Analysing the Success of Counter-Strike:

A Comparative Study of FPS Games using Player Reviews

1 Introduction

This era can be considered a good one for the video game industry as it is anticipated that the video game industry's earnings will display a yearly expansion rate (CAGR 2023-2027) of 7.89%, leading to an estimated market size of US$521.60bn by 2027 (Clement, 2023). It is visible that the video game industry has great potential for growth in the coming years. The highly anticipated video game Halo 3 from Microsoft generated a revenue of $170 million in the United States in just 24 hours (Edery and Mollick, 2009).

Counter-Strike (CS) is considered one of the most famous First-person shooter (FPS) games (Henningson, 2020). In this genre, the players must shoot with pistols, or other similar weaponry, at appearing targets (Lopez-Gordo *et al.*, 2020). Figure 1 contains a state diagram of the gameplay of CS. As you can see from the gameplay, CS consists of two factions playing against one another in a five versus five match for five rounds to win the game. CS has grown from a mod, modified in-game content created by players instead of developers, to a game played internationally by hundreds of thousands (Henningson, 2020). CS: Global Offensive (CS:GO) is what catapulted the CS series to true fame in 2010 by spawning a massive fan following. This following is evidenced by 3.6 million people tuning into the finals of one of its esports events in 2017 (Wolf, 2017).

This report aims to analyse the factors that have contributed to the global success of CS:GO using reviews by players on Steam (a digital platform created to install, distribute, rate and review games) (Dimuro, 2021). Additionally, a comparative study will be conducted between reviews of CS:GO and other FPS games, both from the CS series and other game companies, to identify potential areas for improvement in the game. This study is meant to benefit Valve, the company behind the CS series.
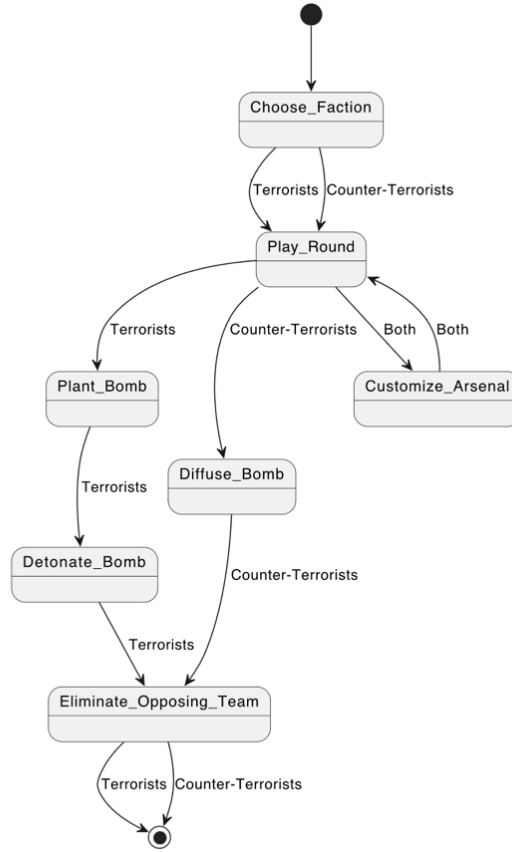
Figure 1: State Diagram for CS gameplay

2   Consumer and Marketing Research

Consumer and marketing research was previously performed using more conventional methods. Strategies based on price, technology and product development were sufficient to gain a competitive advantage (Price, Wrigley and Straker, 2015). However, with the advent of the internet, these strategies are not as effective. Access to information has led to decrease in brand loyalty. This rapid shift in loyalty and thinking is difficult to grasp using traditional market research methods. Traditional market research methods, such as interviews, focus groups, and surveys and questionnaires consist of asking customers pointed questions to reveal their stated preferences. These fail to dig deeper and result in possible missed opportunities. These methods are also difficult to execute due to limited budgets or lack of expertise.

Video games cater to a generation and section of society that is exposed to the internet. According to Clement (2023), the number of users is expected to amount to 3.10bn users by 2027 with 10963 games released in 2022 on steam alone. Gamers are spoilt for choice with gaming companies needing a quick turnaround for market research. Video games currently use the internet as their preferred sales channel as it is a necessary part of the gaming infrastructure.

Word of mouth is considered an important factor in decision making processes for customers (Öğüt and Onur Taş, 2012). The online counterpart of word of mouth is customer reviews. Customer reviews are powerful indicators and source of information in e-commerce and other such industries that are heavily linked to the internet. Increasing volume of reviews has been found to have a positive impact on review credibility and is a good indicator product popularity (Askalidis and Malthouse, 2016). Research by Askalidis and Malthouse (2016), states that "the conversion rate of a product increases by 270% as it accumulates reviews". The sentiment of the reviews is also an important factor driving sales as seen in research conducted by Ren *et al.* (2018). This could be due to consumers relying on the reviews to aid their decision-making.

Thus, it can be seen that customer reviews are an impactful source of consumer research and market analysis for the gaming industry. With the increasing number of users and games released every year, the competition is cutthroat, and the need for quick and efficient market research is vital. Traditional market research methods may not be adequate to provide the in-depth insights required to stay competitive so online customer reviews have become an important element of the decision-making process. In the case of video games, reviews on digital platforms like Steam have become a reliable forum for gamers.

