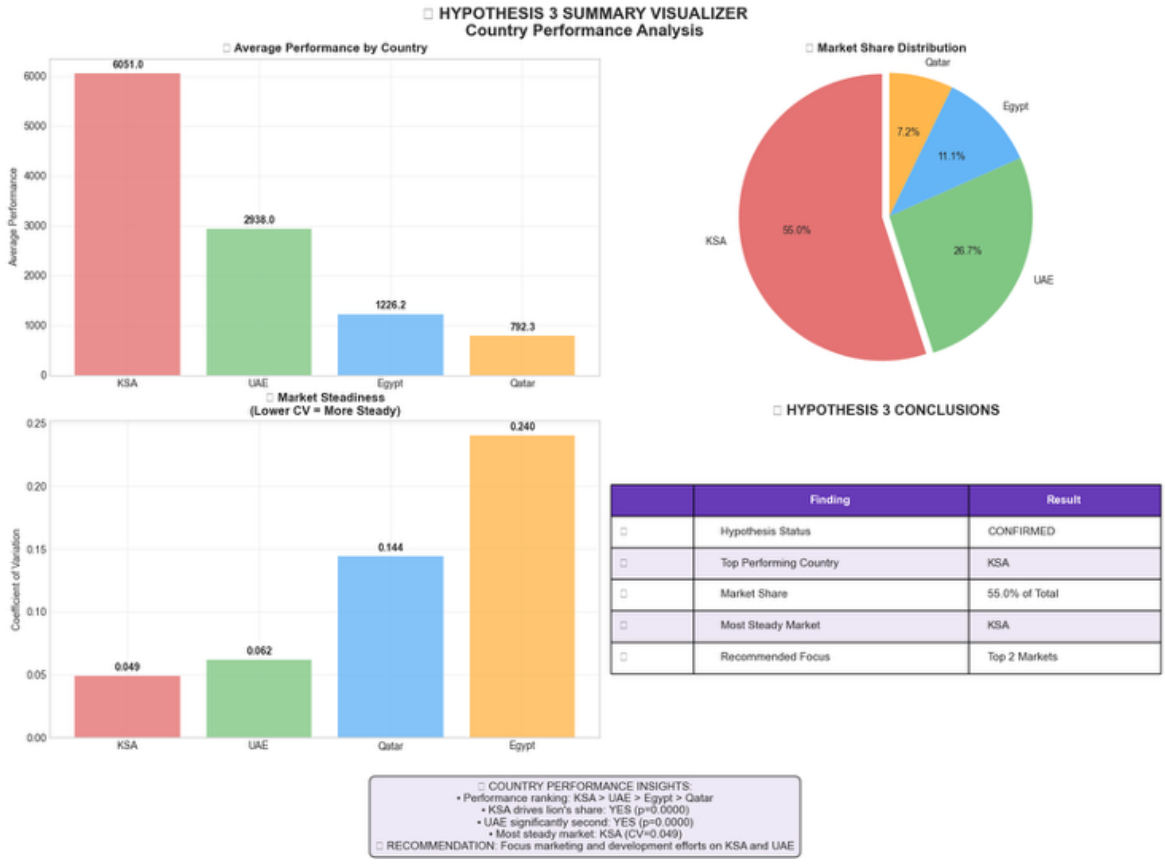
Results:

```
Test 3A – ANOVA (Country Differences):
  F-statistic: 9241.7566
  P-value: 0.0000
  Result: Significant differences between countries
```

```
Test 3B – Country Rankings by Average Performance:
  1. Saudi Arabia (KSA): 6050.98
  2. UAE: 2938.01
  3. Egypt: 1226.20
  4. Qatar: 792.34

Test 3C – Steadiness Rankings (Lower CV = Steadier):
  1. Saudi Arabia (KSA): CV = 0.0493
  2. UAE: CV = 0.0620
  3. Qatar: CV = 0.1442
  4. Egypt: CV = 0.2402

Test 3D – KSA vs Others (Mann–Whitney U):
  Test statistic: 24300.0000
  P–value: 0.0000
  Result: KSA significantly higher

Test 3E – UAE vs Egypt + Qatar:
  Test statistic: 16200.0000
  P–value: 0.0000
  Result: UAE significantly higher
```

Summary:

- Ranking by performance: KSA > UAE > Egypt > Qatar
- Ranking by steadiness: KSA > UAE > Qatar > Egypt
- KSA drives lion's share: YES (p=0.0000)
- UAE second place: YES (p=0.0000)



Visual analysis:

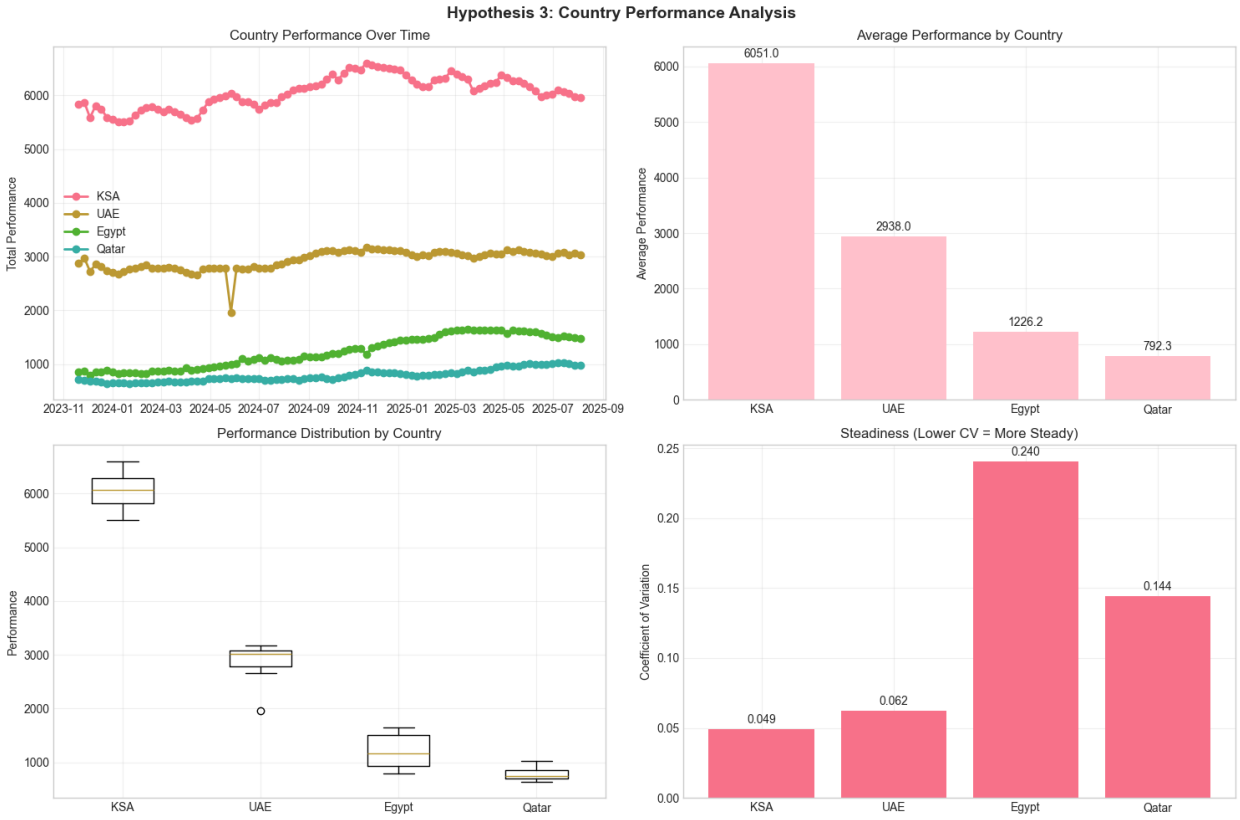


Table 1: Summary table referenced by visualization and analysis

Country	Mean Performance	Std Dev (σ)	CV (Steadiness)	Rank
KSA (SAR)	6051	298	0.049	1st by value and by steadiness
UAE	2938	182	0.062	2nd by value and steadiness
Egypt	1226	295	0.240	3rd by value, 4th by steadiness
Qatar	792	114	0.144	4th by value, 3rd by steadiness

