CS:GO PLAYER ENGAGEMENT ANALYSIS

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CS; GO IS A MASSIVELY POPULAR ONLINE GAME

- CS; GO
  - Counter Strike; Global Offensive
- Online first person shooter focusing on team vs. team interactions
  - Matches or games
    - 15 – 30 rounds
  - Teams composed of 5 – 15 players
- Competitive and casual modes.

VIDEO GAMES ARE A MULTI-BILLION DOLLAR INDUSTRY

- *Fortnight* = $2.4 Billion
- *MineCraft = Upwards of several billion.*
  - Notch = $2.5 Billion
- EA = $4 Billion
- Kadokawa (owns FromSoftware) = $1.18 Billion
- Valve = $4 Billion

CS:GO IS A MODEL SYSTEM FOR VIDEO GAME ANALYSIS

- Few/simple play modes.
- Large and dedicated community.
  - Massively popular.
  - Approximately 2.5 million copies sold and 300k active players at any given time.
- Common mode(s) follow easy to code/understand parameters.
  - Allow for effective data interpretation.

CENTRAL QUESTIONS

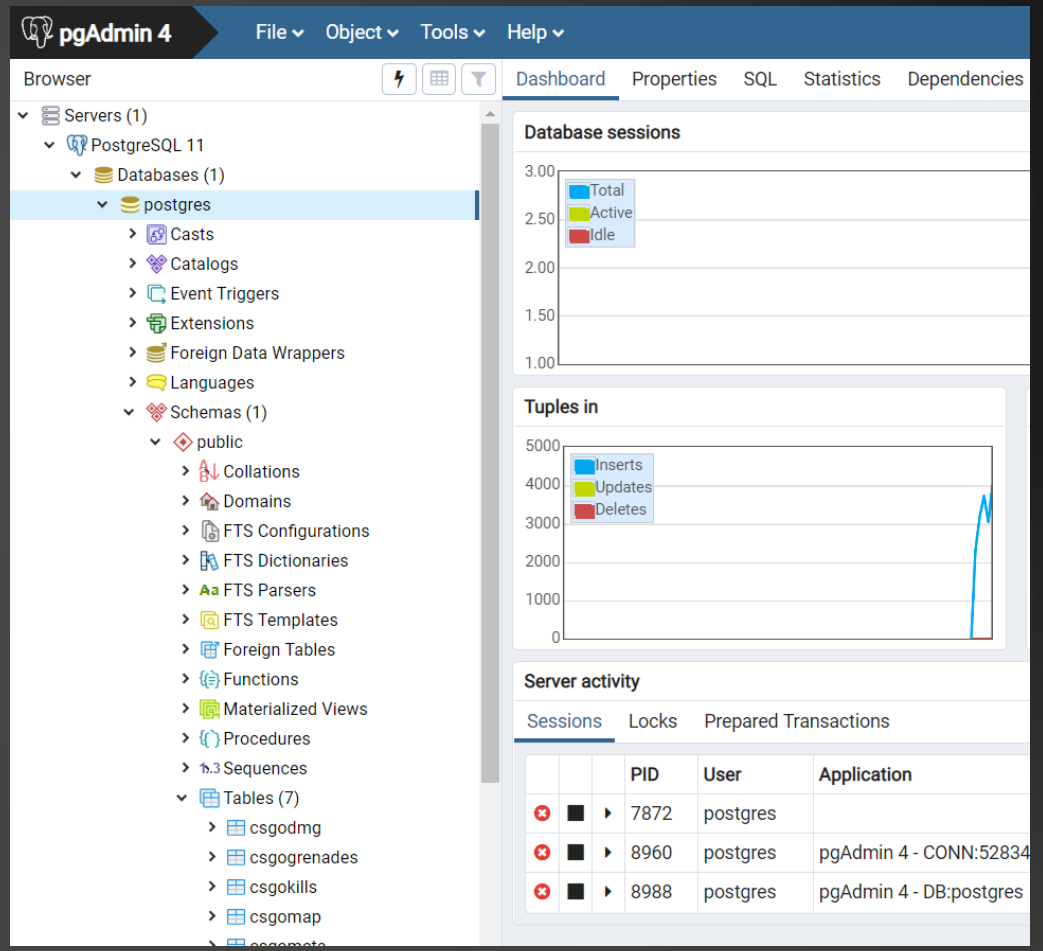
- How are players interacting with each other in the game?
  - What are the best weapons?
  - What is the preferred bomb site?
  - Does round number affect weapon choice?
  - Does the game prefer one team over another?
  - Does map affect player performance?

HYPOTHESES

- Round number does impact weapon used by player.
- Round number does NOT impact team/player performance.
- There is a preferred bomb site.
  - It is bomb site B.
- Map has NO effect on player performance.

DATA OBTAINMENT AND HANDLING

- Data was obtained from Kaggle
  - https://www.kaggle.com/skihikingkevin/csgo-matchmaking-damage
  - Downloaded as several large csv files.
- Imported into a PostgreSQL database
  - pgAdmin 4 used to improve data visualization.