3   Methodology

3.1   Data Collection

Steam contains social media features and provides forums for the gaming community (Khan, 2023). It was created by Valve, the company responsible for developing CS. Using the popular games list within the FPS genre and the CS series, the following games were selected: CS:GO, CS, CS: Source (CSS), CS Nexon: Studio (CSN), CS: Condition Zero (CS:CZ), Grand Theft Auto V (GTAV), PlayerUnknown's BATTLEGROUNDS (PUBG), Tom Clancy's Rainbow Six Siege (R6), Call of Duty: Modern Warfare II (CODMW), and Left 4 Dead 2 (L4D2).

Steam provides a web API that was queried to obtain user reviews (*Steam Web API Documentation*). Python has been used to query the API.

3.2   Data Integration and Preparation

The reviews obtained from Steam had fields as listed in Table 1 (*User Reviews - Get List*).

Table 1: Variables in Steam Review Data (User Reviews - Get List)

Variable	Description
recommendationid	unique id of the recommendation
author	author of the review
steamid	user's SteamID
num_games_owned	number of games owned by the user
num_reviews	number of reviews written by the user
playtime_forever	lifetime playtime tracked in this app
playtime_last_two_weeks	playtime tracked in the past two weeks for this app
playtime_at_review	playtime when the review was written
last_played	time for when the user last played
language	language the user indicated when authoring the review
review	text of the written review
timestamp_created	date the review was created (unix timestamp)
timestamp_updated	date the review was last updated (unix timestamp)
voted_up	true means it was a positive recommendation
votes_up	number of users that found this review helpful
votes_funny	number of users that found this review funny
weighted_vote_score	helpfulness score
comment_count	number of comments posted on this review
steam_purchase	true if the user purchased the game on Steam
received_for_free	true if the user checked a box saying they got the app for free
written_during_early_access	true if the user posted this review while the game was in Early Access
developer_response	text of the developer response if any
timestamp_dev_responded	unix timestamp of when the developer responded, if applicable

In the Data Integration and Preparation section, a data cleaning pipeline, created using the pandas library in python, was applied to the collected data for all games. This pipeline involved several steps to clean, transform, and integrate the data. The following steps were taken for data cleaning (Tang, 2019):

- Unnecessary symbols, duplicate rows, null values and unnecessary columns were removed.

- *Author* column was unpacked by splitting it into separate columns and added these columns to the main data frame.

- *Author* and *recommendationid* columns were removed for anonymising.

- Rows where *weighted_vote_score* was less than zero, *num_games_owned* was zero, and *playtime_forever* was zero were removed to ensure only genuine reviews remained.

- Rows where *playtime_at_review* was less than three hours were removed as all games with lower playtime can be returned and refund can be requested from steam. Hence, only reviews where no refund can be requested were considered to ensure only users that played the game at length might be able to review the game better.
- Reviews were filtered to retain only the ones with a length of at least five words as these would possibly contain more informative reviews.

The cleaned data was further processed to tokenize the text for conducting market research. The text processing included the steps: removing BBcode (a form of markup language used to format bulletin board posts), lemmatization, removal of stop words and removing words smaller than three characters (Tang, 2019).

Post text processing, the cleaned text was then converted into n-grams, bigrams and trigrams, to retain context during sentiment analysis (Nair, 2021). At this step it was found that CS had only 67 usable reviews remaining while L4D2 had 108 which led to their elimination from the report as evaluating them is not very significant. Appendix contains all the code used in the project.

3.3   Analytical Approaches

The user reviews were analysed using two separate approaches to extract recommendations. One approach looked at finding the topics that the users were talking about and the other analysed the sentiment of the reviewer about the game.

3.3.1   Topic Modelling

In natural language processing (NLP), topic modelling is a technique used to identify topics present in a text corpus (Jelodar *et al.*, 2019). Latent Dirichlet Allocation (LDA) was chosen as the method for topic modelling in this paper as it is an unsupervised training method (Kapadia, 2019).

3.3.2   Sentiment Analysis

The most accurate classifier for sentiment analysis of video game reviews, according to Chakraborty *et al.* (2018), was the LinearSVC Classifier. An Amazon dataset of video game reviews (Ni and McAuley, 2019) was used as a training set comprising 80% of the data, and a testing set containing the remaining 20% (Chakraborty *et al.*, 2018).

3.3.3 Metrics

The lower the perplexity value, the better the model is at predicting unseen data (Kapadia, 2019). In this case, the **perplexity value** of **-7.09** indicates that the LDA model has a good predictive ability and is performing well. A higher coherence score indicates that the topics generated by the LDA model are more coherent and interpretable. In this case, the **coherence score** of **0.522** indicates that the LDA model is generating reasonably coherent topics.

In the context of the LinearSVC sentiment analysis classifier model, the model's **accuracy** is **0.892**, which means that it 89.2% of the reviews in the dataset were correctly classified. The **precision score** of the LinearSVC classifier in this case was **0.90**, which means that out of all the positive predictions made by the model, 90% of them were correctly classified as positive. In this case, the **recall** for the positive class is **0.97**, which means that the model correctly identified 97% of the actual positive cases. In this case, the **F1-score** for the positive class is **0.94**, which is a high value indicating good performance of the model. Overall, the high accuracy, recall, f1-score and precision of the LinearSVC classifier indicate that it is effective for sentiment analysis of the given dataset.

4 Results

4.1 CS:GO Overview

Using LDA, Table 2 shows the topics that most users have commented about and are concerned with. The overall themes have been selected as such since:

- Gameplay Experience – This topic includes phrases related to the overall experience of playing the game, such as "game good fun play get nice really great friend bad." It indicates that users are discussing their overall experience of playing the game and the factors that made it so.
- Love of Game – This topic includes phrases like "game best love play better". It suggests that users are discussing their love for the game, with many considering it to be the best game they have ever played.
- In-Game Monetization: This topic includes phrases that discussions about the in-game monetization, including the purchase and trade of items like skins, cases, and other virtual goods.
- Competition and Time: This topic includes phrases which suggest that users are discussing the competitive aspect of the game, including tactics for managing time and making quick decisions.