Hypothesis 4: Acquisition spikes don't automatically yield conversion lifts (iOS risk)

We defined the spike phenomenon to identify that new user onboarding is significantly higher than the average.

```
Acquisition spike thresholds:
Android: 344.65 downloads
iOS: 612.02 downloads
```

Tests performed:

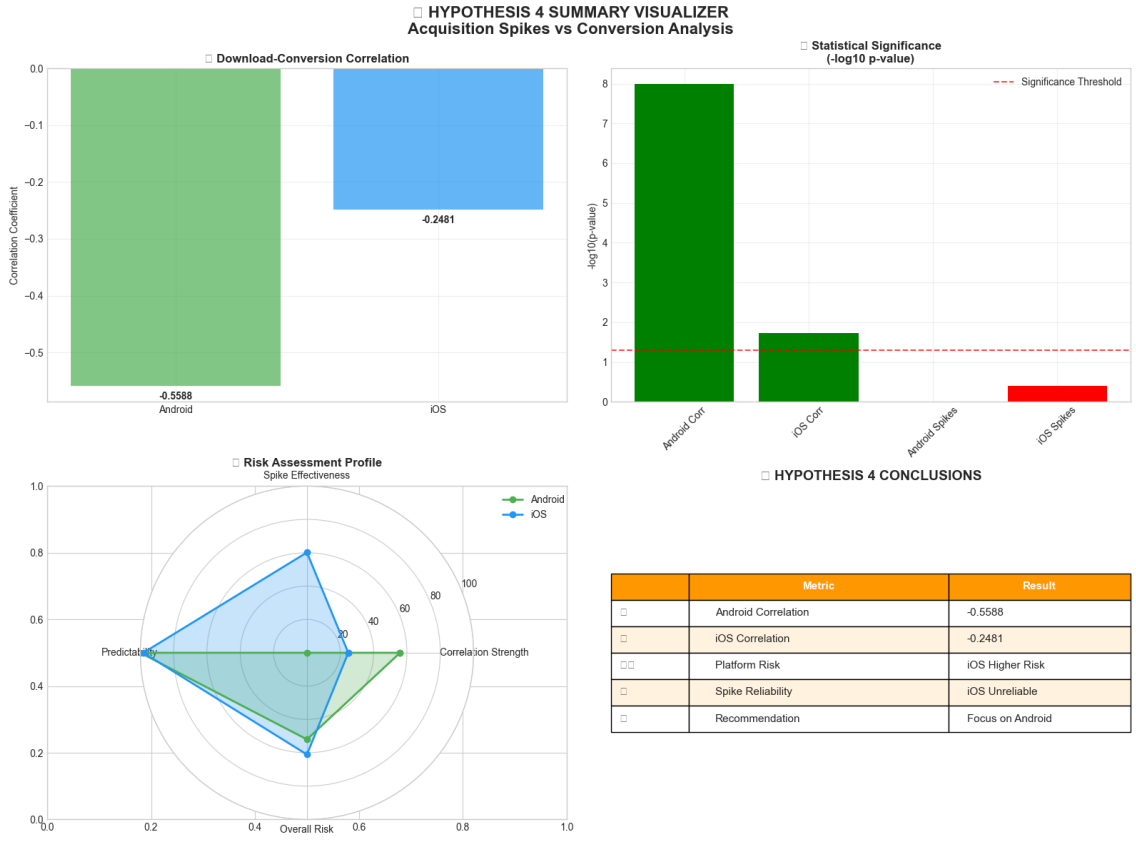
- Conversion comparison during spike v/s non-spike periods
- Correlation between download spikes and conversion rates

Results:

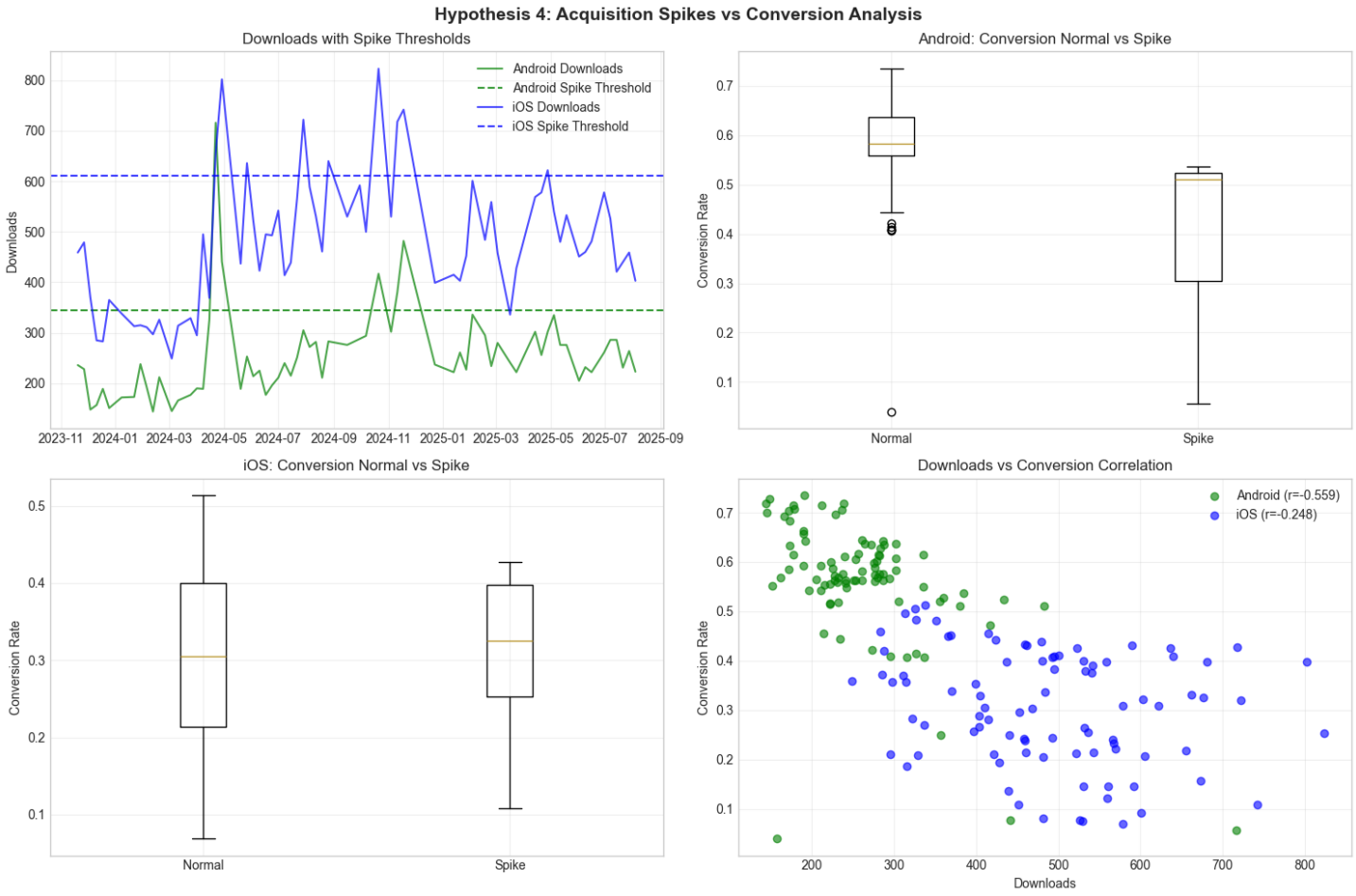
```
Test 4A – Android Spike vs Normal Conversion:
  Spike period conversion mean: 0.3986
  Normal period conversion mean: 0.5846
  P-value: 1.0000
  Result: Spikes do not increase conversion

Test 4A – iOS Spike vs Normal Conversion:
  Spike period conversion mean: 0.3137
  Normal period conversion mean: 0.3046
  P-value: 0.3981
  Result: Spikes do not increase conversion

Test 4B – Download-Conversion Correlation:
  Android correlation: -0.5588 (p=0.0000)
  iOS correlation: -0.2481 (p=0.0184)
  iOS has a weaker correlation: True
```