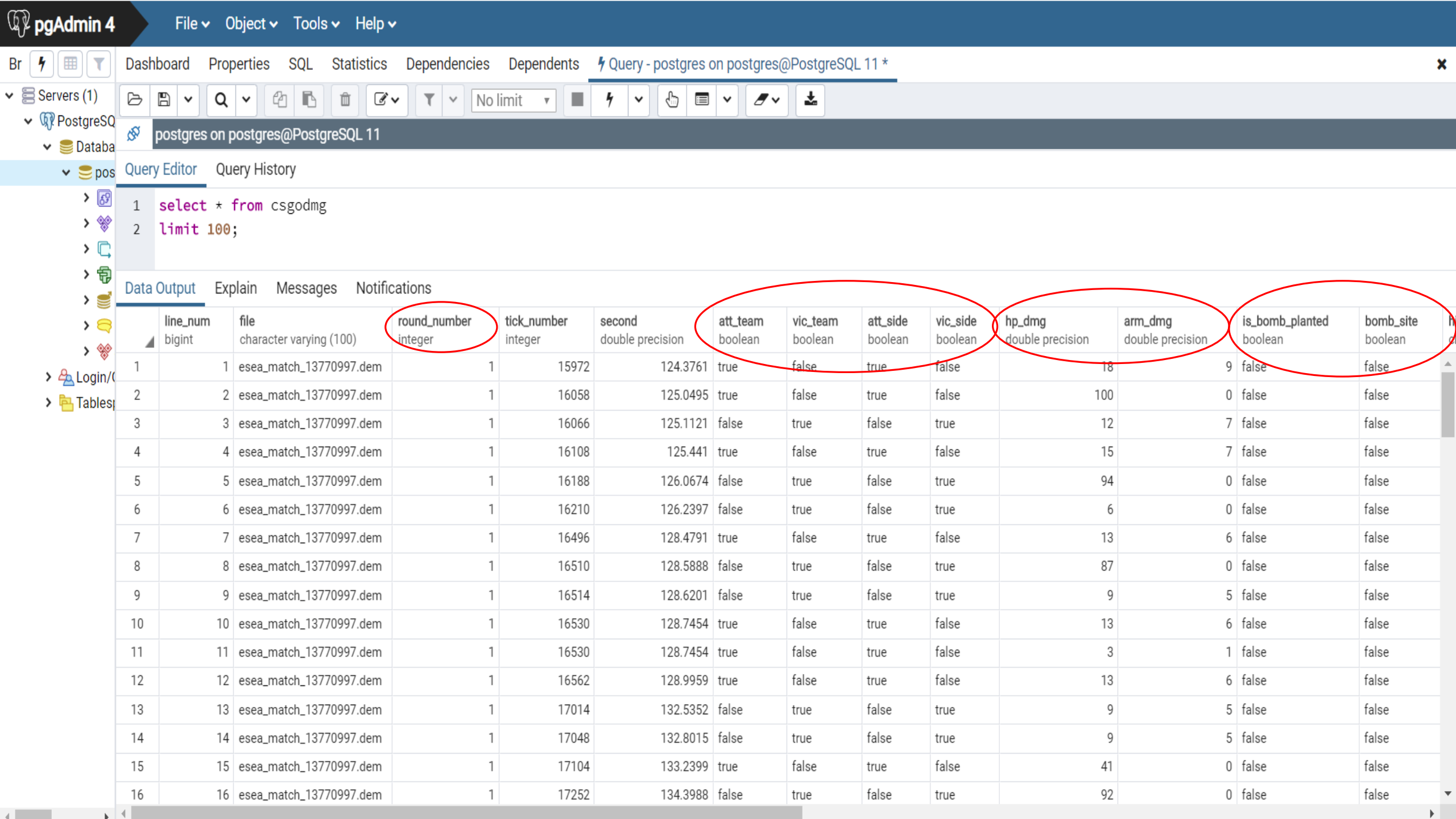


DATA STRUCTURE

```
def tableBuilder():
    cur.execute('''CREATE TABLE csgomap(
            line_num integer,
            map_name VARCHAR(100) PRIMARY KEY,
            endX integer NOT NULL,
            endY integer NOT NULL,
            resX integer NOT NULL,
            resY integer NOT NULL,
            startX integer NOT NULL,
            startY integer NOT NULL);''') # Chec

    cur.execute('''CREATE TABLE csgommmaster(
            line_num bigint,
            record_id integer,
            file_number VARCHAR(300) NOT NULL,
            map_name VARCHAR(100),
            date VARCHAR(200),
            avg_match_rank float);''') # Ch

            cur.execute('''CREATE TABLE csgodmg(
                    line_num bigint,
                    file VARCHAR(100),
                    round_number integer,
                    tick_number integer,
                    second float,
                    att_team boolean,
                    vic_team boolean,
                    att_side boolean,
                    vic_side boolean,
                    hp_dmg float,
                    arm_dmg float,
                    is_bomb_planted boolean,
                    bomb_site boolean,
                    hitbox  VARCHAR(50),
                    wp VARCHAR(50),
                    wp_type VARCHAR(50),
                    att_id bigint,
                    att_rank float,
                    vic_id bigint,
                    vic_rank bigint,
                    att_pos_x float,
                    att_pos_y float,
                    vic_pos_x float,
                    vic_pos_y float);''') # Checked!

            cur.execute('''CREATE TABLE csgogrenades(
                    line_num bigint,
                    file VARCHAR(100),
                    round_number integer,
```

```
                    vic_id bigint,
                    vic_rank integer,
                    att_pos_x float,
                    att_pos_y float,
                    vic_pos_x float,
                    vic_pos_y float,
                    round_type VARCHAR(100),
                    ct_eq_val integer,
                    t_eq_val integer,
                    avg_match_rank float);''') # Checked!

cur.execute(''' CREATE TABLE csgommgrenades(
                    line_num bigint,
                    record_id bigint,
                    file_number VARCHAR(300) NOT NULL,
                    map_name VARCHAR(100),
                    round_number integer,
                    start_second float,
                    second_number float,
                    end_second float,
                    att_team boolean,
                    vic_team boolean,
                    att_id bigint,
                    vic_id float,
                    att_side boolean,
                    vic_side boolean,
                    hp_dmg integer,
                    arm_dmg integer,
                    is_bomb_planted boolean,
                    bomb_site boolean,
                    hitbox VARCHAR(100),
                    nade VARCHAR(100),
```