- Nostalgic Experience: This topic includes phrases that indicate the users are discussing the nostalgic aspects of playing the game and other memories associated with the game.

- Innovative Skins: This topic includes phrases (gut knife rust coat is an in-game item) that suggests the users are discussing innovative and unique skins or other cosmetic items available in the game (*Gut Knife | Rust Coat*).

- Multiplayer Experience and Weaponry: This topic includes phrases that seem to be discussions about the multiplayer experience of the game, including the importance of teamwork and strategic use of weaponry.

Figure 2 shows the number of reviews that are about each topic. Most people talk about "Gameplay Experience" and their "Love of Game". There is also some chatter about "Competition and Time", "Nostalgic Experience" and "Multiplayer Experience and Weaponry". "In-Game Monetization" and "Innovative Skins" are talked about the least. The reviews remain overwhelmingly positive in nature. These can be considered the elements that made CS:GO the success it is.

Table 2: Topic Modelling Outcome for CS:GO

| No.	Topics found by LDA	Overall Theme
1	game good fun play get nice really great friend bad	Gameplay Experience
2	game best love play better get one ever still time	Love of Game
3	money case please source skin counter_strike give make valve lost	In-Game Monetization
4	know time minute one let see make enemy two second	Competition and Time
5	like game people feel god real gun rush time memory	Nostalgic Experience
6	cancer gut_knife_rust_coat man disease brain child boy pew_pew gave pain	Innovative Skins
7	game player map also mode one community play weapon team	Multiplayer Experience and Weaponry
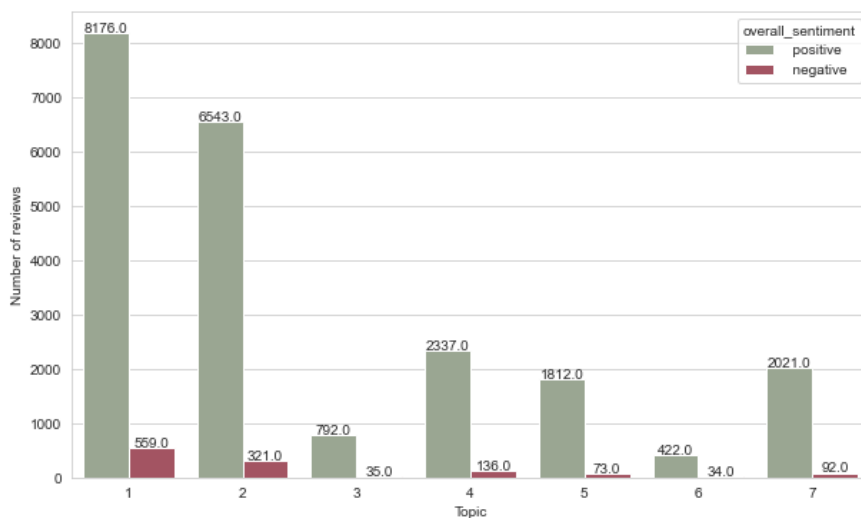
Figure 2: Number of Positive and Negative Reviews about topics for CSGO

4.2   CS Series Overview

4.2.1   CSS

From Figure 3 and Table 3, it is visible that CSS has a favourable impression on the users overall with "Gameplay Experience" being the primary reason. "Server and Community" and "Source Engine and Graphics" are the next few themes that users have talked about the most. "Gunplay and Combat", "Fire and Warfare" and the "Rage mod" hold the same level of lower importance (Konvikt). It is quite surprising and significant that a mod holds such a high favourability.

Table 3: Topic Modelling Outcome for CSS

| No.	Topics found by LDA	Overall Theme
1	game better best ever buy got good like play get	Gameplay Experience
2	game fun good play great still really old love time	Fun and Enjoyable
3	server game map play people like player get community surf	Server and Community
4	like gun get shoot kill skin shot people guy would	Gunplay and Combat
5	fire_hole_fire_hole life step word man fire_hole men war day cup	Fire and Warfare
6	let life year_old spray child never face wall rage right	Rage mod
7	game source graphic counter_strike_source player new one weapon shooter experience	Source Engine and Graphics
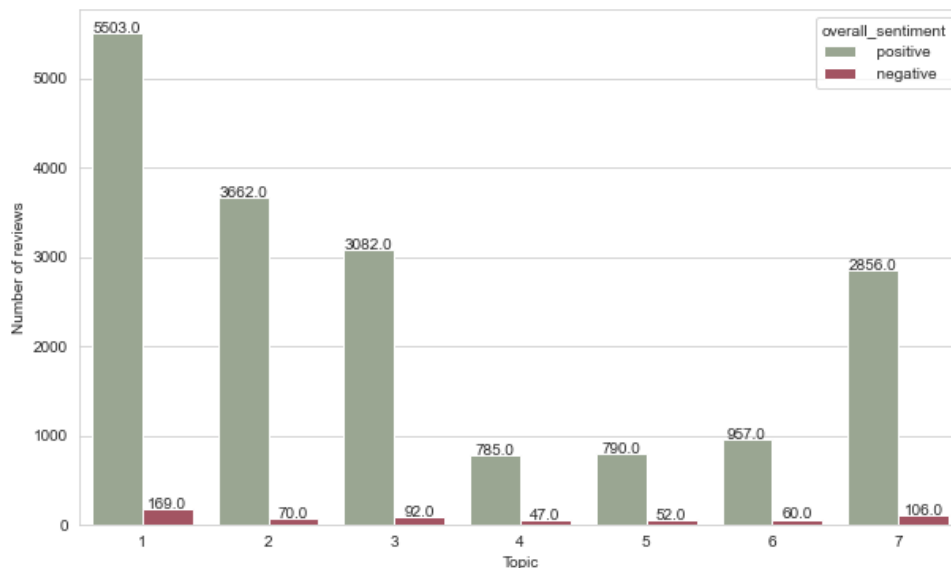
Figure 3: Number of Positive and Negative Reviews about topics for CSS