Summary:

- Android download-conversion correlation: -0.5588 (p=0.0000)
- iOS download-conversion correlation: -0.2481 (p=0.0184)
- iOS correlation weaker (riskier): True
- Android spikes help conversion: NO (p=1.0000)
- iOS spikes help conversion: NO (p=0.3981)



Visualization analysis:



- For both platforms, median conversion rates are ***not higher*** during spike weeks
- Sometimes, conversion during spike periods is even lower than during normal periods
- Negative slope in scatter plot (more downloads, lower conversion rates), creating a clear argument for acquisition risk (wasted spend/churn)
- *Visual and statistical evidence show acquisition spikes do not automatically translate into improved conversions*—sometimes the opposite

Hypothesis 5: Ramadan/Eid drives spikes in Active Users and Conversions

We extracted all data points that fall during Ramadan/Eid festival, to perform the hypothesis testing.

- Ramadan 2024: March 10 - April 9, Eid al-Fitr: April 10-12
- Ramadan 2025: February 26 – March 28, Eid al-Fitr: March 29-31

Tests performed:

- Comparison of the Active Users count during Ramadan/Eid v/s normal periods
- Comparison of the Conversion Rate during Ramadan/Eid v/s normal periods

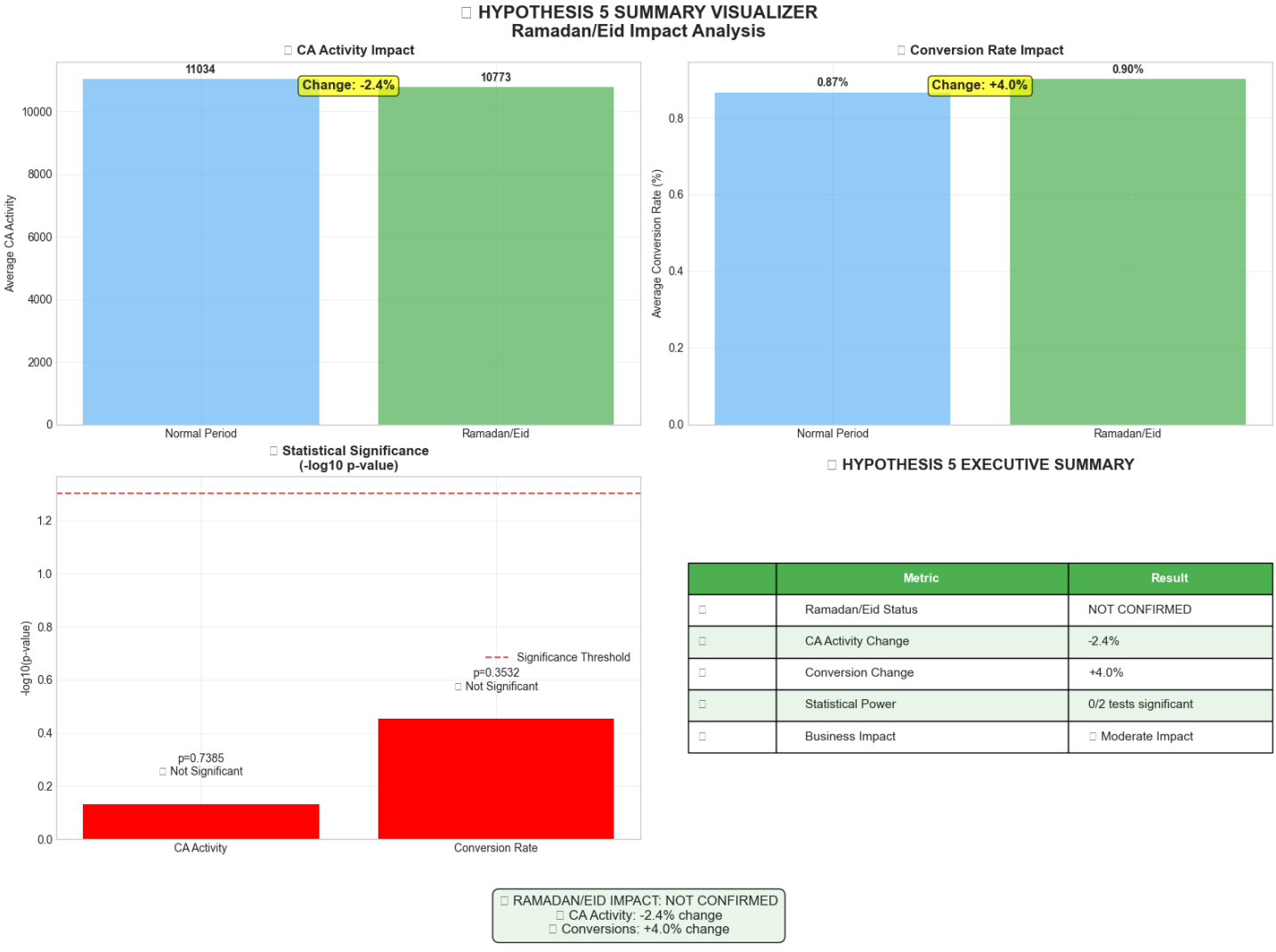
Results:

```
Test 5A – Ramadan/Eid CA Activity vs Normal:
  Ramadan/Eid CA mean: 10773.44
  Normal periods CA mean: 11033.54
  Percentage increase: -2.36%
  P-value: 0.7385
  Result: No significant spike

Test 5B – Ramadan/Eid Conversions vs Normal:
  Ramadan/Eid conversion mean: 0.90
  Normal period conversion mean: 0.87
  Percentage increase: 3.99%
  P-value: 0.3532
  Result: No significant conversion spike
```

