Statistical Analysis Report:
Impact of Food and Drink Banner on GloBox

Date: August 25, 2023
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Executive Summary

This report presents the results of a comprehensive statistical analysis of an A/B test conducted by GloBox. The primary objective of the test was to assess the **effectiveness of a new banner highlighting food and drink** offers on the website in terms of key metrics - **average spend** and **conversion rates**. The analysis included hypothesis testing, confidence intervals, practical significance assessment, sub-group analysis and temporal analysis of change over time to provide actionable insights for informed decision making.

Methodology

Hypotheses

Null Hypothesis (H0): The new banner does not significantly impact the average amount spent and conversion rates when compared to the control group.

Alternative Hypothesis (H1): The new banner has a significant effect on average amount spent and conversion rates compared to the control group.

Statistical Tests

1. **Conversion Rates (CVR):** A two-sample Z-test for difference in proportions was conducted to compare conversion rates between Group A (control) and Group B (treatment).

2. **Average Amount Spent:** A two-sample t-test was performed to compare the average amount spent between Group A and Group B.

Results

[Overview]

Group	Size	Avg. spent (US$)	CVR	Total_Spent_STDEV	Total_spent	Conversion Count	Median_ Total Spent
A	24343	3.374518468	0.03923099043	25.9363905 6	82145.90306	955	65.46
B	24600	3.390360259	0.04630081301	25.4138268 4	83402.86237	1139	54.54
Overall	48943	3.382480956	0.04278446356	25.6748050 3	165548.7654	2094	
Differece		1.004694534	1.180210148	0.9798521035	1.015301546	1.192670157	0.833180 5683
Percentage Increase		0.469% increase	18.021% increase	2.014% decrease	1.530% increase	19.267% increase	17% decrease
Practical Significance (1%)		3.7120	0.0432				72.01
CI lower bound		-0.4391	0.0035				
CI upper bound		0.4708	0.0107				
Is the increase above the Practical Significance?		No	Yes				
Is the entire CI above Practical Significance?		No	No				

Conversion Rates (CVR)

Calculation	Notation	Value	Rounded
sample size (control)	n1	24343	
sample size (treatment)	n2	24600	
sample proportion (control)	p1 hat	0.03923099043	0.0392
sample proportion (treatment)	p2 hat	0.04630081301	0.0463
poopled proportion	p hat	0.04278446356	0.0428
test statistic	T	3.86429177	3.8643
p-value	pval	0.0001114119853	**0.0001**

The p-value for the z-test comparing the conversion rates between Group A and Group B was calculated to be **0.0001**. With an alpha value (p-value cut-off) of 0.05, the null hypothesis is rejected. The results indicate a **statistically significant difference** in conversion rates between the two groups. The 95% confidence interval for the difference in CVR is [**0.0035, 0.0107**].

Calculation	Notation	Value	Rounded
sample size (control)	n1	24343	
sample size (treatment)	n2	24600	
sample proportion (control)	p1 hat	0.03923099043	0.0392
sample proportion (treatment)	p2 hat	0.04630081301	0.0463
sample statistic / point estimate	stat	0.00706982258	0.0071
standard error	SE	0.001828488403	0.0018
critical value	z	1.959963986	1.96
margin of error	moe	0.00358377142	0.0036
lower bound		**0.00348605116**	**0.0035**
upper bound		**0.010653594**	**0.0107**

Average Amount Spent (USD)