4.2.2 CSN

According to Table 4 and Figure 4, most people had a positive experience of the zombie mode experience. The Overall themes revolved around the novel mode and that was the unique selling point of this game. The negative experience consisted of very few reviews. There was appreciation for the "Overall Game Experience" and the "Connection and Multiplayer Experience".

Table 4: Topic Modelling Outcome for CSN

| No.	Topics found by LDA	Overall Theme
1	game play zombie good free like fun get bad weapon	Zombie Mode Experience
2	game like play time good even one steam fun get	Overall Game Experience
3	get like time name know one play steam review sound much server thing	Community Forum
4	game connection_server_please_launch mode fun zombie like play weapon even player	Connection and Multiplayer Experience
5	zombie game mode get human like one time play even	Zombie Mode vs Human Mode
6	game option like time well first set also one put	Game Options and Settings
7	zombie zombie_back mode terrible game even super guy retarded player	Negative Zombie Mode Experience
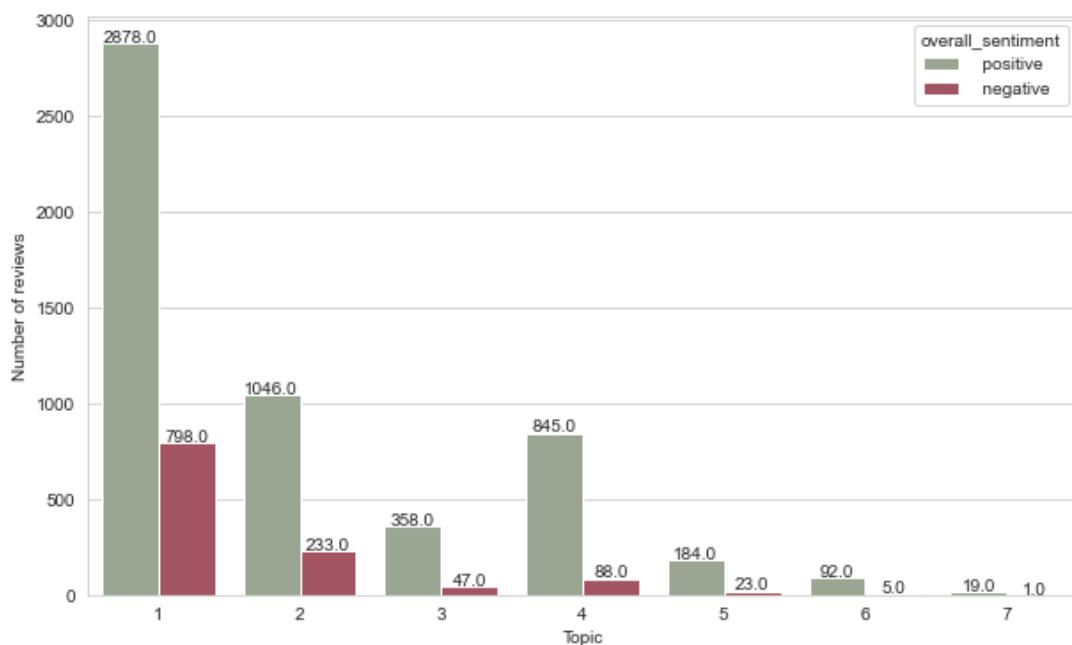
Figure 4: Number of Positive and Negative Reviews about topics for CSN

4.2.3 CS:CZ

As seen in Figure 5 and Table 5, "Gameplay Experience" remains positive. Many players who have played this game also display a similar sentiment as CS:GO where they declare their "Love of Game". "Mission and Teamwork" elements of CS:CZ has also caught the eyes of the users. Weaponry seems to be a highlight in this game with two of the overall themes ("Shooting Experience" and "Map and Weapon Details") dedicated to it. The "Environmental Details" are barely even noticed.