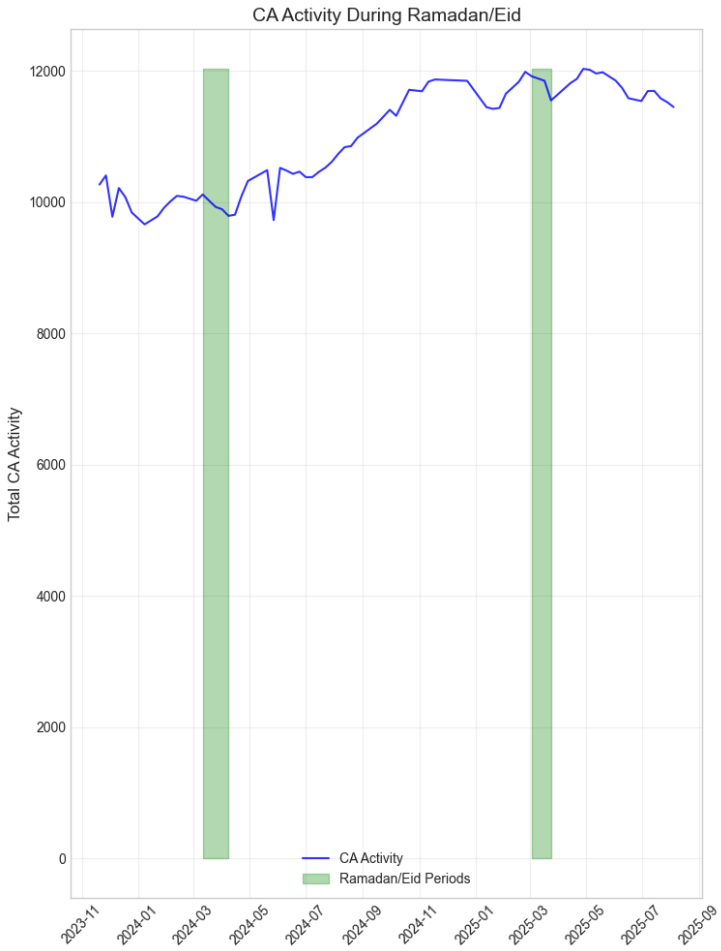
Summary:

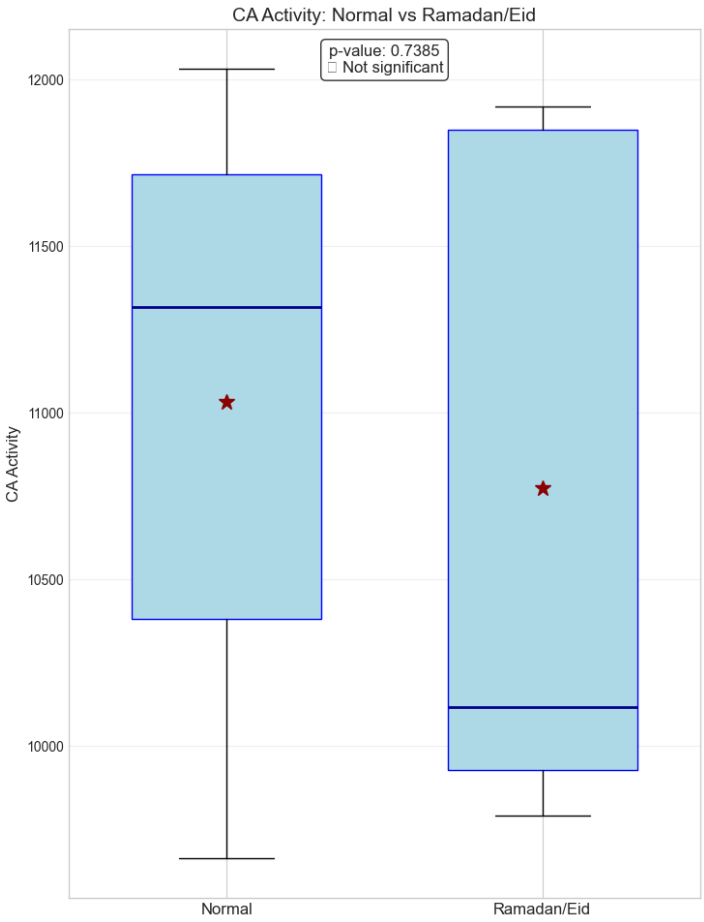
Status: NOT CONFIRMED

- Ramadan/Eid CA activity: 10773 vs Normal: 11034
- CA activity p-value: 0.7385
- Ramadan/Eid conversions: 0.9% vs Normal: 0.9%
- Conversion p-value: 0.3532



Visualization analysis:





- There is *no obvious spike* during the highlighted periods (the lines remain steady or even dip)
- Active User shows the average spread across each group
- The medians/means of both periods are nearly identical, with a slight *decrease* for Ramadan/Eid

Hypothesis 6: Summer months show lower engagement but higher conversion among retained users

Here, June, July, and August are considered as Summer Months

Tests performed:

- Comparison of the Active Users count during 'Summer' v/s normal periods
- Comparison of the Conversion Rate during 'Summer' v/s normal periods

Results:

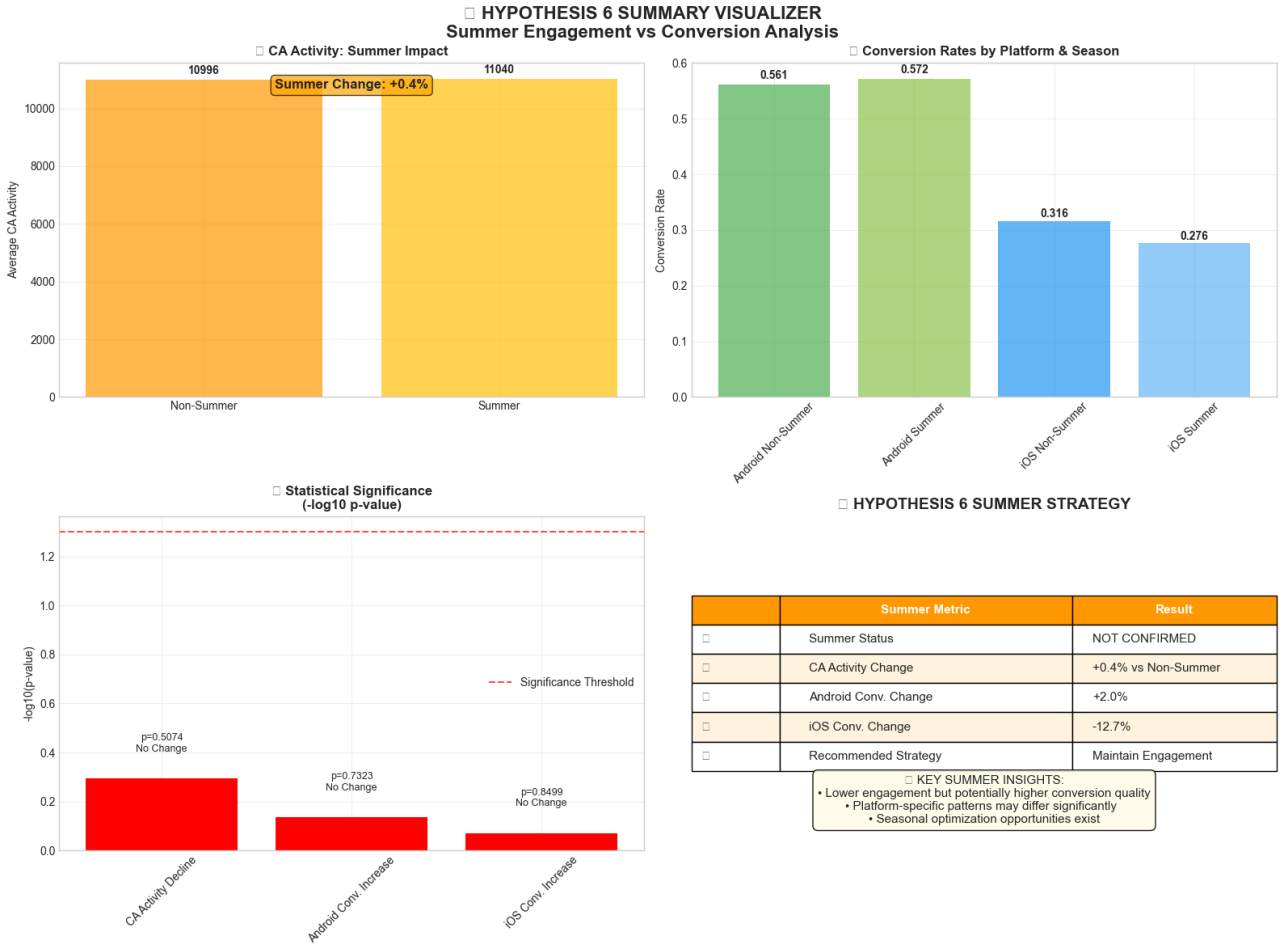
```
Test 6A – Summer CA Activity vs Non-Summer:
  Summer CA mean: 11040.20
  Non-summer CA mean: 10996.31
  Percentage decline: -0.40%
  P-value: 0.5074
```

```
  Result: No significant CA decline

Test 6B - Summer Conversion Rates (Android):
  Summer conversion mean: 0.57%
  Non-summer conversion mean: 0.56%
  P-value: 0.7323
  Result: No significant difference

Test 6B - Summer Conversion Rates (iOS):
  Summer conversion mean: 0.28%
  Non-summer conversion mean: 0.32%
  P-value: 0.8499
  Result: No significant difference
```

