Rotman

GROUP Assignment Cover Sheet

Course Code:	RSM 8502	**Student Numbers:** *Please list all student numbers included in this group assignment.*	1003499289
Course Title:	Data-Based Management Decisions		1005936490
Instructor Name:	Binyamin Oz		1006006153
Assignment Title:	Group Assignment		1009850671
Date:	Sep 14, 2023		1009698043
			1005684074

Academic Integrity Compliance

In submitting this **group** work, we affirm:

- The student numbers listed above are correct and complete.
- The work is original. Due credit is given to others where appropriate and we have acknowledged the ideas, research, phrases etc. of others with accurate and proper citations.
- All members have contributed substantially and proportionally to this assignment.
- All members have sufficient familiarity with the entire contents to be able to sign off on this work as original.
- This is the final version of the assignment and not a draft.
- We have followed any specific formatting requirements set by the instructor.
- We are submitting this work for the correct course, via the specified platform/method (e.g., Quercus).
- We accept and acknowledge that any assignments found to be plagiarized in any way will be subject to sanctions under the University of Toronto's:

  Code of Behaviour on Academic Matters.

We agree that the statements above are true. If we have concerns, we will consult the course instructor immediately.

Optional: you may wish to follow the standard naming convention when saving files:

Complete Course Code (including Section) – GROUP – **Assignment Title**

Example: **RSM1234HF.2021-0108**-Group22-**Homework1**

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I. Case Summary

Case objective

We evaluate the sales team proposal for an online gaming company looking to revamp the matching algorithm employed in their two-player game platform. The aim is to determine whether an increase in average waiting time and a reduction in frequency of bot matches will effectively boost ad revenue in-game purchases while not deteriorating user experience.

Background information

The online gaming platform matches players based on rank (0 to 100), with a 5-point rank difference allowed within a 15-second timeframe, known as the "tolerance parameter" and "cut-off parameter", respectively. Revenue is generated through ad clicks made during wait time ($0.01 per click) and in-game virtual item purchases ($1 to $5 each), with the observation that closer-ranked players playing longer and leading to more in-game purchases. If no suitable match is found, players are matched with a bot, resulting in a less optimal user experience and shorter gameplay sessions.

The sales team suggests reducing the rank tolerance parameter from 5 to 4 points and raising the cut-off parameter from 15 to 20 seconds will lead to longer player times, thus further increasing revenue - computed as ad click earnings during idle time plus in-game purchases during gameplay. We further evaluate the proposal using A/B testing.

Key stakeholder concerns

Stakeholders want to understand whether the proposed changes will have a favorable impact on the business KPI of interest - revenue generated. They want to ensure the changes will lead to more revenue but not undermine the user experience and engagement. Moreover, the budget and resource allocation associated with A/B testing will also have to be taken into consideration.

Decision point

We identified two key performance indicators (KPIs) for the online gaming industry: revenue and user experience. The table below illustrates the measurement method for both KPIs, along with our designated decision point – the threshold from which we consider the change to be practically significant.

	(1) Revenue	**(2) User experience**
How to measure	Ad clicks revenue ($0.01 /click) + In-game purchases ($1 - $5)	% of game sessions with bot
Decision point	≥ 15% **increase** in revenue	≥ 15% **decrease** in game session with bot

Combining the two KPIs above, we can validate the effectiveness of the game's algorithm changes if revenue increases without a decrease in user experience.

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II. A/B Test Design

With the proposed change being decreasing the rank tolerance parameter to 4 points and increasing the cut-off parameter to 20 seconds:

Hypotheses 1:

- H_0: μA = μB (the proposed change has no impact on the revenue)
- H_a: μA > μB (the proposed change increases the revenue)

μA, μB: mean of revenue for group A and r group B respectively

Hypotheses 2:

- H_0: pA = pB (the proposed change has no impact on the proportion of games played with bots)
- H_a: pA > pB (the proposed change increases the proportion of of games played with bots)

pA, pB: proportion of games played with bots for group A and group B respectively

Randomization plan

Split the sample into two groups using a computer to generate random numbers that determine group assignment. For each user, assign them to Group A as the control group if the random number is even, and to Group B as the treatment group if it's odd. While players in the control group users are treated with no treatment. And, the treatment group players, decreases the rank tolerance parameter of the users to 4 points and increases the cut-off parameter of the users to 20 seconds.