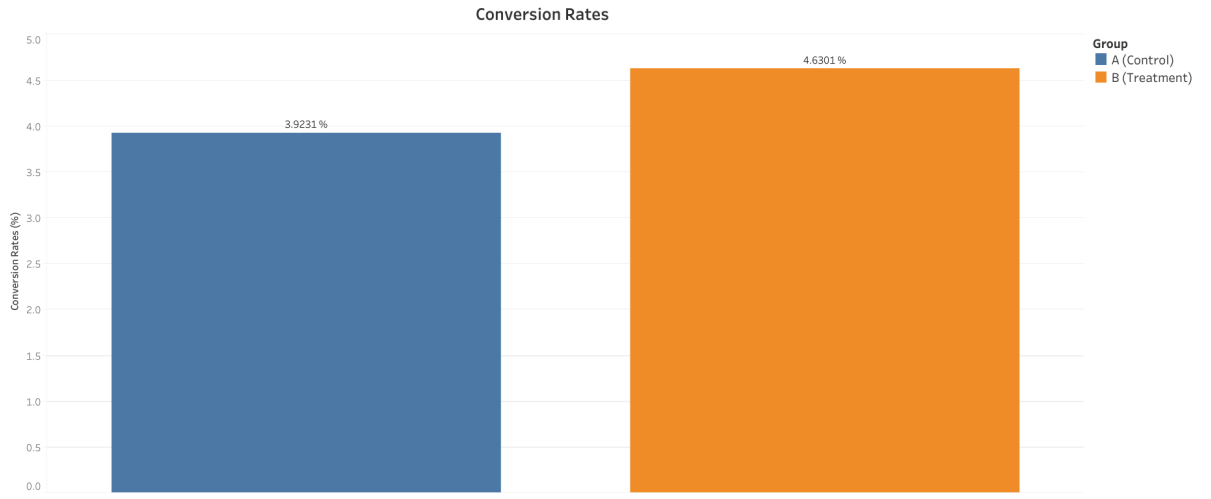
Calculation	Notation	Value	Rounded
sample size (control)	n1	24343	
sample size (treatment)	n2	24600	
sample proportion (control)	x1	3.374518468	3.3745
sample proportion (treatment)	x2	3.390360259	3.3904
sample standard deviation (control)	s1	25.93639056	25.9364
sample standard deviation (treatment)	s2	25.41382684	25.4138
sample statistic / point estimate (x1-x2)	stat	0.01584179109	0.0158
standard error	SE	0.2321393004	0.2321
test statistic	T	0.06824260718	0.0682
p-value	pval	0.9455925104	**0.9456**

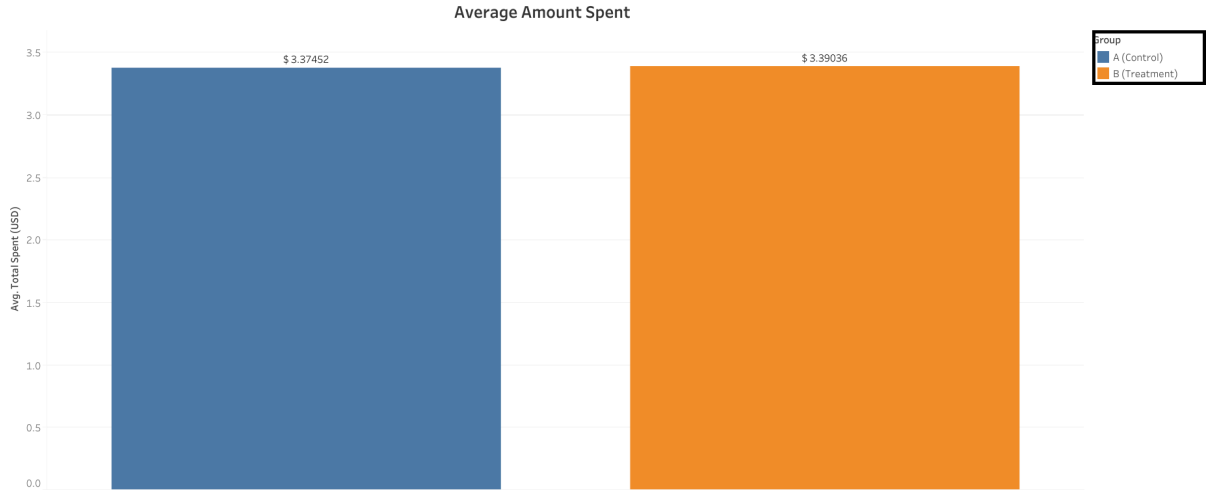
The p-value for the t-test comparing the average amount spent between Group A and Group B was calculated as **0.9456**. Since the significance level is 0.05, the null hypothesis is not rejected. This means that **there is no statistically significant difference** in the average amount spent between the two groups. The 95% confidence interval for the difference in average amount spent is [**-0.4391, 0.4708**].