- Following Data Tables:
  - Maps
  - Grenade Kills
  - Regular Weapon Kills
  - Meta data about players.
- Each kill includes information about:
  - Weapon
  - Killer
  - Victim
  - Damage done



	line_num bigint	file character varying (100)	round_number integer	tick_number integer	second double precision	att_team boolean	vic_team boolean	att_side boolean	vic_side boolean	hp_dmg double precision	arm_dmg double precision	is_bomb_planted boolean	bomb_site boolean
1	1	esea_match_13770997.dem	1	15972	124.3761	true	false	true	false	18	9	false	false
2	2	esea_match_13770997.dem	1	16058	125.0495	true	false	true	false	100	0	false	false
3	3	esea_match_13770997.dem	1	16066	125.1121	false	true	false	true	12	7	false	false
4	4	esea_match_13770997.dem	1	16108	125.441	true	false	true	false	15	7	false	false
5	5	esea_match_13770997.dem	1	16188	126.0674	false	true	false	true	94	0	false	false
6	6	esea_match_13770997.dem	1	16210	126.2397	false	true	false	true	6	0	false	false
7	7	esea_match_13770997.dem	1	16496	128.4791	true	false	true	false	13	6	false	false
8	8	esea_match_13770997.dem	1	16510	128.5888	false	true	false	true	87	0	false	false
9	9	esea_match_13770997.dem	1	16514	128.6201	false	true	false	true	9	5	false	false
10	10	esea_match_13770997.dem	1	16530	128.7454	true	false	true	false	13	6	false	false
11	11	esea_match_13770997.dem	1	16530	128.7454	true	false	true	false	3	1	false	false
12	12	esea_match_13770997.dem	1	16562	128.9959	true	false	true	false	13	6	false	false
13	13	esea_match_13770997.dem	1	17014	132.5352	false	true	false	true	9	5	false	false
14	14	esea_match_13770997.dem	1	17048	132.8015	false	true	false	true	9	5	false	false
15	15	esea_match_13770997.dem	1	17104	133.2399	true	false	true	false	41	0	false	false
16	16	esea_match_13770997.dem	1	17252	134.3988	false	true	false	true	92	0	false	false

VARIABLES

INDEPENDENT

- Round Number
- Weapon Type
- Grenade Type
- Team
- Hit Box

DEPENDENT

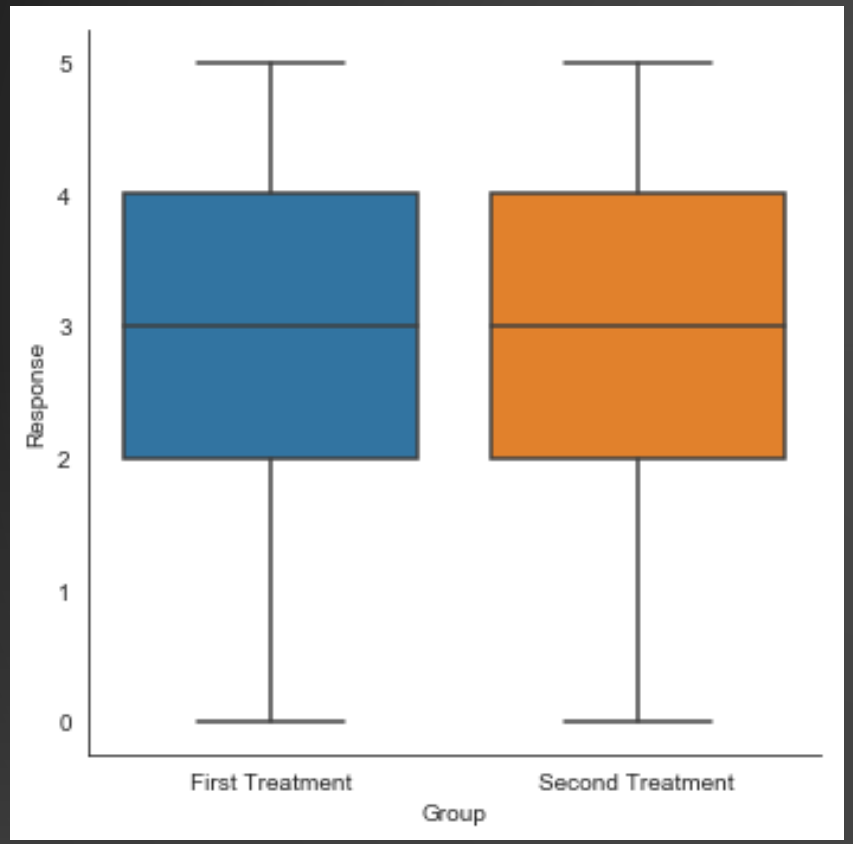
- Weapon Type
- Damage
- Number of Kills
- Bomb site
- Player funds

DATA MANIPULATION AND HANDLING

- Anaconda:
  - Spyder
- Packages:
  - Numpy
  - Pandas
  - Tkinter
  - PIL
  - Warnings
  - Random
  - Datetime
  - Seaborn
  - Psycopg2
  - Scipy
  - Statsmodels