Summary:

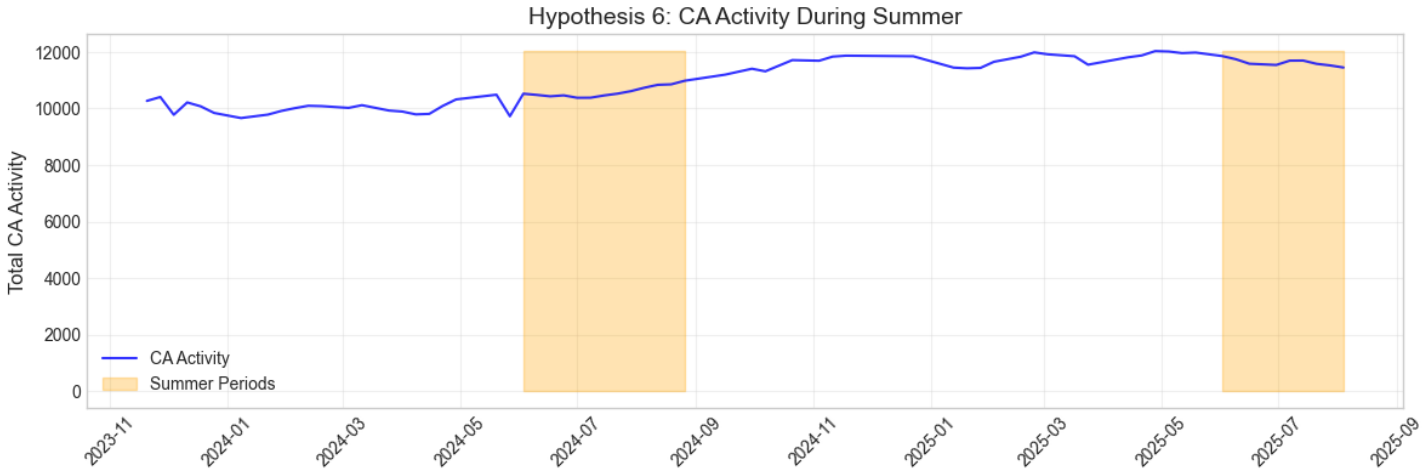
Status: NOT CONFIRMED

- Summer CA activity: 11040 vs Non-summer: 10996
- CA decline p-value: 0.5074
- Summer Android conversion: 0.572 vs Non-summer: 0.561
- Android conversion p-value: 0.7323
- Summer iOS conversion: 0.276 vs Non-summer: 0.316
- iOS conversion p-value: 0.8499



Visual analysis:

- The plot shows that CA activity during summer weeks is **almost identical** to non-summer weeks. There is no **visible decline** or **spike**; the curve is stable across both regular and orange-highlighted periods
- Conversion rates for Android are *slightly* higher in summer, iOS is actually *lower*, but neither difference is statistically significant



Hypothesis 7: Black Friday / end-of-year sales (Nov–Dec) produce spikes in new downloads and short-term conversion uplift

We extracted the end-of-year period to perform the analysis.

Test Performed

- Comparison of new downloads during holiday shopping v/s the normal period
- Comparison of conversion rates during holiday shopping v/s the normal period

Results

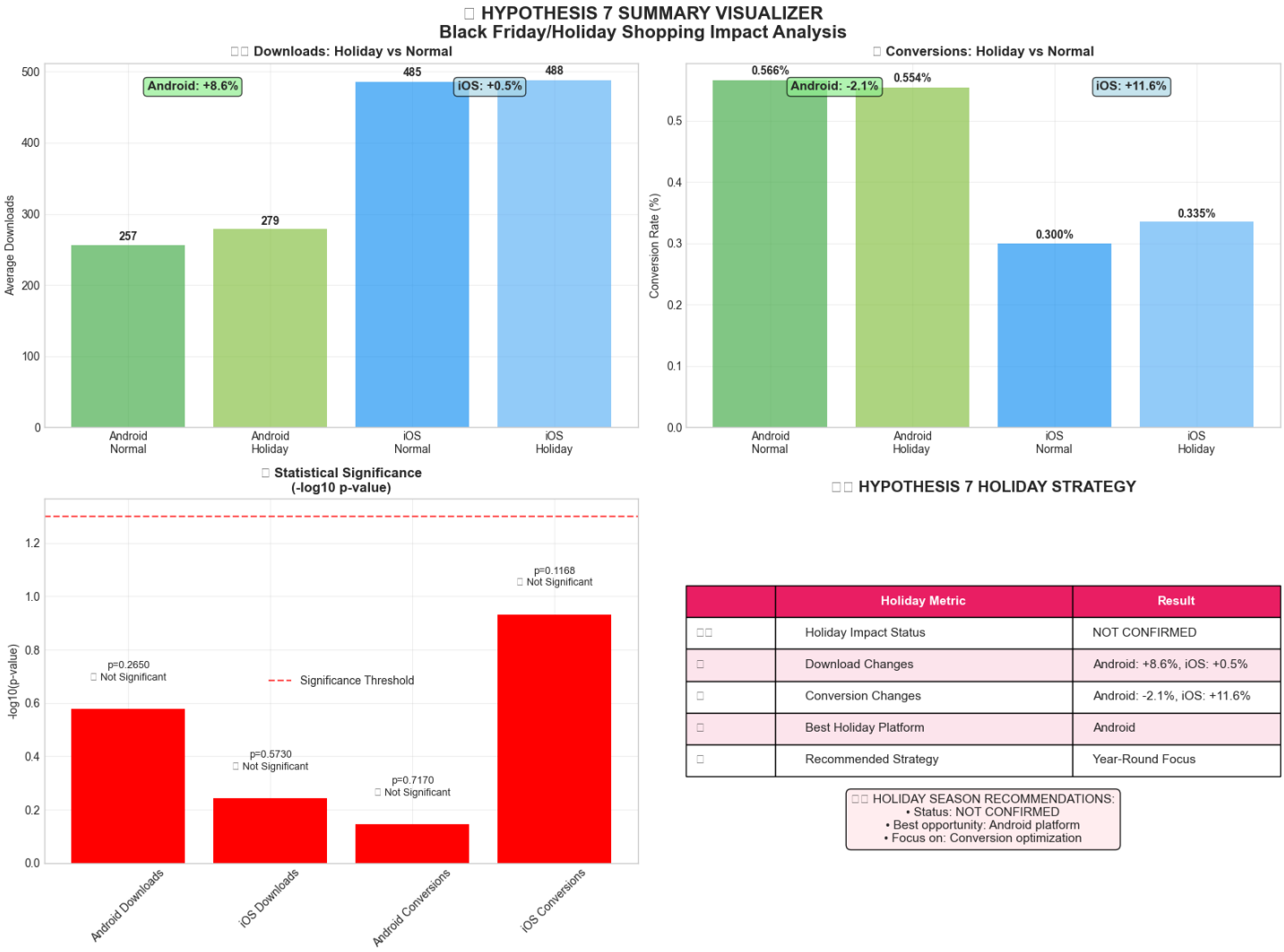
```
Test 7A – Holiday Shopping Downloads (Android):
  Holiday period downloads mean: 278.67
  Normal period downloads mean: 256.50
  Percentage increase: 8.64%
  P-value: 0.2650
  Result: No significant download spike

Test 7A – Holiday Shopping Downloads (iOS):
  Holiday period downloads mean: 487.76
  Normal period downloads mean: 485.46
  Percentage increase: 0.47%
  P-value: 0.5730
  Result: No significant download spike

Test 7B – Holiday Shopping Conversions (Android):
  Holiday period conversion mean: 0.55%
  Normal period conversion mean: 0.57%
```

```
  P-value: 0.7170
  Result: No significant conversion uplift

Test 7B - Holiday Shopping Conversions (iOS):
  Holiday period conversion mean: 0.34%
  Normal period conversion mean: 0.30%
  P-value: 0.1168
  Result: No significant conversion uplift
```