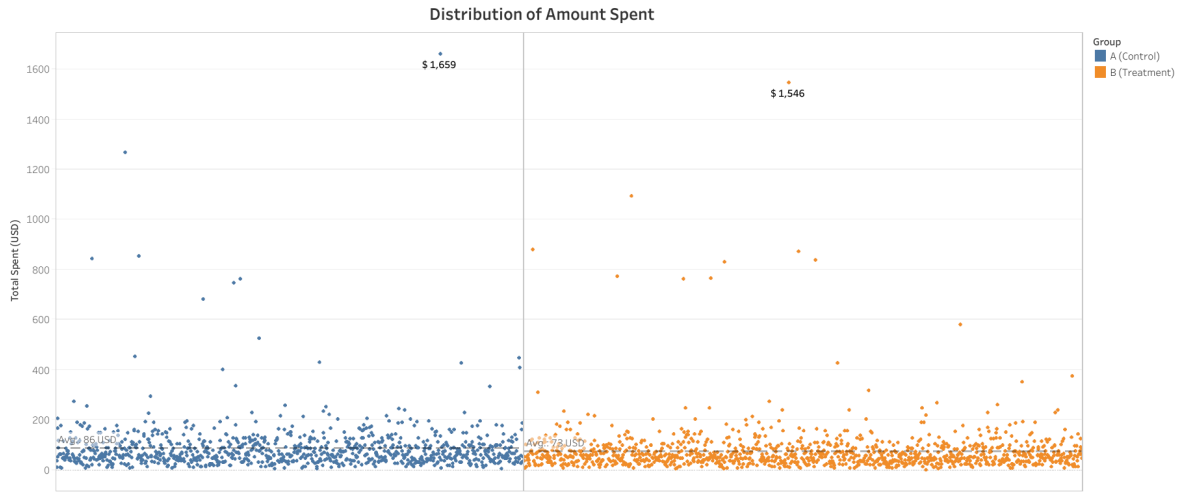
Calculation	Notation	Value	Rounded
sample size (control)	n1	24343	
sample size (treatment)	n2	24600	
sample mean (control)	x1	3.374518468	3.3745
sample mean (treatment)	x2	3.390360259	3.3904
sample standard deviation (control)	s1	25.93639056	25.9364
sample standard deviation (treatment)	s2	25.41382684	25.4138
sample statistic / point estimate (x1-x2)	stat	0.01584179109	0.0158
standard error	SE	0.2321393004	0.2321
critical value	t	1.959963986	1.96
margin of error	moe	0.4549846686	0.455
lower bound		**-0.4391428775**	**-0.4391**
upper bound		**0.4708264597**	**0.4708**

Practical Significance

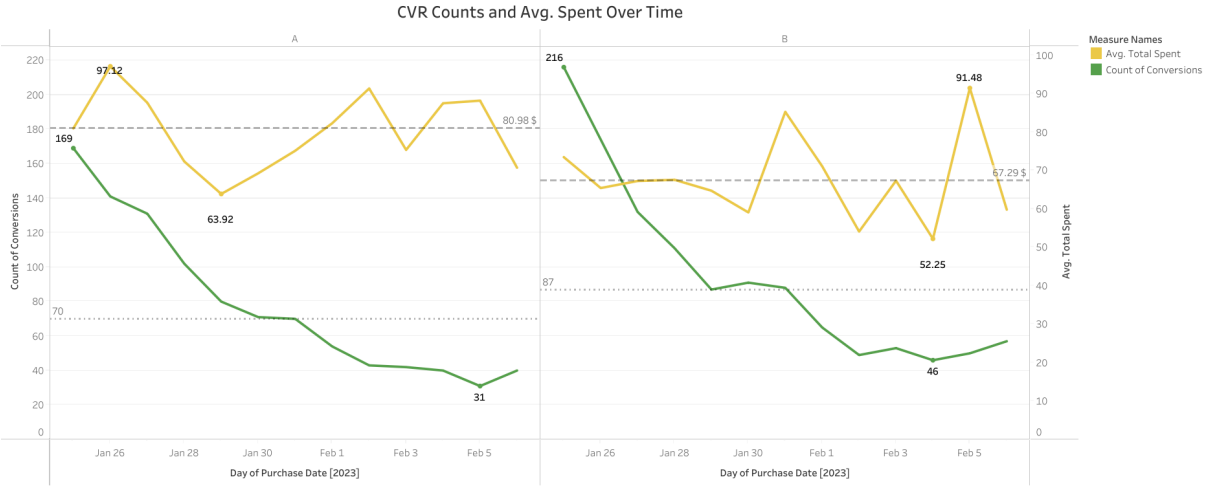
The practical significance level was set at **1%**. While the statistical tests revealed **significant differences in conversion rates** (**18.021%**), the observed changes are above the practical significance threshold. Conversely, the **average amount spent did not show a significant difference** (**0.469%**), which is below the practical significance threshold.