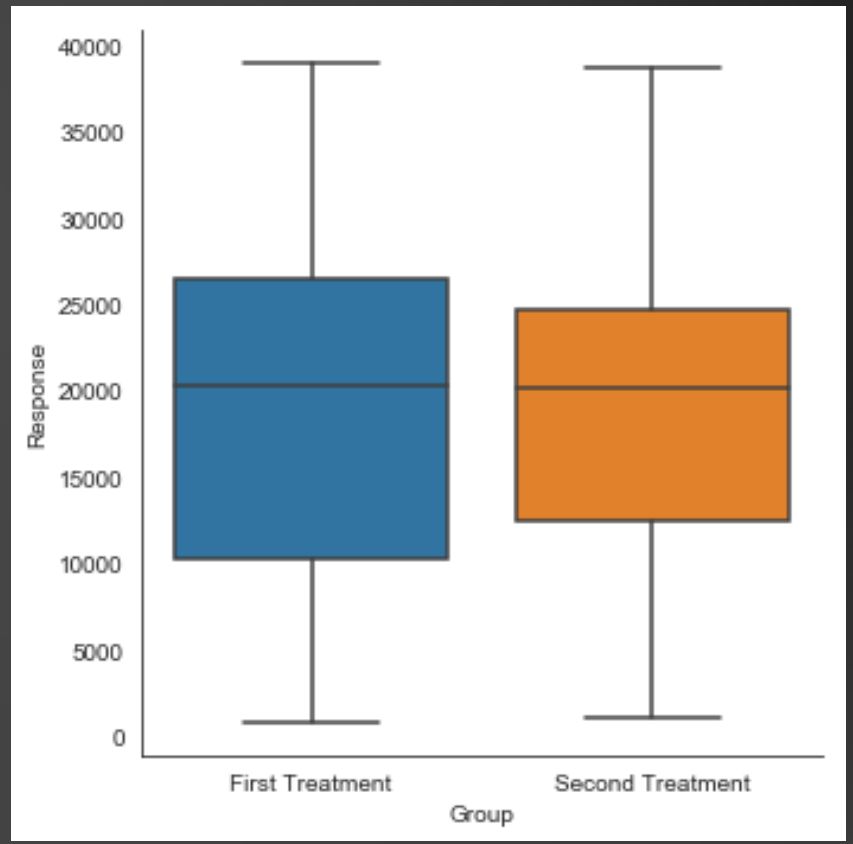
RESULTS: TEAM PERFORMANCE

- Wilcoxon:
  - Stat = 69
  - P-value = 0.00077



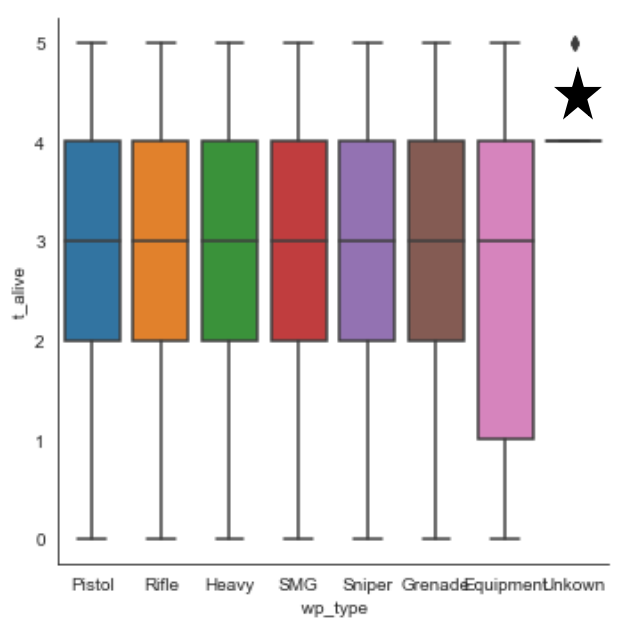
- T-test:
  - T-score = 0.2804
  - P-value = 0.780

- Wilcoxon:
  - Stat = 111
  - P-value = 0.01245



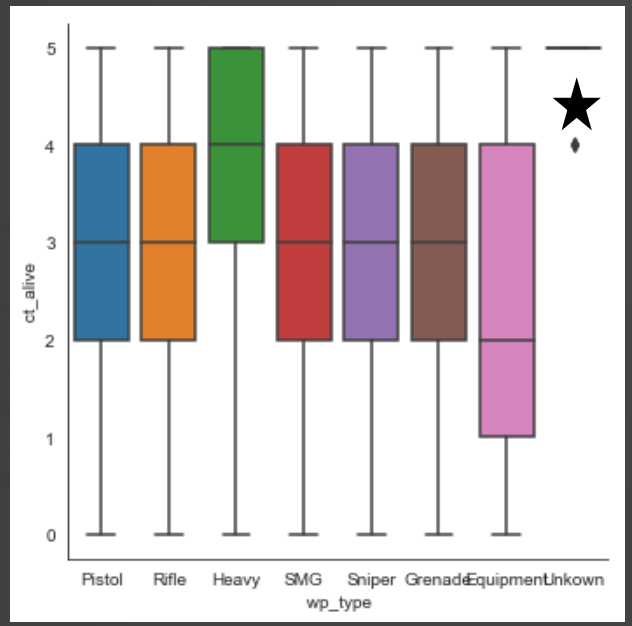
- T-test:
  - T-score = 0.198
  - P-value = 0.8433