Table 5: Topic Modelling Outcome for CS:CZ

| No.	Topics found by LDA	Overall Theme
1	game good fun play still like great better time really	Gameplay Experience
2	valve scene mission one bot game ritual like level half_life	Valve and Half-Life
3	game ever play one would condition_zero counter_strike time best love	Love of Game
4	shoot condition_zero spray minute experience let old_school point gun beat	Shooting Experience
5	even map change hard cant find gun model look weapon	Map and Weapon Details
6	game bot mission like map get team counter_strike player weapon	Mission and Teamwork
7	window office door learned walk modern year_old world move save	Environmental Details
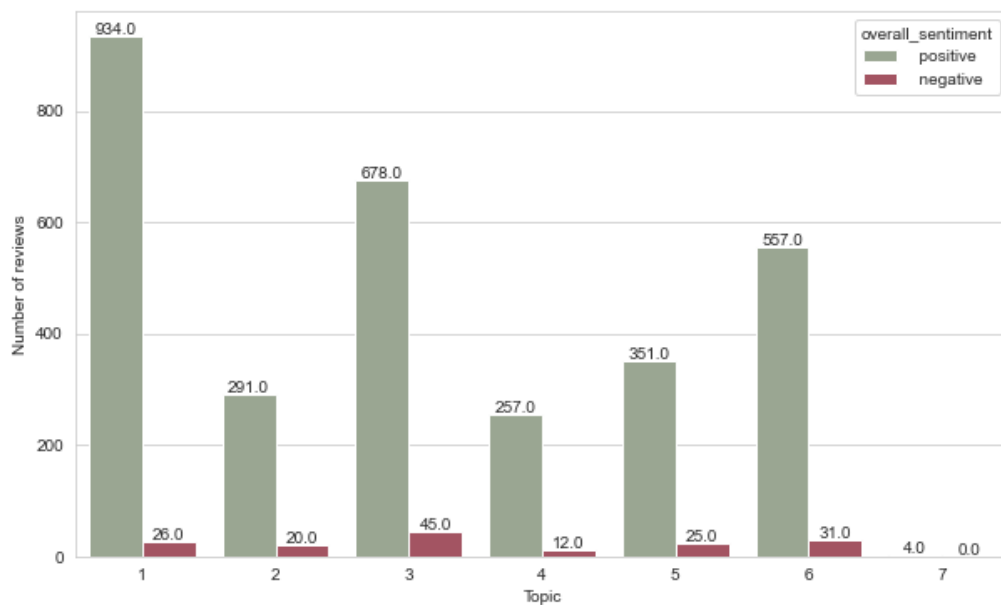
Figure 5: Number of Positive and Negative Reviews about topics for CS:CZ

4.3   FPS Genre Analysis

4.3.1   GTA

From Table 6 and Figure 6, "Game World and Story" is the core reason for the positive sentiment about GTA. "Game Story and Graphics" have also received positive reviews. The user reviews for GTA show that despite "Technical issues" being one of the themes, the overall sentiment of the review remains positive.

Table 6: Topic Modelling Outcome for GTA

| No.	Topics found by LDA	Overall Theme
1	game like love best ever car people get play cool	Love of Game
2	game play hacker even get never hour time got cant	Gameplay and Technical Issues
3	game character story one grand_theft_auto mission still time player well	Game World and Story
4	get game money fun play friend time make people player	Money and Gameplay
5	game good great really story play amazing lot story_mode still	Game Story and Graphics
6	kill_kill_kill_kill cum_cum_cum_cum step yes_yes_yes_yes ball ball_ball_ball_ball building team_member_team_member anti_cheat_anti_cheat yes_yes	Violent Expressions
7	fun friend play good bug super money hour time_long_enough bug_never_minor_bug	Fun Despite Bugs
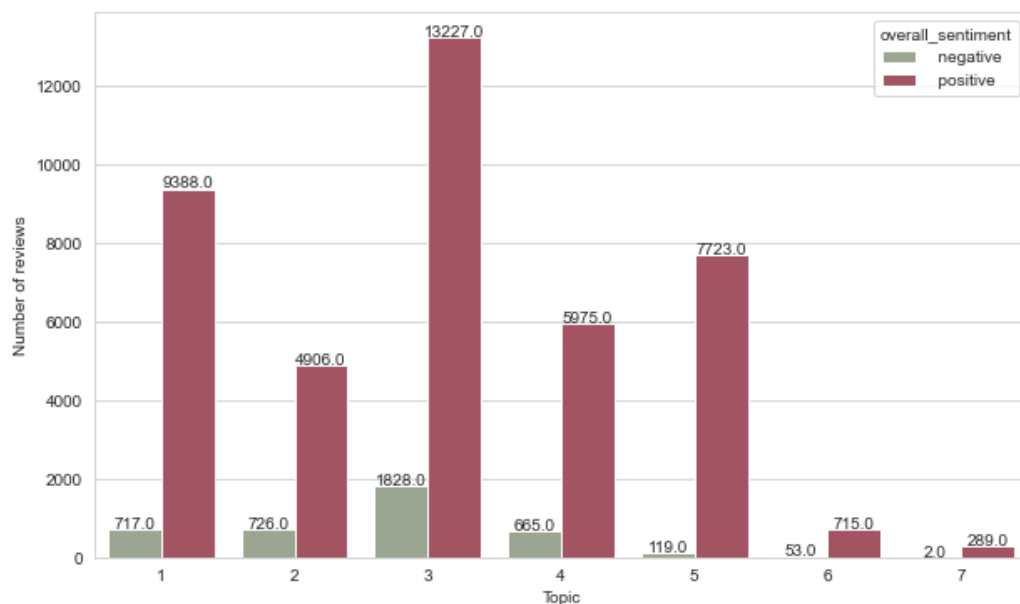
Figure 6: Number of Positive and Negative Reviews about topics for GTA

4.3.2 PUBG

As seen in Figure 7 and Table 7, PUBG is loved by the users for the "Socialising" aspect of the game. Another well-liked feature is the "Graphics and Realism" part of the game. There is a lot of discontent about bugs and crashes with multiple topics referencing them.