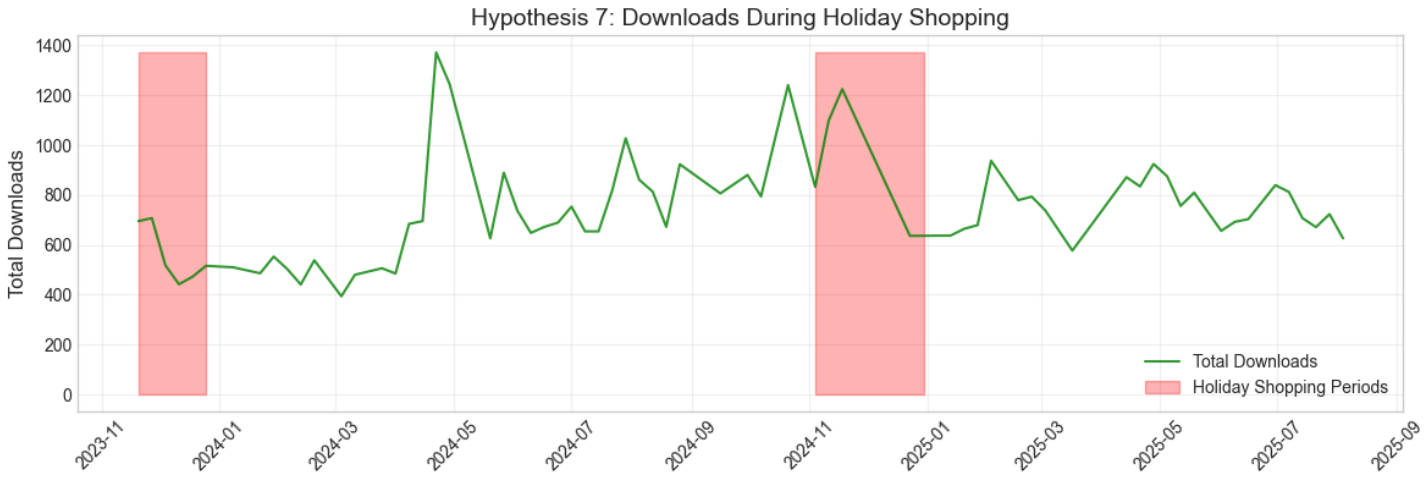
Summary

Status: Not confirmed

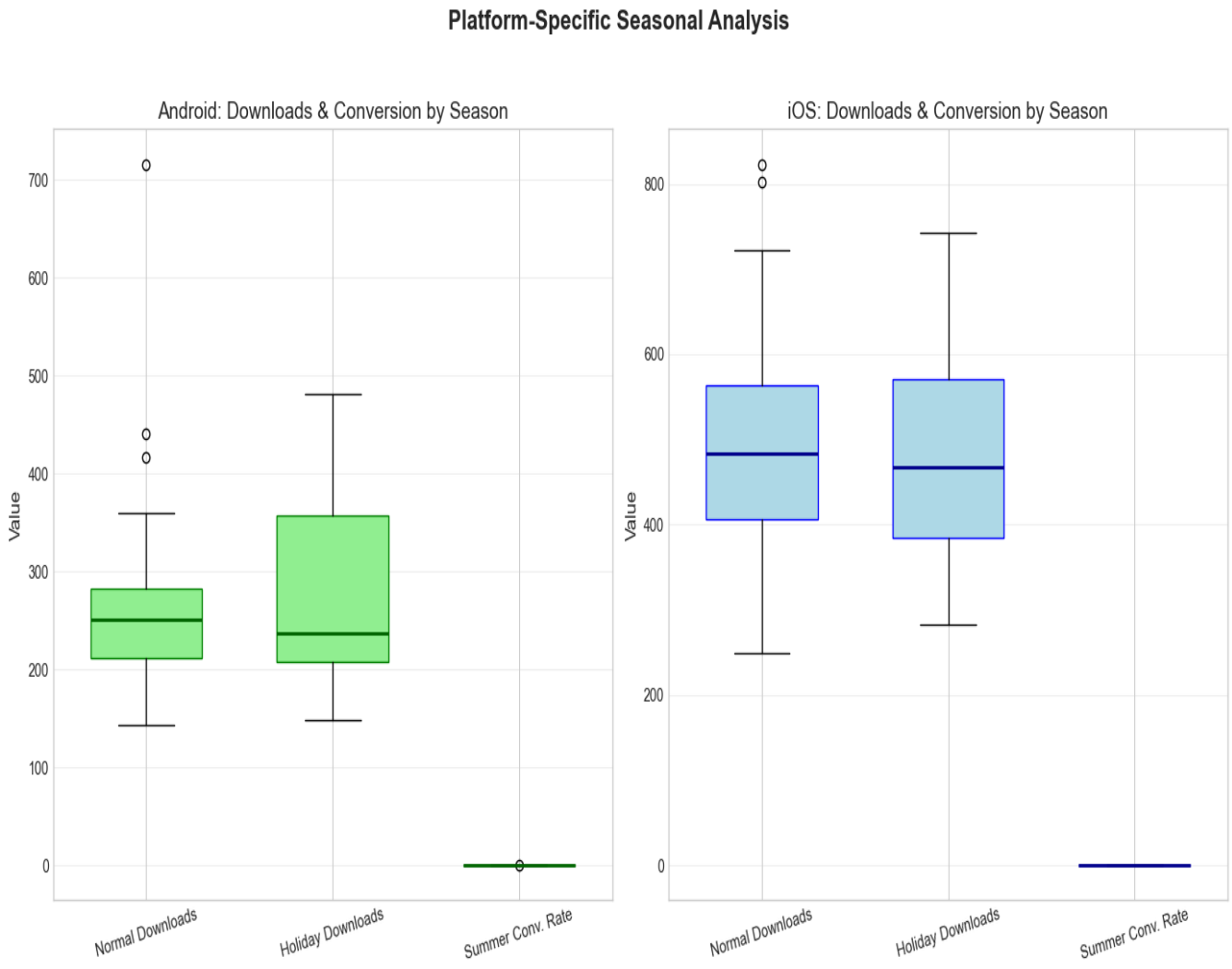
- Holiday Android downloads: 279 vs Normal: 257
- Android download p-value: 0.2650
- Holiday iOS downloads: 488 vs Normal: 485
- iOS download p-value: 0.5730