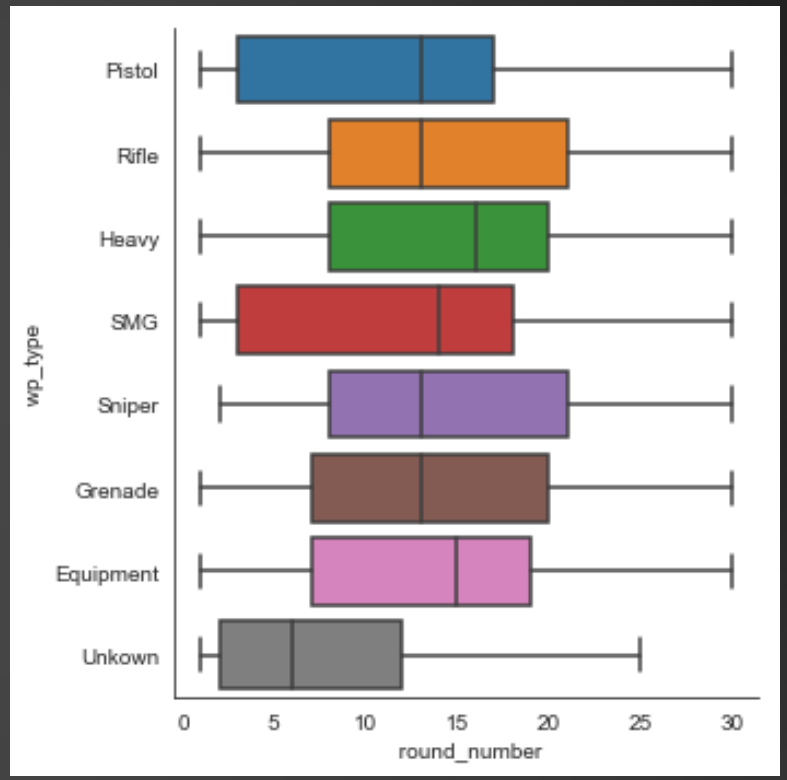
RESULTS: WEAPON USE OVER TIME



- ANOVA:
  - F-Stat = 553
  - P-value = 0.0

- ANOVA:
  - F-Stat = 3422
  - P-value = 0.0

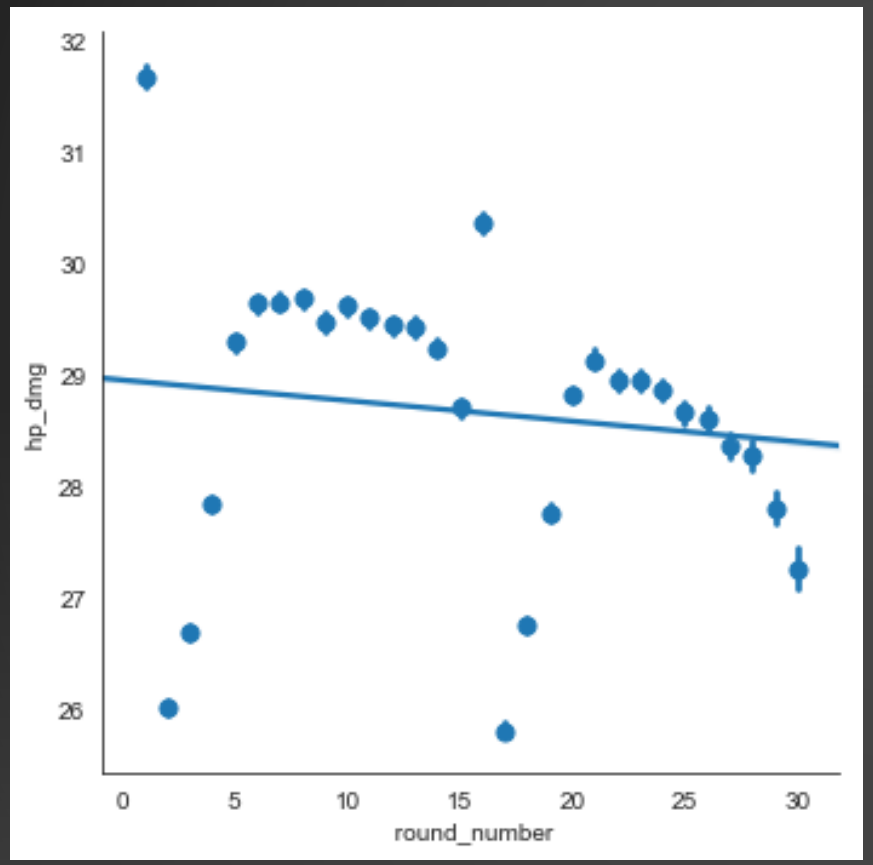




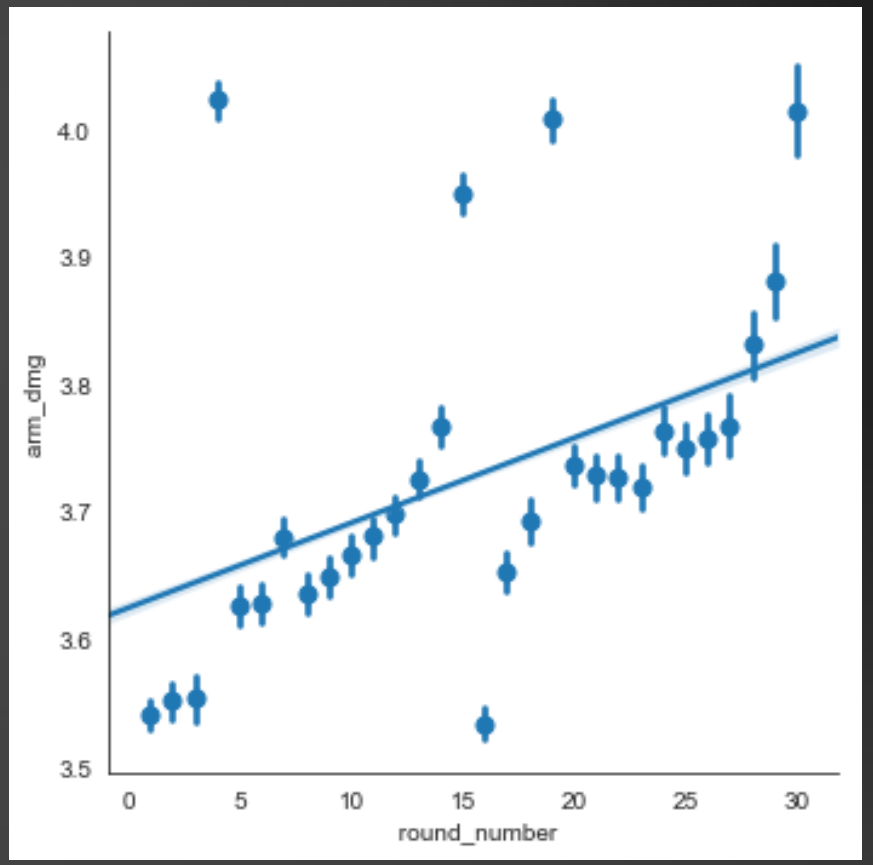
- Chi-Square Test
  - P-value: 0.0

RESULTS: DAMAGE OVER TIME

- Correlation:
  - P-value = 3.9573 * e^-77
- Regression:
  - R^2 = 3.32 * e^-0.5
  - P-value = 3.9573 * e^-77