Table 7: Topic Modelling Outcome for PUBG

| No.	Topics found by LDA	Overall Theme
1	game play fun good free like friend still get really	Socializing
2	game player cheater level skin bot hacker money developer ban	Cheating and Hacking
3	game play hour time tutorial match bug good training even	Game Features and Bugs
4	nice dog_dog_dog_dog spoiler_spoiler_spoiler_spoiler man battleground crash_crash_crash_crash lite battleground_battleground name con	Bugs and crashes
5	game good map like graphic gun great realistic player battle_royale	Graphics and Realism
6	get die one kill people someone time match minute like	Killing and Matches
7	game crash bad fix server time lag update every run	Technical Issues
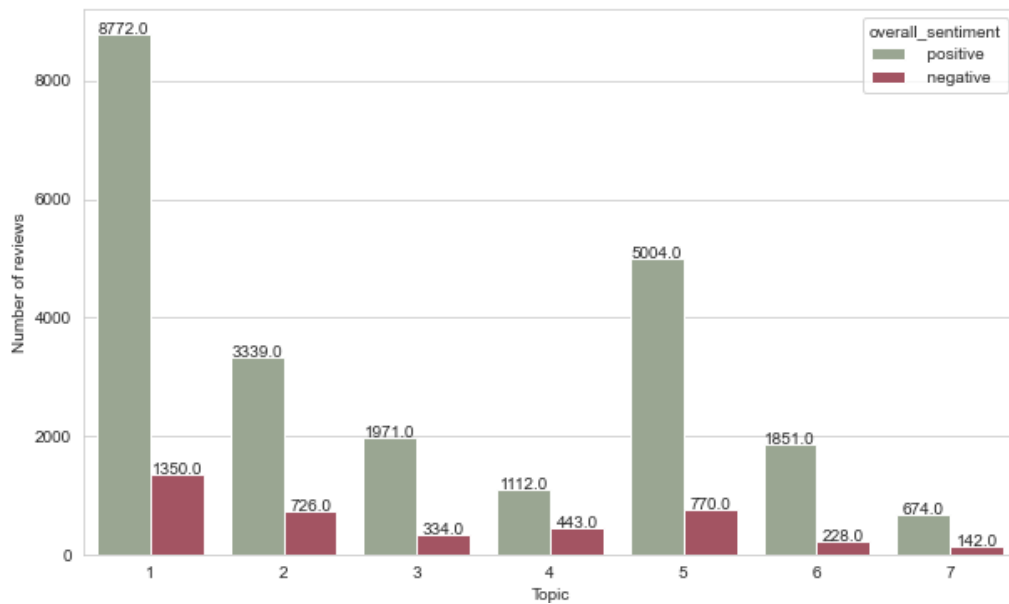
Figure 7: Number of Positive and Negative Reviews about topics for PUBG

4.3.3 CODMW

As seen in Table 8 and Figure 8, CODMW has more positive reviews for every topic but the proportion of positive reviews to negative reviews is higher than previous games. The themes that users prefer are "player interaction" and "gameplay elements" of CODMW.

Table 8: Topic Modelling Outcome for CODMW

| No.	Topics found by LDA	Overall Theme
1	game fun good play cod like great really bad lot	Gameplay Experience
2	game cod love like buy want make play one ever	Likelihood to buy / continue playing
3	yes_yes_yes_yes point_point_point_point kill_kill_kill_kill spawn_die_spawn_die simulator driver_date_reinstall_play man die hate_hate_hate_hate shipment_shipment_shipment_shipment	Gameplay frustrations
4	game play time fix get even update still issue hour	Technical issues
5	game map like one weapon gun mode campaign new time	Game elements
6	game player get kill people play gun even lobby bad	Player interactions and experiences
7	crash play often constantly disconnected_steam random every_minute every_match cancer lose_everything	Technical issues (crashes and connectivity problems)
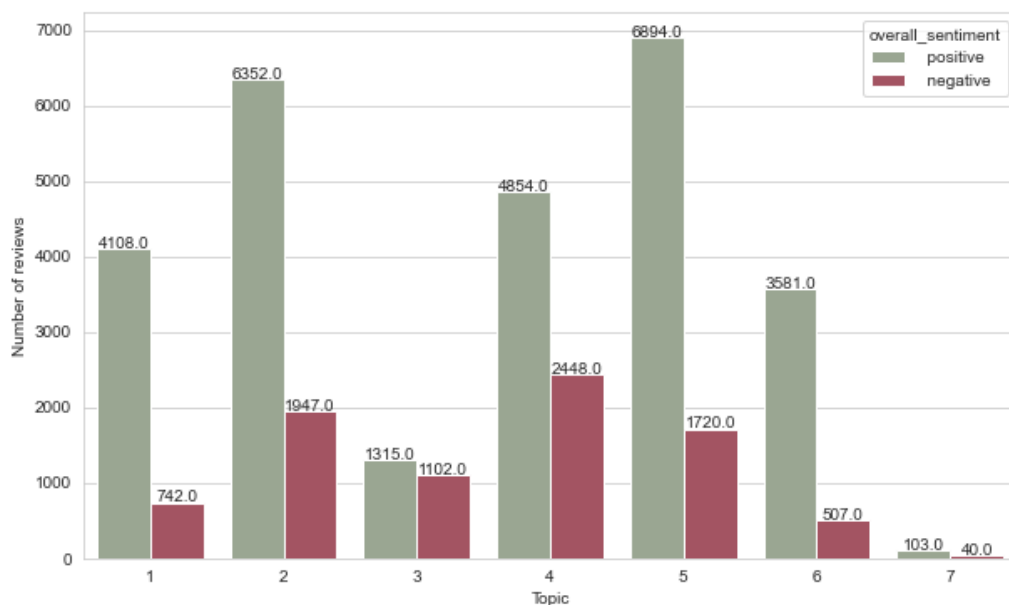
Figure 8: Number of Positive and Negative Reviews about topics for CODMW

4.3.4 R6

From Figure 9 and Table 9, it can be seen that R6 mostly has user reviews about their gameplay experience. The other topics are not discussed in detail however some outstanding factors are "Gameplay Mechanics", "Characters" and "Gameplay Strategy".