Data collection plan (duration, sample size, metrics, etc.)

The population includes players entering the platform. The sample should ideally include players with different characteristics within the game. The data collection period spans one week and 24 hours within each day to encompass any variations across different weekdays or different time periods. The minimum required sample size is determined by the power analysis (with power 0.8, significant level 0.05, minimum defective size 15%). A sample size of at least 551 is derived. Therefore we decided to set the sample size of each group to be 1000, as a larger sample provides more statistical power to detect significant differences. Thus the data collection procedure starts with randomly selecting 2000 players from the population. Repeat the randomization data collecting procedures mentioned above over a span of four days. These four days should be chosen randomly within a week. The metrics of the data should include Start time, User's rank, Number of games in this sessions, Number of games with a bot, Total play time (in seconds), Play time with a bot (in seconds), Total idle time (in seconds), Total ad clicks, Total in game purchases (in dollars).

Statistical testing method

The statistical testing method chosen is A/B testing with two sample T-test. Eliminating other options, T-test is commonly used when computing with continuous data, for our case is revenue per user and proportion of games played with bots. We chose to do a one sided T-test, instead of a two sided base on strong believe on the sales group's proposal

Ethical considerations

Data transparency and user control should be provided with game players, we should let users know what data we collect, who has access to it, what it will be used for and their willingness to share the personal information. The process of utilizing this data should be governed by strict policies, underscored by a strong commitment to respecting players' privacy.

III. A/B Test

A/B test result

Metrics	P-value	Confidence Interval
Revenue	0.003286	[-Inf, -0.991]
User Experience (% of game sessions with bot)	0.6529	[-0.032, 1.000]

Interpretation of the result

For the revenue metric, the P-value generated by T-test is below the level of 0.05 and 0 is not included in the confidence interval, therefore we can reject the null hypothesis and conclude that the revenue increases when decreasing the rank tolerance parameter to from 5 to 4 points and increasing the cut-off parameter from 15 to 20 seconds. For the user experience metric, the P-value is above the level of 0.05 and 0 is included in the confidence interval, hence we fail to reject the null hypothesis and conclude that the proposed change does not increase the proportion of games played with bots.

IV. Decision

The results of the A/B testing showed a 22% increase in expected revenue, which exceeded our initial target of 15%. In addition, the user experience was not negatively affected by the changes. As a result, we validated the sales team's proposal suggest proceeding with the change, while carefully considering potential risks.

The proposed change is expected to boost company revenue while preserving user experience. However, potential post-implementation risks, such as unforeseen technical issues (e.g., server latency), user resistance to the new matching algorithm, and the long-term impact on user satisfaction and profitability, should be acknowledged. Stakeholders should carefully consider the implications of launching the new matching algorithm since maintaining a balance between revenue growth and user satisfaction is crucial in the gaming industry.

V. Conclusion & Further Discussion

As the Data Science team, we validate the sales team proposal.

The proposal's scope can be further expanded to ensure more robust results by considering factors such as increasing the sample size for higher statistical power, extending testing periods to at least a week, incorporating additional metrics to assess the impact of changes on revenue and user experience, including demographics data. Additionally, for potential strategies to boost revenue, we should consider implementing rewarded video ads. For enhancing user experience, we can gather user feedback through surveys and take steps to fortify our infrastructure to prevent server latency issues resulting from changes.

VI. References

1. Heslop, Brent. “7 Strategies for Increasing Game App Revenue, Engagement, and More.” *Contentstack.Com*, 25 Mar. 2020, www.contentstack.com/blog/all-about-headless/7-strategies-to-increase-game-app-revenue.
2. Oz, Binyamin. “Lecture 4”, University of Toronto q.utoronto.ca/courses/. Accessed 13 Sept. 2023. https://q.utoronto.ca/courses/315131/files/27275736?module_item_id=4950848
3. Oz, Binyamin. “Tutorial 2.” University of Toronto q.utoronto.ca/courses/. Accessed 13 Sept. 2023. https://q.utoronto.ca/courses/315131/files/27386773?module_item_id=4991675

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Grade: _____