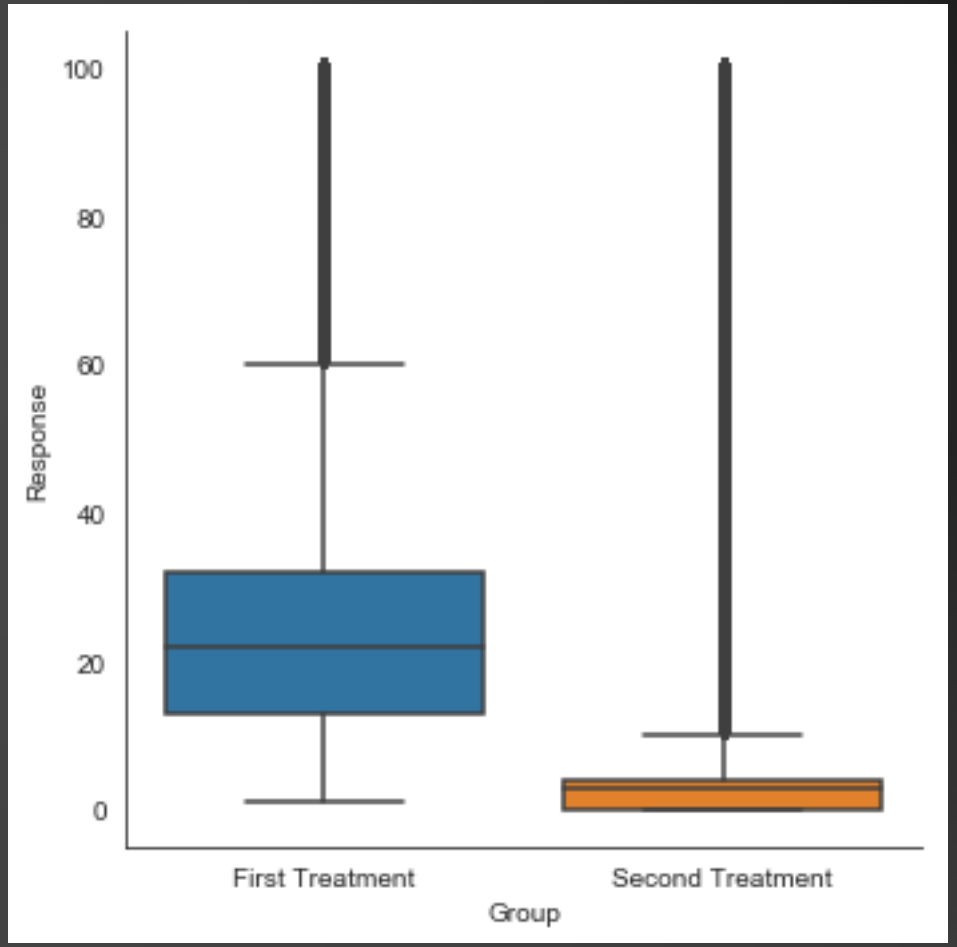


- Correlation:
  - P-value = 1.8728 * e^-247
- Regression:
  - R^2 = 0.000108
  - P-value = 1.8728 * e^-247



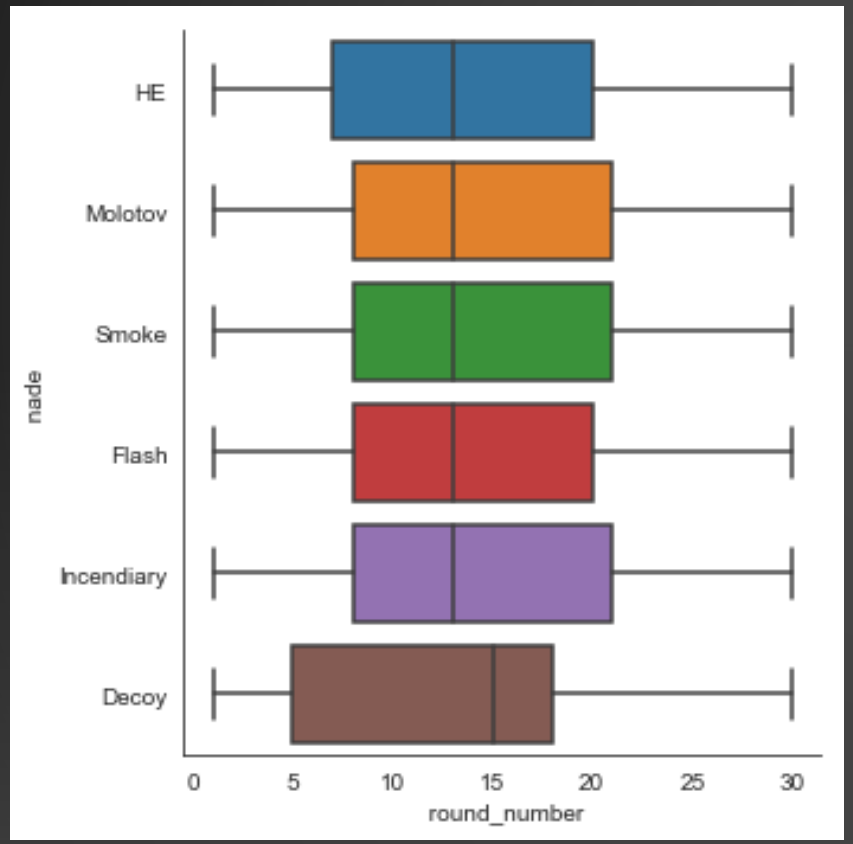
RESULTS: DAMAGE TYPE

- Wilcoxon Test:
  - Stat = 0.0
  - P-value = 1.73 * e^-6
- Indicates that players generally take more damage than their armor.