Table 9: Topic Modelling Outcome for R6

| No.	Topics found by LDA	Overall Theme
1	game play fun good like get friend time love still	Gameplay Experience
2	like want good gun connect get shoot people guy time	Gameplay Mechanics
3	game get bug people good better got time bad work	Bugs and Issues
4	game player hate_hate_hate_hate ban_ash_ban_ash rainbow_six_siege like operator shooter one really	Characters
5	cancer disease child syndrome help_help_help_help disorder brain infection chronic nous	Game Storyline
6	game hate_clash_hate_clash different enemy even play round one kill make	Gameplay Strategies
7	wall_wall_wall_wall good yeah sex lemon pie potato_decent_fast_rich graphic_forget_reality_beautiful good_lovely decent_bad_look_long	Miscellaneous
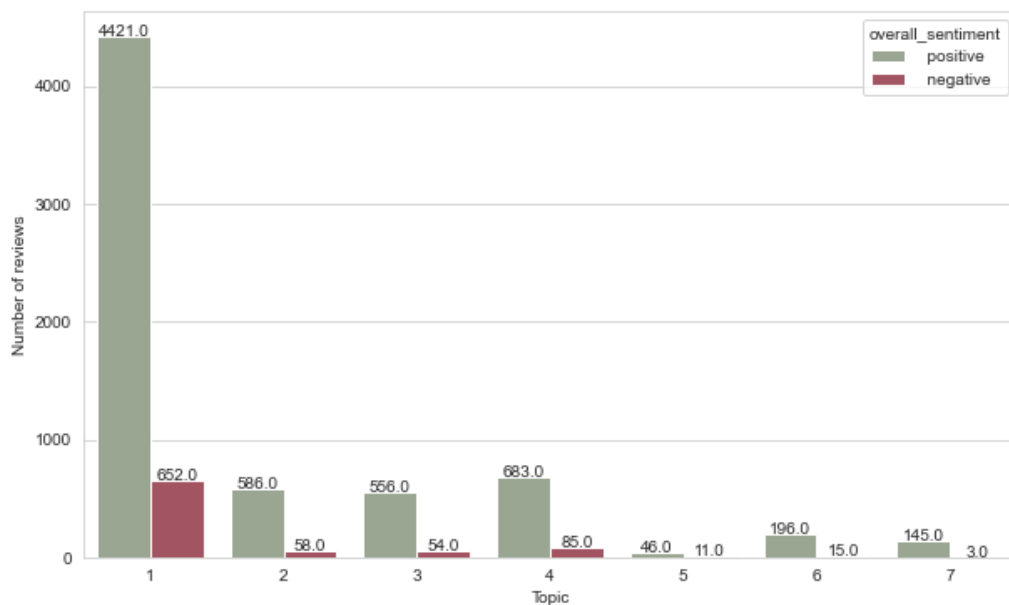
Figure 9: Number of Positive and Negative Reviews about topics for R6

5   Discussion

The results of the analysis shed light on the aspects of CS:GO, as well as the other FPS games like CSS, CSN, CS:CZ, GTA, PUBG, R6 and CODMW that are of significance to players. As seen from Figure 10 and Figure 11, CODMW is the most disliked game while GTA is the most liked game.
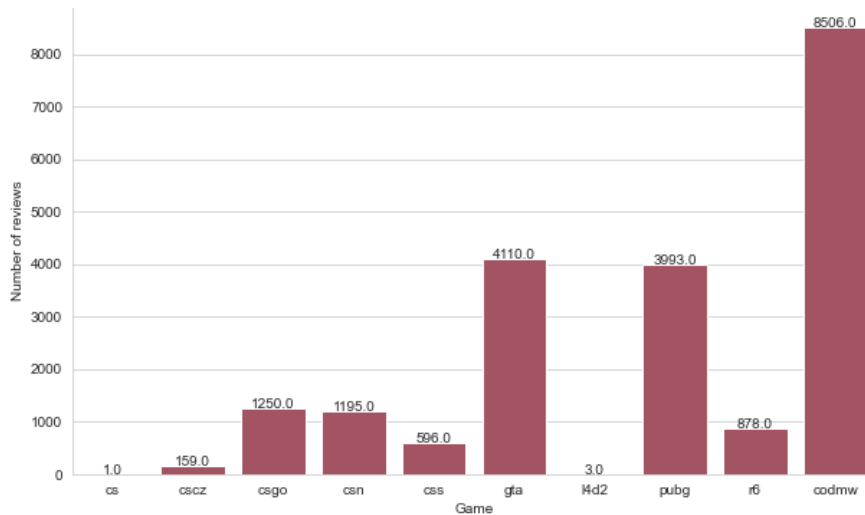
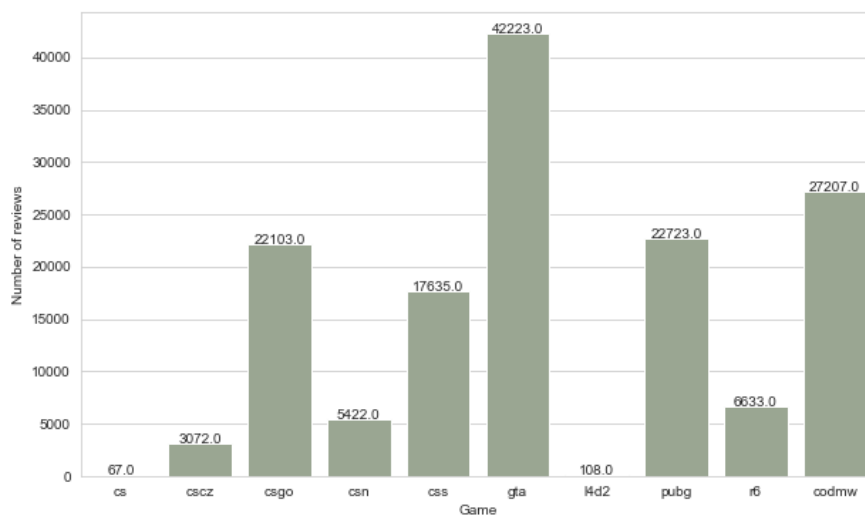*Figure 10: Number of Negative Reviews Per Game*