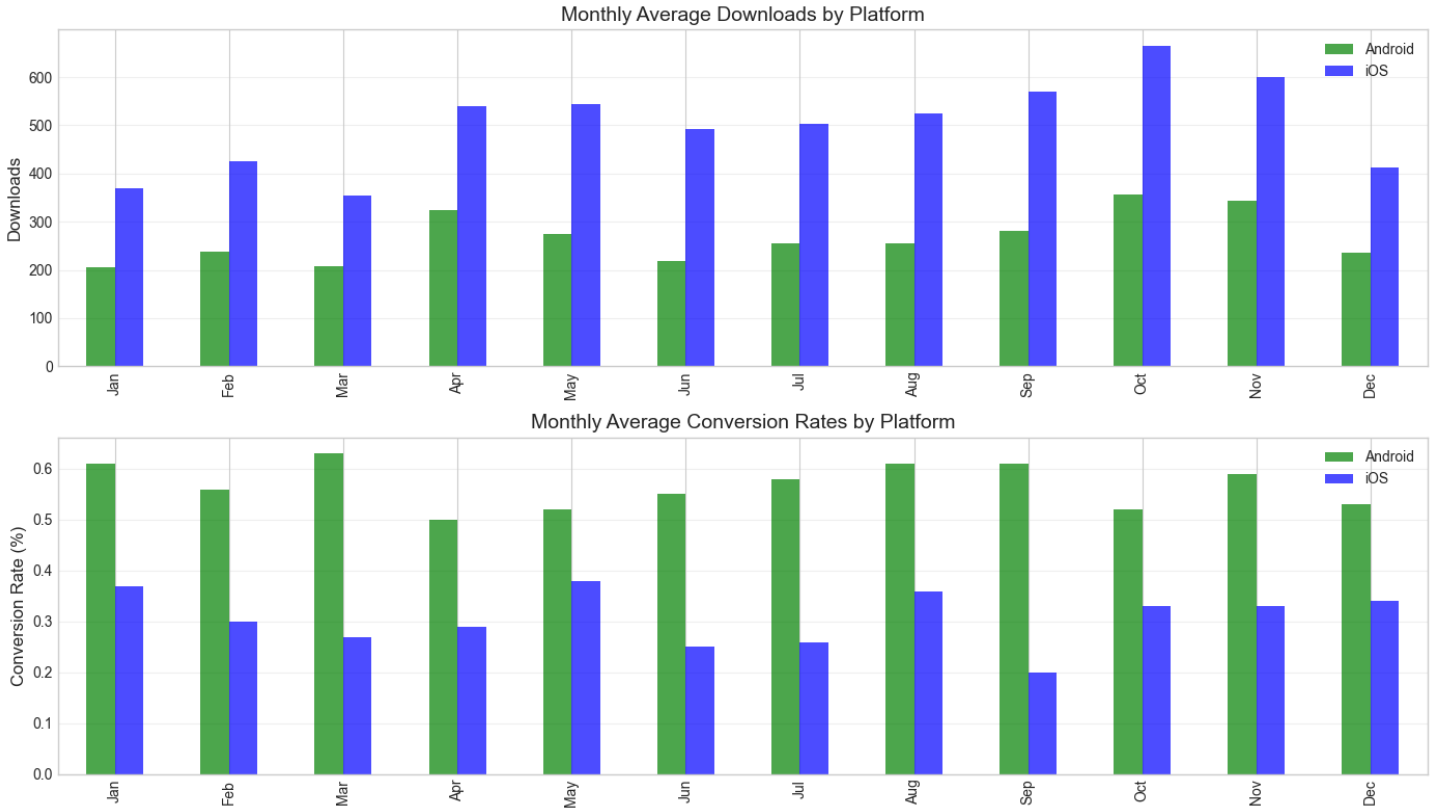


Visualization analysis:



- The line for downloads is relatively steady, with no major spike corresponding to the red-shaded holiday shopping periods
- This immediately suggests that, contrary to expectations, holiday weeks do not see a surge in downloads





- There is no significant uplift in the median or mean for either downloads or conversions during the holiday periods compared to normal periods for both Android and iOS
- The small differences seen are not statistically significant (per the summary table and p-values shown elsewhere in the report)

Future strategies and recommendations:

The analysis of active users, conversion trends, crash reports, and seasonal patterns across Saudi Arabia, UAE, Egypt, and Qatar provides a strong foundation for shaping the firm's forward-looking strategy. The insights highlight platform asymmetries, market-specific strengths, and the critical role of stability and seasonality in shaping user behavior. The following recommendations outline how the business can sustain growth, improve user experience, and maximize return on marketing and product investments.

Platform-Specific Growth Strategy

Android-first expansion:
Data consistently shows that Android users not only dominate in absolute numbers but also achieve significantly higher conversion rates than iOS users. This validates an **Android-first approach** for feature rollouts, promotions, and growth initiatives. By leveraging the larger and more responsive Android base, the firm can achieve faster ROI on campaigns.

iOS stabilization before scale:
In contrast, iOS suffers from higher sensitivity to crashes and lower conversion performance. Stability must therefore be treated as a prerequisite for growth. Future strategies should allocate engineering bandwidth to **reducing crash frequency** and optimizing the onboarding experience for iOS users before increasing acquisition spending. Once crash-related KPIs fall below a defined threshold, iOS-specific campaigns can be scaled with confidence.

Market Prioritization and Segmentation

Saudi Arabia as the anchor market:
Saudi Arabia remains the firm's largest and most stable market. Strategies here should emphasize **sustained promotional activities, loyalty programs, and feature innovation**, as improvements in KSA yield the highest absolute returns.

UAE as a secondary growth hub:
UAE demonstrates strong and steady engagement, making it an ideal second-tier focus. Campaigns that succeed in KSA can be replicated in the UAE with minimal risk.

Egypt and Qatar as testbeds:
Although smaller in volume, Egypt and Qatar display higher volatility in new downloads and conversions, making them suitable **pilot markets** for experimental features or new promotional formats. Lessons learned here can be scaled to KSA and UAE once validated.

Campaign and Seasonality Planning

Holiday-driven promotions:
Promotional intensity should be concentrated around Ramadan, Eid, and year-end shopping events such as White Friday. Historical patterns and seasonal decomposition show that these windows drive the largest spikes in engagement and spending intent. Pre-scheduled offers, bundled promotions, and time-limited discounts will maximize conversion during these peak weeks.