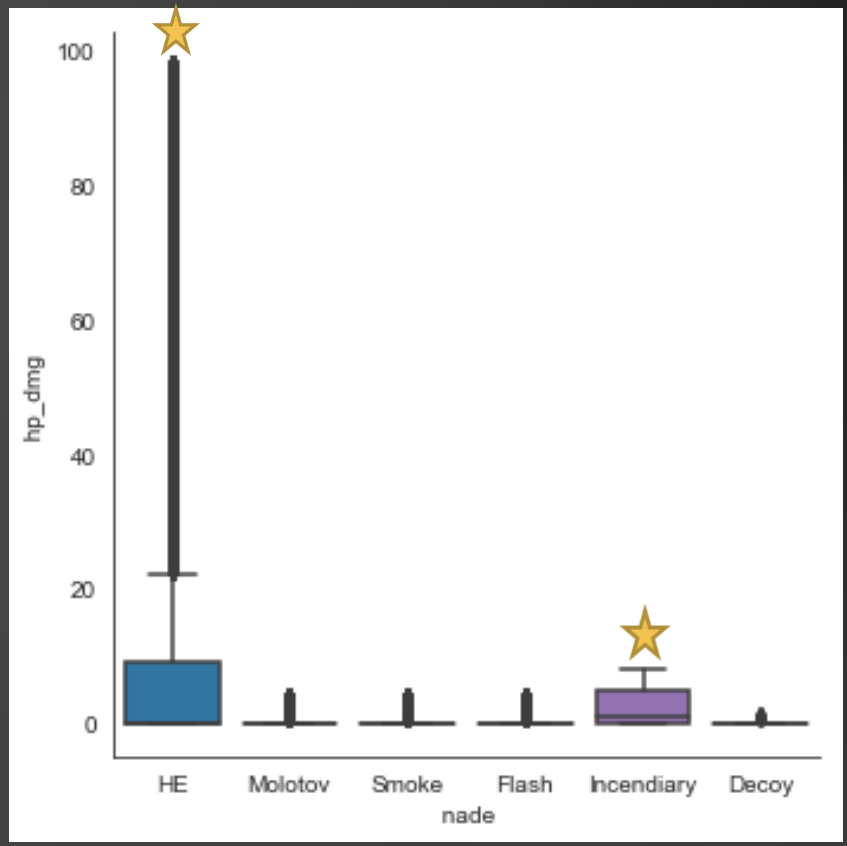
RESULTS: GRENADE USE OVER TIME

- Chi-Square:
  - P-value = 0.0



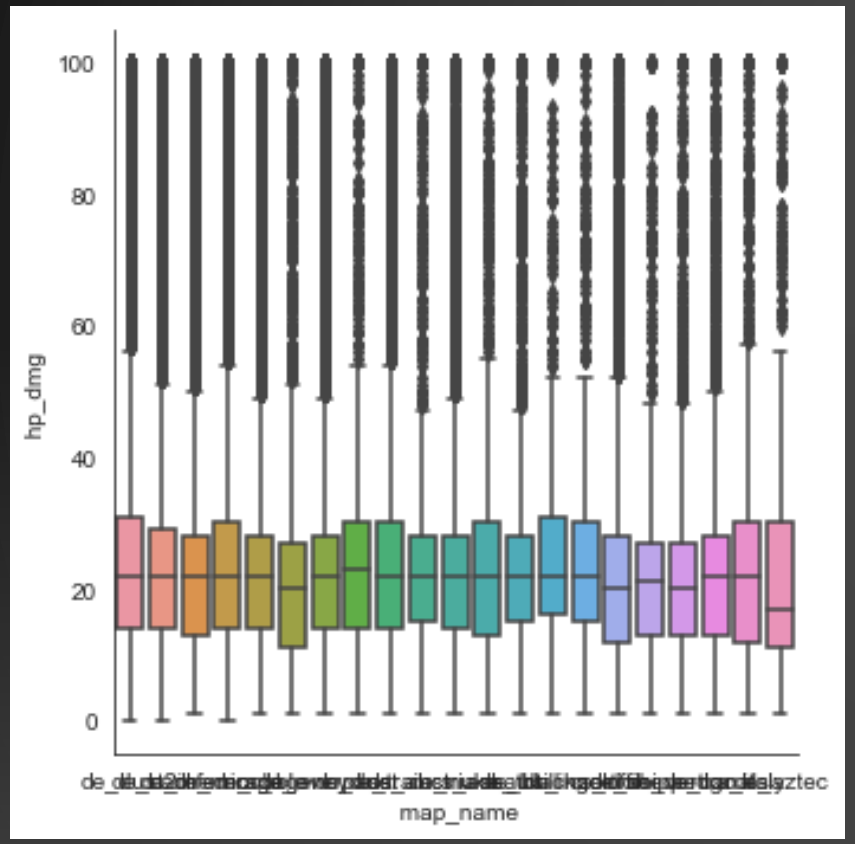
ANOVA:

- F-stat = 211877
- P-value = 0.0



RESULTS: PLAYER PERFORMANCE PER MAP

- ANOVA:
  - F-Stat: 66.79
  - P-value: 9.96 * e^-271



- Tukey's Test indicates maps within game modes were not statistically different.
  - p >= 0.05
- Indicated that there is a difference in game mode but not a difference in map within game modes.

19	cs_agency	de_vertigo	-1.3110	...	0.8613	0.820444	False
20	cs_assault	cs_insertion	-0.8791	...	2.6104	0.900000	False
21	cs_assault	cs_italy	-0.7834	...	2.2904	0.900000	False
22	cs_assault	cs_office	-2.2385	...	0.1621	0.105493	False
23	cs_assault	de_austria	-1.0276	...	1.9578	0.900000	False
24	cs_assault	de_aztec	-1.0641	...	3.0389	0.900000	False
25	cs_assault	de_blackgold	1.2922	...	5.2478	0.900000	False
26	cs_assault	de_cache	-0.6389	...	1.4877	0.900000	False
27	cs_assault	de_canals	-2.0483	...	0.5211	0.345988	False
28	cs_assault	de_cbble	-1.4917	...	0.6577	0.606377	False
29	cs_assault	de_dust	-1.1644	...	1.9190	0.900000	False