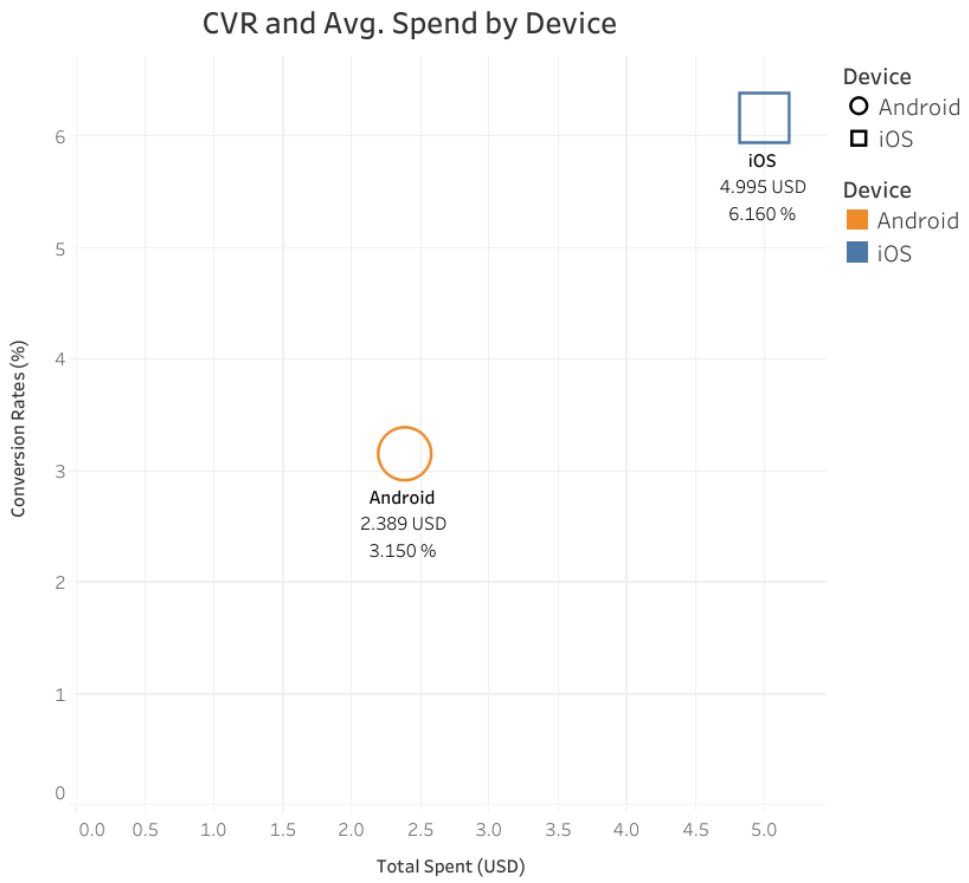
Change Over Time



Additional analysis of the number of conversions and the average amount spent over time showed a **gradual decline in both groups over the test period**. This suggests a temporal pattern that requires further investigation to fully understand the dynamics of user behavior. At the same time, it suggests that the **novelty effect is not the cause** of the drop in performance in Group B, as Group A struggled in a similar way.