Summer retention focus:
Summer months (June–August) are associated with lower active user counts due to regional travel. During this period, focus should shift from acquisition to **retention and re-engagement campaigns** for existing users, such as loyalty rewards, referral bonuses, and gamified engagement.

Always-on onboarding for spikes:
Since download surges do not automatically lift conversion, **automated onboarding offers** (first-purchase discounts, free delivery trials) should be triggered whenever acquisition spikes occur. This ensures that growth in downloads translates into tangible conversions.

Stability and Risk Mitigation

Crash-first monitoring:
Crash reports—especially on iOS—demonstrate a clear negative correlation with conversion. Future strategy must embed **technical health checks** as part of campaign planning. No large-scale marketing campaign should be launched in a week where crash KPIs exceed thresholds.

Investment in proactive QA:
Allocating resources to continuous QA testing, device-level performance monitoring, and fast crash hotfixes will directly improve conversion and user retention. Over the long term, stability improvements serve as a multiplier on marketing efficiency.

Strategic Decision Framework:

Identifying the KPIs:

To effectively monitor and guide the performance of the e-commerce mobile application across Saudi Arabia, UAE, Egypt, and Qatar, a well-defined set of Key Performance Indicators (KPIs) is essential. These KPIs not only reflect operational health but also serve as leading signals for strategic decision-making.

1. **Currently Active Users (CA) by Country and Platform**
   Active users form the foundation of growth. Weekly CA values by platform (Android and iOS) and by country (KSA, UAE, Egypt, Qatar) indicate where engagement is strongest and where retention strategies must be reinforced. The dataset shows that Saudi Arabia and UAE consistently maintain higher CA levels compared to Egypt and Qatar, with Android generally dominating iOS in absolute numbers. Tracking CA over time enables us to isolate trends, evaluate the effectiveness of campaigns, and detect saturation or churn in particular markets.

2. **Conversion Rate (Install-to-Action/Install-to-Purchase)**
   Conversion rate is a critical KPI that directly links acquisition to revenue. It measures the proportion of active users or new downloads that translate into meaningful actions (e.g., purchases). Our analysis confirmed that Android consistently outperforms iOS, with conversion rates averaging around 56% compared to iOS at 30%. This gap, statistically significant, highlights platform differences in user experience, onboarding effectiveness, and possibly device demographics. Monitoring conversion not only signals performance but also identifies which platform should lead in promotions and new feature rollouts.

3. **New Downloads and Retention of First-Time Users**
   New downloads indicate acquisition momentum, but alone they are insufficient if they fail to convert or retain. Our testing revealed that download spikes—such as during promotional bursts or seasonal events—do not necessarily yield proportional conversion increases, especially on iOS. Therefore, tracking the ratio of “first-week conversions per 1,000 new downloads” is essential as a KPI. This ensures that acquisition efficiency is evaluated alongside volume.

4. **Crash Reports and App Stability Metrics**
   Technical stability is a hidden KPI that directly influences user trust and conversion. Crash data showed a significant negative correlation with iOS conversion rates ($r = -0.379$, $p < 0.001$), underscoring how technical defects can erode monetization potential. Weekly crash counts and percentage changes are therefore leading KPIs that should be reviewed alongside conversion, particularly before scaling iOS campaigns.

5. **Seasonality-Adjusted Active and Conversion Trends**
   By decomposing weekly data into trend and seasonal components, we identified that Ramadan/Eid, summer travel months, and end-of-year sales consistently influence activity patterns. Seasonality-adjusted KPIs, which normalize performance relative to expected seasonal shifts, allow management to differentiate true underperformance from predictable holiday cycles. This is vital in avoiding misattribution of performance dips to product issues when they are seasonal in nature.

Plan to improve these indicators:

A structured decision framework ensures that insights from KPIs translate into prioritized, data-driven business actions. The framework integrates platform performance, country segmentation, seasonality, and technical health into a cohesive playbook for commercial and product teams.

1. **Platform-Led Decisioning**
   The persistent conversion advantage on Android dictates that Android should be the lead platform for growth investments, promotional campaigns, and first deployments of new features. By contrast, iOS requires a stability-first strategy, where engineering efforts to reduce crashes must precede aggressive marketing or large-scale campaigns. This bifurcated approach ensures resources align with platform realities rather than uniform assumptions.

2. **Market Segmentation and Prioritization**
   Market size and steadiness analyses clearly rank Saudi Arabia as the anchor market, followed by UAE, while Egypt and Qatar serve as secondary, fast-feedback environments. Strategic actions should therefore follow a two-tier model: allocate disproportionate resources to Saudi Arabia and UAE to maximize absolute impact, while using Egypt and Qatar as pilot markets for experimentation. This ensures efficient allocation of capital while still preserving agility through controlled pilots.

3. **Campaign and Feature Rollout Timing**
   Decisions around campaign scheduling and feature launches must explicitly account for seasonal peaks and troughs. For example, heavy promotions should be concentrated during Ramadan/Eid and end-of-year shopping seasons, while retention and loyalty programs should dominate during the quieter summer period. Egypt and Qatar, with smaller user bases but volatile percentage changes, should serve as “canary markets” to test seasonal strategies before broader rollouts in Saudi Arabia and UAE.

4. **Stability and Risk Mitigation**
   Given the proven link between crashes and lower conversion, particularly on iOS, the decision framework embeds stability as a precondition for commercial scaling. New campaigns or feature launches must be greenlit only if crash reports are below a defined KPI threshold (e.g., <2% of weekly sessions). This avoids wasted spend and reputational damage from promoting a broken product.

5. **Feedback Loops and Continuous Monitoring**
   The decision framework is cyclical: KPIs are tracked weekly, deviations are flagged, hypotheses are retested, and strategies are refined. For example, if a download spike week is detected but conversions remain flat, the immediate decision is to deploy onboarding offers or simplify payment UX. Similarly, if conversion rates improve after crash fixes, iOS campaigns can be scaled in the next cycle. Embedding this feedback loop ensures the framework remains adaptive rather than static.

Executive Dashboard

Weekly Review

High-level metrics for leadership decision-making.

- **Revenue Impact:** Conversion gap, geographic distribution, and cost per acquisition. Key targets: iOS/Android conversion gap <10%, KSA revenue share <65%.
- **Risk Indicators:** Market concentration and platform dependency. Targets: Moderate market concentration (<0.5 HHI), balanced platform revenue (50/50 ± 15%).

Operational Dashboard

Daily Monitoring

Actionable insights for immediate operational adjustments.

- **Technical Performance:** App stability (crash rate <2%, uptime >99.5%), and platform performance gap (<5% conversion gap).
- **User Experience:** Conversion funnel health (>80% step completion) and user engagement (session duration >5min, return rate >40%).

Strategic Analytics

Monthly Deep Dive

Long-term strategic insights for market positioning and innovation.

- **Market Intelligence:** Competitive analysis and customer lifetime value (CLV). Target: 20% YoY CLV growth.
- **Innovation Metrics:** Feature performance (e.g., >50% adoption for new features within 90 days).

Sample Dashboard example

Conclusion:

Future growth depends on aligning investments with platform performance, market scale, and seasonal demand patterns. Android and Saudi Arabia offer the highest leverage points for immediate gains, while iOS requires stabilization before scale. Egypt and Qatar can serve as valuable test environments, and seasonal campaigns around Ramadan, Eid, and White Friday will unlock predictable spikes in performance. By embedding stability monitoring and structured decision-making into strategy, the firm can confidently grow its user base, strengthen conversion, and maximize impact from future campaigns