Figure 11: Number of Positive Reviews Per Game

The zombie mode in CSN was the unique selling point. The analysis of FPS games like GTA, PUBG, and CODMW indicates that players are mostly concerned about game world and story, graphics, player interaction, and gameplay elements (such as maps and weaponry). Technical issues and bugs were also present in almost every game as a point of contention and discussion by the users.

The analysis shows that the central aspects of a game, such as gameplay experience, are of utmost importance for players. Developers must focus on creating a game that offers an interactive user experience which appeals to the players' emotions. The analysis also highlights the importance of innovation and uniqueness in FPS games. Developers need to come up with unique features, such as the zombie mode in CSN, to attract and retain players.

5.1 Recommendations

5.1.1 Elements for a Successful Game

Using the overall themes found in successful FPS games, the following elements are considered necessary:

- Engaging gameplay mechanics
- Immersive story or world-building
- Memorable characters
- Good graphics
- Social gameplay
- Unique selling point

5.1.2 Managerial Recommendations

On the basis of the elements of a successful game, CS:GO developers must continue to focus on improving the gameplay experience, as it is the most talked-about topic among users. This can be done by expanding the multiplayer experience of the game, with possible focus on the community aspect of the game. Community aspect can be enhanced by adding interactive experiences in the lobby area or enhancing in-game co-operation.

Innovative skins or other cosmetic items available in the game can be considered as it is an important topic of conversation for some users. CS:GO might benefit from introduction of characters as an additional feature.

A zombie or survival mode can be introduced, possibly as an interesting mod, to provide variety. In-game monetization needs to be re-examined for effectiveness. The sense of nostalgia among users must be leveraged both in-game and outside to foster a stronger sense of community. The graphics and overall technical performance of the game must be constantly upgraded to maintain user satisfaction. The best aspects of the game, such as the engaging

gameplay, multiplayer experience, and innovative skins, must be made the focus for promotion in marketing and advertising efforts.

5.2   Limitations

A limitation that hasn't been addressed is the sentiment analysis model misclassifying reviews that use language patterns like "not good" or "not bad" as positive, even if the intended sentiment is negative (Tang, 2019). This could lead to misclassification of reviews and errors in understanding consumer sentiment. Neutral reviews have not been specified or identified which can also lead to mislabelling. The word game was also found in multiple topics during LDA which may not be significant. However, upon removing the word game, references related to gameplay were lost which led to less significant model, so it has been retained in this report as a necessary evil.

Coherence of the model changes according to the number of topics chosen. A general value of 7 has been chosen here after some trial and error. This has resulted in a varied coherence value across different games ranging from 0.42 to 0.59. Ideally, the topics should be chosen specific to each dataset to obtain optimal coherence values. It is difficult to strike a balance between optimising for perplexity while achieving coherence as well. LDA assumes that words are interchangeable and does not model sentence structure (Bansal, 2020). As a result, LDA is not capable of capturing correlations that could lead to the emergence of unrelated topics.

5.3   Potential for Future Research

To overcome limitation of misclassifying statements such as "not bad" mentioned in limitations, further work needs to check for such language patterns in the data and replace them with their corresponding positive or negative words. A blog by Kelechava (2019), suggests a novel method of using LDA inputs as features in supervised classification model like logistic regression or SVC which then predicts review sentiment. This can be utilised by future work to get a more accurate understanding of the relationship between sentiment and topics.

A general value of seven topics has been chosen for this report which has led to a varied coherence value across different games. A possible alternative that could be used is Hierarchical Dirichlet Process (HDP) (Kelechava, 2019). This method identifies the

appropriate number of topics from the data. This could also help bypass LDA model instability (Robinson, 2022). Another way to deal with this is by using Ensemble LDA.

Lastly, an important element which has not been utilised is the column of *weighted_vote_score* which marks the helpfulness of the review. This report has not utilised it due to ambiguity in the meaning of the numbers however it could be used to further refine the research.

6   Conclusion

In conclusion, the success of FPS games depends on key elements such as engaging gameplay, immersive storytelling, memorable characters, good graphics, social gameplay, and unique selling points. To improve CS:GO, Valve should focus on expanding the multiplayer experience, introducing unique skins or characters, introduce a survival mode, etc. CS:GO's key features such as captivating gameplay, social multiplayer experience, and unique skins should be utilised effectively in Valve's marketing and advertising campaigns.

7   Reference:

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8   Appendix

Python notebooks used in project for fetching reviews, cleaning data, text processing, ngram making, topic modelling, sentiment analysis and visualisation are attached from the next page.