Subgroup Analyses

Difference by Device



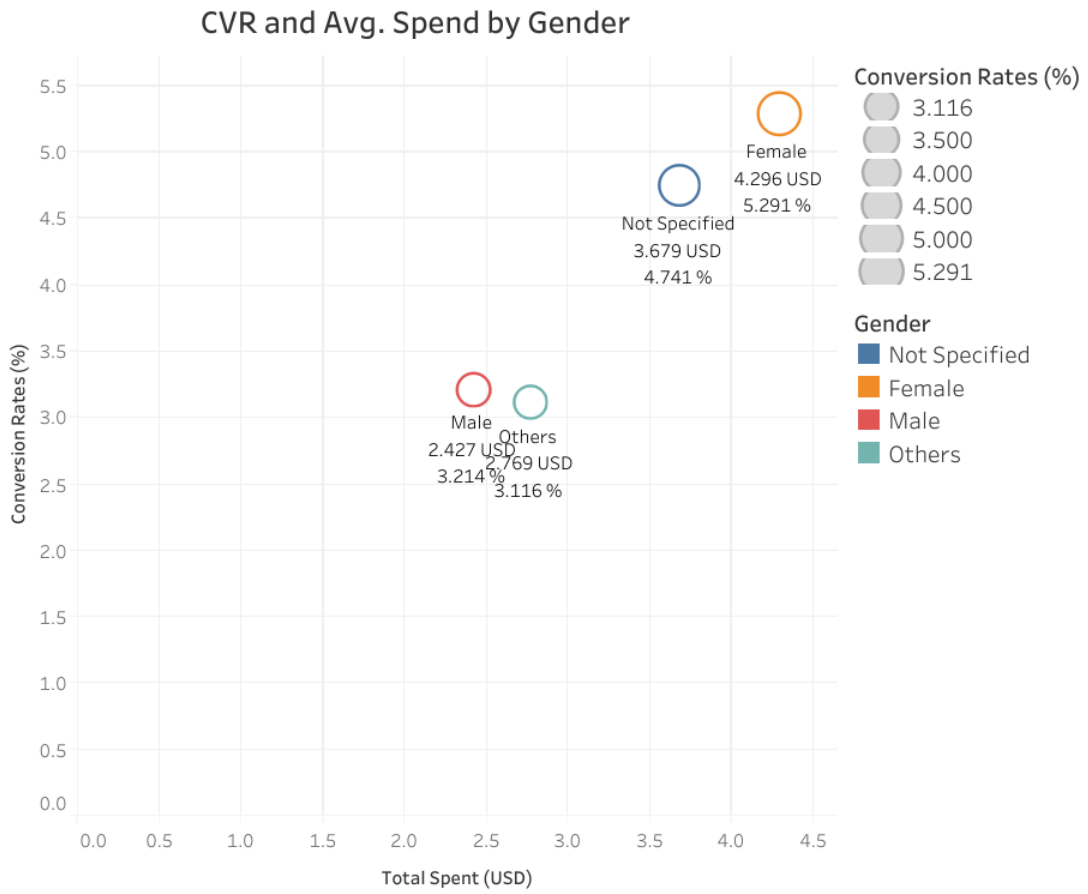
iOS Users: Those who engaged with the banner spent, on average, $4.995 and had a conversion rate of 6.160%. This user group responded exceptionally well to the new banner.

Android Users: Although the conversion rate increase was not as significant, Android users who interacted with the banner spent, on average, $2.389—showing potential for future growth.

- **iOS:** Users on iOS exhibited an average amount spent of $4.995 and a CVR of 6.160%.