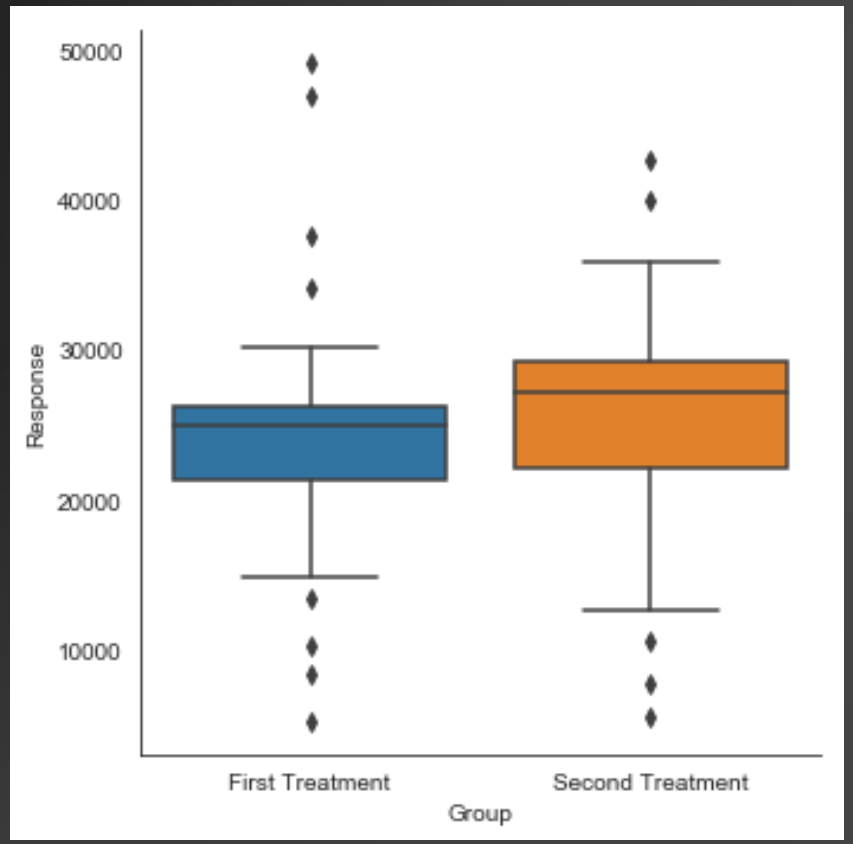
BUT WAIT… WHAT ABOUT RUSHING B?

DON'T BE A NOOB

- Bomb sites are labeled A and B
- Community Believes that Site B is inherently better
- Players on the terrorist team are told to "rush B" at the start of each round
  - Refers to the strategy by which the entire team quickly heads to the site in an attempt to overwhelm the enemy team.

AND NOW FOR A DEMO

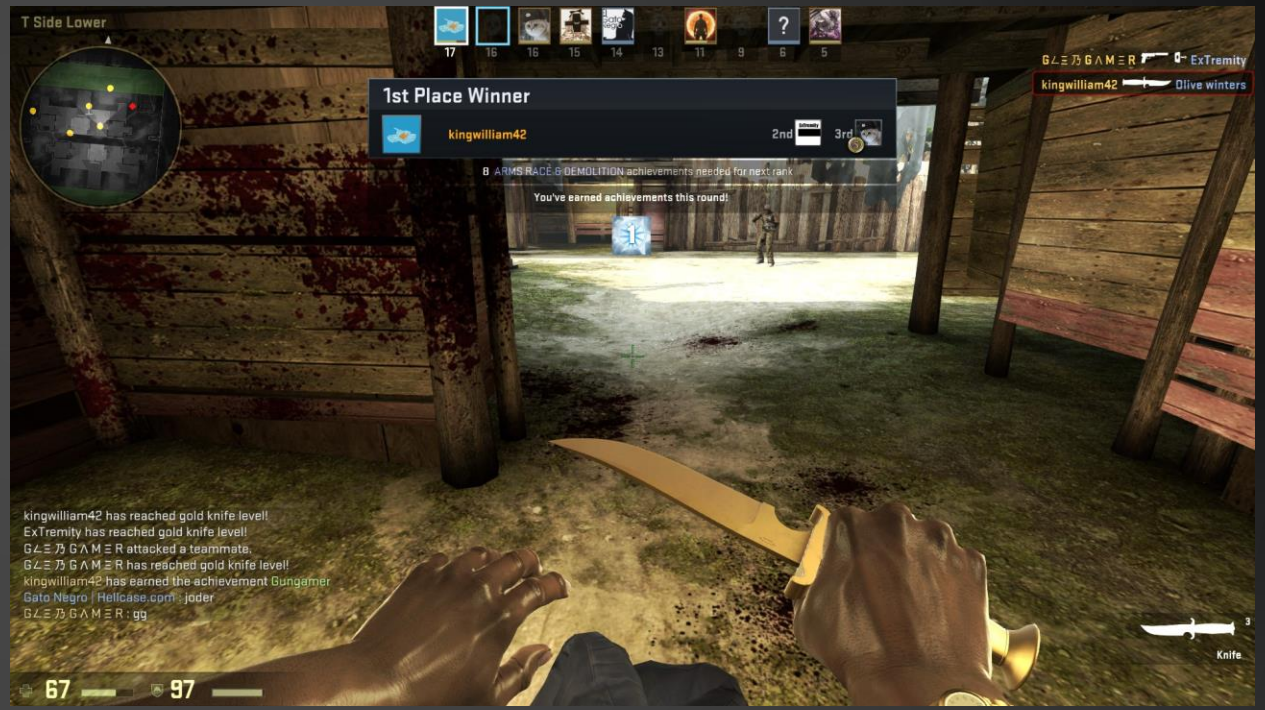
RESULTS: BOMB SITE PREFERENCE



- Wilcoxon:
  - P-value = 0.00468
- Site B is preferred over Site A
  - Doesn't say much about success rate
- Large number of outliers

LIMITATIONS/SET BACKS

- Multiple tables
  - Difficult to keep track of variables
  - Redundancy in tables
- Large Data
  - Time to upload to the database
  - Format of the data was inconsistent
- Time



FUTURE DIRECTIONS

- Player rank calculations
- Machine learning
- Focus more on players
  - What makes one successful?
  - What makes a good play?
  - How do you get better?
  - Focus on P-v-P interactions.
- Increase user friendliness.

CONCLUSIONS

- Teams are fairly well balanced
  - There is no clear advantage/disadvantage between being on a particular side and how well one performs in game
- As rounds progress players user larger/heavier weapons
  - As a result damage output increases
- Players have a clear preference for heavy weaponry.
  - Additionally, only a select amount of equipment is utilized when interacting with other players.

CONCLUSIONS

- Weapons do damage proportional to their programing
  - Players aren't able to get "cheap" kills off of smaller caliber weapons
  - Similar to grenades
- Game mode influences player performance.
  - However map within game mode does not influence player performance.
- Skill is the major factor in player performance.

RUSH B!

…If you're CT…

QUESTIONS?

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LITERATURE

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