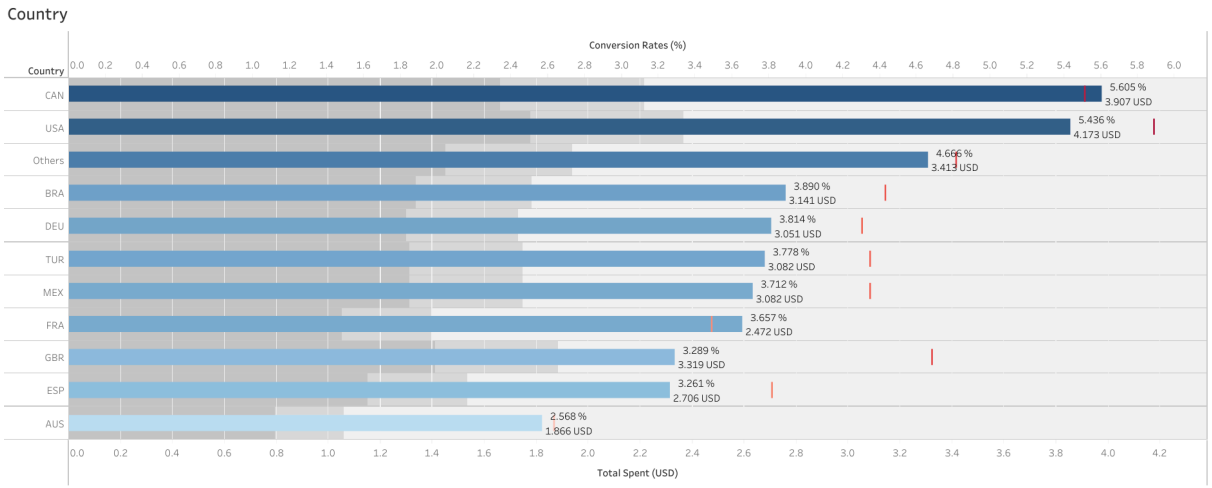
- **Android:** Users on Android demonstrated an average amount spent of $2.389 and a CVR of 3.150%.

Difference by Gender



Female users have the highest conversion rate, at 5.291%, followed by users with unspecified gender (4.741%), others (3.116%), and male users (3.214%).
Female users also have the highest average total spent, at $4.296 per user, followed by users with unspecified gender ($3.679), others ($2.769), and male users ($2.427).

Difference by Country



Canada and the **USA** have the highest conversion rates, while Mexico and Turkey have the lowest. Canada and the USA also have the highest average total spent per user, while Spain and Australia have the lowest.

Canada and USA

Canada and the USA have the two highest conversion rates, at 5.605% and 5.436%, respectively. They also have the two highest average total spent per user, at $3.907 and $4.173, respectively.

Brazil, Germany, Turkey, Mexico, and France

Brazil, Germany, Turkey, Mexico, and France have conversion rates that are lower than the average, but still higher than the lowest conversion rates. Their average total spent per user is also lower than the average, but still higher than the lowest average total spent per user.

United Kingdom, Spain, and Australia

The United Kingdom, Spain, and Australia have the lowest conversion rates and average total spent per user of all the countries listed.

- **Canada: Conversion rate among Canadian users was 5.605%, with an average total spent of $3.907 per user.

- **USA: Conversion rate among US users was 5.436%, with an average total spent of $4.173 per user.

- **Brazil: Conversion rate among Brazilian users was 3.890%, with an average total spent of $3.141 per user.

- **Germany: Conversion rate among German users was 3.814%, with an average total spent of $3.051 per user.

- **Turkey: Conversion rate among Turkish users was 3.778%, with an average total spent of $3.082 per user.

- **Mexico: Conversion rate among Mexican users was 3.712%, with an average total spent of $3.082 per user.

- **France: Conversion rate among French users was 3.657%, with an average total spent of $2.472 per user.

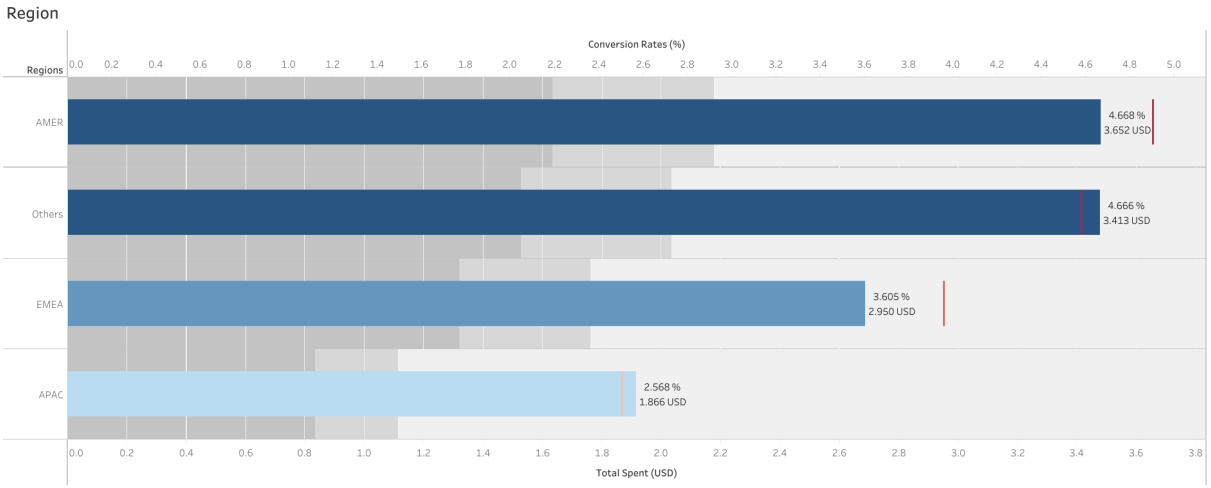
- **United Kingdom: Conversion rate among UK users was 3.289%, with an average total spent of $3.319 per user.

- **Spain: Conversion rate among Spanish users was 3.261%, with an average total spent of $2.706 per user.

- **Australia: Conversion rate among Australian users was 2.568%, with an average total spent of $1.866 per user.

- **Others: Users with null or unspecified country data had a conversion rate of 4.666%, with an average total spent of $3.413 per user.

Difference by Region



Overall, the conversion rate for **AMER** is highest, followed by **EMEA**, and then **APAC**. The average total spent per user is also highest in AMER, followed by EMEA, and then APAC.

- **AMER (Brazil, Canada, Mexico, USA):** Users in the Americas region showed a conversion rate of 4.668%, with an average total spent of $3.652 per user.

- **EMEA (Germany, Spain, France, United Kingdom, Turkey):** Users in the Europe-Middle East-Africa region exhibited a conversion rate of 3.605%, with an average total spent of $2.950 per user.

- **APAC (Australia):** Users in the Asia-Pacific region demonstrated a conversion rate of 2.568%, with an average total spent of $1.866 per user.

Conclusion

GloBox's A/B test looked at the impact of a new food and drink banner on user engagement and purchase behaviour. The analysis revealed

significant differences in conversion rates, which were above the range of practical significance. In addition, there was no significant difference in average spend. These findings highlight the need for strategic considerations, including practical significance and statistical power, when interpreting test results. The observed change over time also warrants further investigation.

Recommendations

Based on the analysis, it is recommended that the **new banner be implemented across the platform** due to its significant impact on conversion rates. Further optimisation strategies are recommended to improve the average spend. In addition, findings from sub-group and regional analysis provide insights for tailored marketing approaches to improve user experience and revenue potential.

Further Exploration

For a more complete understanding, future analyses could include user demographics, qualitative feedback, longer test durations, and a deeper examination of the observed temporal pattern of change over time. Consideration of larger sample sizes, aligned with the results of the power analysis, will strengthen the statistical robustness of the findings.

Thank you for your attention.

Best regards,
Ryunosuke Morohara

Appendix

Tableau Workbook (public)

A/B Test_Analysis & Raw Data Spreadsheet

SQL query to extract the A/B Test Data

```
SELECT

u.id,
u.country,
u.gender,
g.device,
g.group,

CASE WHEN SUM(COALESCE(a.spent, 0)) > 0 THEN 1
ELSE 0 END AS Conversions,
SUM(COALESCE(a.spent, 0)) AS Total_Spent,
a.dt AS Purchase_Date, g.join_dt AS Join_date

FROM users AS u

LEFT JOIN activity AS a ON u.id=a.uid
LEFT JOIN "groups" AS g ON u.id=g.uid

GROUP BY u.id, g.group, g.device, a.dt, g.join_dt

ORDER BY u.id;
```